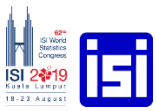

Analysis of Korean regional economic resilience after COVID 19 pandemic

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Abstract: This study measures the resilience of the Korean regional economy after the COVID-19 pandemic and analyzes the determinants. In order to measure the resilience index, 151 cities and counties in Korea were analyzed and employment data from 2019 to 2021 were used. The spatial autocorrelation of the regional resilience index was confirmed and the spatial error model (SEM) was found to be suitable as a result of comparing the spatial metric models. As a result of spatial regression analysis, the factors that affect regional economic resilience, GRDP, per capita GRDP, financial independence, and whether it is city or county status are found to be statistically significant. It was confirmed the positive effect(+) , the GRDP and the presence of a city had a negative(-). Based on these research results, the following policy implications can be considered. First, industrial hypertrophy policies that increase the size of the economy in a specific region are no longer effective. Second, in order to prepare for an economic shock, the local government must increase its local income and improve its fiscal soundness. Finally, a transition to an industry that is less sensitive to economic shocks is required.

Keywords:
regional economy, resilience, SEM

1. Introduction

The Korean economy has achieved compressed and high growth in the past, but has recently recorded a low growth rate, and this trend is also occurring in each regional economy. In addition, external shock crises such as the foreign exchange crisis of 1997, the global financial crisis of 2008, and the COVID-19 pandemic are occurring frequently. Therefore, the regional economy is growing with interest in how well it can respond to such shocks and recover to the previous level rather than simply pursuing economic growth. A lot of research has been done on methods and determinants. Nevertheless, many research literatures demand that more studies be carried out to address the problem because the theory and measurement method of regional economic resilience are not completely unified. In particular, since research on regional economic resilience is absolutely lacking in Korea, it is very urgent to analyze the resilience of the Korean regional economy and explore its determinants through clarification of the concept of resilience studied so far and improvement of measurement methods.
Therefore, this study attempts to measure resilience and explore several influencing factors in order to determine how well each regional economy has withstood and recovered from the impact of the COVID-19 pandemic in Korea. For this purpose, spatially, 151 cities, counties, excluding metropolitan cities were targeted, and the temporal range was limited to around 2020, when the COVID-19 pandemic has a full impact. As a specific analysis method, first, by using employment data of each region, resilience is analyzed in terms of engineering resilience, and then, Moran's I is measured considering spatial autocorrelation to spatially analyze the correlation of resilience between adjacent regions. Lastly, based on these spatial correlations, determinants affecting resilience were demonstrated by comparing traditional regression methods (OLS), spatial lag model (SLM), and spatial error model (SEM) in terms of industrial structure, social structure and geographical structure.

2. Methodology:

2.1 Data

In this study, various variables were used to measure the resilience of Korean cities and counties and to regressively explore the factors affecting resilience. The dependent variable is the resilience of each region. To measure the resilience index, the number of employed people from the 2019-2021 regional employment survey was used. Independent variables were selected in consideration of industrial structure, social structure, and geographic structure. In terms of industrial structure, using data from the 2020 economic census, the Herfindahl index(diversity), GRDP, and manufacturing share, income (GRDP per capita) and financial independence from the social aspect, and finally, geographical location in terms of geography, whether it is city/county or Capital area were used.

2.2 Resilience measurement

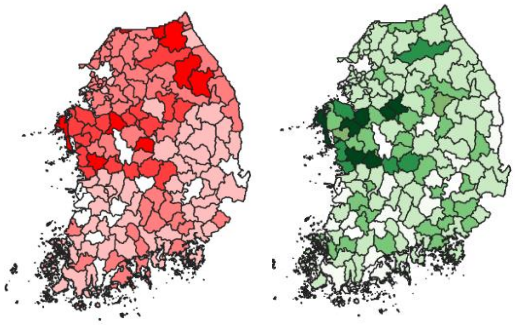
Before defining the resilience of a local economy, it is necessary to define resilience. Resilience is translated as '恢復力' in Chinese and 'resilience' in English. The word resilience comes from the Latin 'resilire', which means returning to the original state or returning to original form (Martin, 2012). Resilience index is a very ambiguous concept and measurement method is not uniform, so it is necessary to think about this part. Resilience is divided into three types: engineering resilience, ecological resilience, and evolutionary resilience. In this study, in terms of engineering resilience, which is easy for empirical analysis, it is possible to calculate the resilience, which is resistance and recoverity

$$resistance = \frac{\Delta Y_{r(t,t+k)} - \Delta Y_{N(t,t+k)}}{\Delta Y_{N(t,t+k)}} \qquad (1)$$

Δy is the proportional change in employment, ( )is the shock period, r is the region, and N is the whole country. In other words, it is resistance that compares the relative magnitude of change in employment in a region with the change in employment across the country. That is, the expression of this resistance can be positive, negative, or zero. If the resistance index is positive, the change in employment in one region during the shock is greater than that of the nation's employment, and conversely negative, then is less, and if it is zero, exactly the same with nation. Recovery can also be verified in the same way as resistance to changes in employment after a shock.

<Figure1> Resilience Index

1.resistance 2. Recovery



*note : The darker the color, the stronger the resistance and recovery

2.3 Measures of Spatial Dependence

2.3.1 Global Moran's I

In this study, the spatial correlation of resilience was confirmed through the Global Moran's I index. In general, the value of Moran's I has a value between -1 and 1, and it can be interpreted that the closer to 1, the greater the spatial correlation. The value of the Global Moran's I index of resilience was 0.494, and the p-value was 0.0000, which was found to be statistically significant.

2.3.2 Spatial autocorrelation analysis

In this study, the location information of administrative districts provided by Statistical Geographic Information Service was used to analyze the spatial effects. Spatial econometrics is a model that considers the correlations including the geographic relationship and resilient relations between regions. The general linear regression model is as follows.

$$y = X\beta + \mu \quad (1)$$

Considering the spatial autocorrelation(ρ=0) of the dependent variable in Equation (1), it is called the Spatial Lag Model (SLM), and is shown in Equation 2 below.

$$y = \rho Wy + X\beta + \epsilon \quad (2)$$

Considering the spatial autocorrelation (λ=0) of the error term, it is called the Spatial Errors Model (SEM). Unlike the spatial parallax model, the spatial parallax term is included in the error term, not the explanatory variable term.

$$y = X\beta + \mu, \mu = \lambda W\mu + \epsilon \quad (3)$$

3. Result

3.1. Model Comparisons

Multicollinearity is a problem that indicates how similar the variables are. Montgomery and peck (1992) determined that there is no serious multicollinearity if the value of the multicollinearity condition number(multicollinearity determination index) does not exceed 100. In this study, the value of this index calculated from GeoDa was found to be 17.4, and it was determined that there was no serious multicollinearity problem.
The spatial quantification model presupposes that the spatial dependence is controlled and analyzed only when it is verified that the dependent variable has a spatial correlation between adjacent regions. In other words, the limitations of the OLS model must be shown through the BP test (Breusch-Pagan test), which verifies the equality of residuals assumed in the general regression model, and the JB test (Jarque-Bera test), which diagnoses the non-normality of the error term. As a result of verification, it was found to be significant at the 1% level ($p<0.0000$) in both the BP test and the JB test. In other words, it was judged that heteroscedasticity exists in the residuals and normality does not exist in the error term. Prior to analyzing the influence factors of the resilience index, in the case of a spatial metric model, a preliminary test is required to establish the most appropriate spatial regression model. To test spatial dependence and spatial heterogeneity, Lagrange Multiplier (LM) and Robust LM tests are conducted. From the results of spatial regression analysis, the LM(err) value was 55.8061 and the Robust LM(err) value was 51.4632, which was more statistically significant. This confirms that the spatial error model is more suitable than the spatial lag in consideration of spatial correlation.

3.2. Estimation Results

From the <table 1>, the determinants affecting regional economic resilience, GRDP, per capita GRDP, financial independence, and city/county are found to be statistically significant. Among them, per capita GRDP and financial independence were analyzed to have a positive (+) effect, and GRDP and city status were analyzed to have a negative (-) effect.

<Table 1> Regression results

Model	OLS	SEM
λ(Lamda)		0.686347***
CONSTANT	0.98394***	0.6863470
Herfindahl index	-0.0896265	-0.0568211
GRDP	-1.34303e-009**	-1.02194e-009**
Manufacturing share	0.000183786	0.000166958
Per capita GRDP	0.00105245***	0.000468359*
Financial independence	0.00138136*	0.00116666*
Capital city area(dummy)	0.0036703	-0.0118662
City/county(dummy)	-0.00569545	-0.0134196**
R^2	0.086906	0.467085
LOG LIKLEHOOD	277.495	304.826001
AIC	-538.99	-593.652

note: p<0.01***, p<0.05**, p<0.10*

Many resilience studies suggest that GRDP will be negative for resilience because larger economies cannot respond quickly to unpredictable external shocks. The results of this study are also consistent with the results of this study. A relatively large economy is an advantage that can lead to stable regional economic growth under normal circumstances, but on the contrary, it takes a relatively long time to absorb and recover from external crisis shocks, so it has a disadvantage in resilience. Local financial independence has a positive effect on resilience, and this also shows the same results as many studies. It is analyzed that it is because there is a material that can absorb the employment that brings the economic shock first if there is relatively financial capacity in the shock of the economic crisis. These results are interpreted in the same context as GRDP per capita, which can be interpreted as income, has a positive effect on resilience. This is because the higher the income, the more stamina to absorb and withstand the shock. Interestingly, the city area is more vulnerable to resilience than the county area. Since employment in the city area is sensitive to the economy and is easily affected by the economy, changes in employment are likely to occur easily. Conversely, it is analyzed that this is because the industrial structure contributes to job stability in the event of an external shock because the ratio of manufacturing and agriculture is higher than that of the service industry, which is an urban-type industry.

4. Discussion and Conclusion

In Korea, the industry has been structured and developed around efficiency for rapid economic growth, so the specialization of local industries has been made, but as a result, regional imbalances have deepened. Since such an industrial structure is not sufficient to effectively respond to the unpredictable and frequent external economic shocks, it is time to change the industrial structure. Therefore, Korea's regional economy needs innovation in economic structural change from the perspective of resilience rather than the growth-oriented perspective of the past, and related studies should be conducted.
Because of these realistic demands, this study can be said to be very meaningful, and the implications are as follows. First, industrial hypertrophy policies that increase the size of the economy in a specific region are no longer effective. Second, in order to prepare for an economic shock, the local government

must increase its local income and improve its financial health. Finally, An industry less sensitive to economic shock may need to be converted.

This study analyzed the region from the perspective of resilience and explored its influencing determinants. However, the ambiguity of the concept and the inconsistent measurement method were still revealed as limitations of the study. In the future, we look forward to research on quantification methods that can accurately reflect reality and pursue clarity of concepts through analysis of various cases.

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