Measurement of Volatility in Operation Ratio Index

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1. Introduction

The purpose of this study is to measure the volatility of monthly manufacturing operation ratio index in Korea, and investigate the characteristics of volatilities.

National Statistical Office has compiled the operation ratio index from Production and Operation Survey (POS) after 1979. The POS is designed to collect the output and production capacity data of major establishments in 20 divisions of manufacturing industry by Korean Standard Industrial Classification.

2. Components of Operation Ratio Index

Operation ratio is to divide the output by production capacity. We assume that the output has trend and cyclical component, seasonality, and irregular component. On the other hand, we assume that production capacity has trend component because it is changed when production plants are newly established or new production methods are selected. Therefore we can assume that operation ratio has the cyclical component, seasonality and irregular component. And the cyclical component can be decomposed into long-term and short-term components.

For the analysis, we assume that the main components of operation ratio follow a multiplicative ARIMA model such that

$$O_t = C_t \times S_t \times I_t$$

where O_t stands for the unadjusted series, C_t the cycle, S_t the seasonal, and I_t the irregular.

Long-term cyclical component is estimated by Hodrick-Prescott(HP) filter from the cycle data C_t. The HP filter chooses C_t^L to minimize :

$$\sum_{t=1}^{T} (C_t - C_t^L)^2 + \lambda \sum_{t=2}^{T-1} ((C_{t+1}^L - C_t^L) - (C_t^L - C_{t-1}^L))^2$$

where C_t^L is the long-term cycle. The penalty parameter ë controls the smoothness of the series C_t, which is recommended as 14,400 for monthly data. The short-term cyclical component can be calculated through dividing C_t by C_t^L.

3. Measure of Volatility

Operation Ratio is rewritten as follows :

$$o_t = c_t^L + c_t^S + s_t + i_t$$

where small letters stand for logarithmic series of main components.

By theorem of expected value in multi-variables, we can decompose the variance of operation ratio into the variance and covariance of main components as follows :

$$\begin{aligned} var(o) = {} & var(c^L) + var(c^S) + var(s) + var(i) + 2[cov(c^L \cdot c^S) + cov(c^L \cdot s) + cov(c^L \cdot i) \\ & + cov(c^S \cdot s) + cov(c^S \cdot i) + cov(s \cdot i)] \end{aligned}$$

4. Conclusion

The characteristics of volatilities in Korean operation ratio index is as follows :

1. Long-term cycle is appeared as slow down or up or normal cyclical shape.
2. Volatility of shot-term cyclical component is relatively strong in radio & TV communication on equipment, wood & products of wood, office accounting & computer machinery.
3. Seasonality is a large factor of volatility in non-metallic mineral products, foods, pulp & paper, radio & TV communication on equipment, tobacco.
4. Irregularity is an important factor of volatility in tobacco, office accounting & computer machinery, transport equipment excluding motor vehicles & trailers, pulp & paper.

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