

Modelling of Index System of Economic Vitality During the COVID-19 Epidemic

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Abstract

Economic vitality is an important indicator to measure the level and potential of economic development. The paper puts forward three social problems about economic vitality and establishes a model to solve them. We build panel data model to analyze the influencing factors of economic vitality. Based on the section data of Beijing, the VAR-VEC model is established to analyze the long-term and short-term effects of economic policies on economic vitality. The development strategy of ORT is put forward, and the scheme to promote the growth of economic vitality is given during the COVID-19 epidemic. For the first problem, the paper preprocess panel data, and test its independence, and find that each factor is not independent of each other. Through the correlation analysis, we found that there is a strong correlation between the various elements. After Random Effect Test and Fixed Effect Test combined with Hausman Test, the data panel conforms to fixed effect model.

18

19 **Index terms**— panel data model; VAR-VEC model; factor analysis; index system.

20 1 Modelling of Index System of Economic Vitality

21 During the COVID-19 Epidemic Shenglan Chu ? , Jinming Cao ? & Bin Zhao ? Abstract-Economic vitality is an important indicator to measure the level and potential of economic development.

23 The paper puts forward three social problems about economic vitality and establishes a model to solve them. We build panel data model to analyze the influencing factors of economic vitality. Based on the section data of Beijing, the VAR-VEC model is established to analyze the long-term and short-term effects of economic policies on economic vitality. The development strategy of ORT is put forward, and the scheme to promote the growth of economic vitality is given during the COVID-19 epidemic.

28 For the first problem, the paper preprocess panel data, and test its independence, and find that each factor is not independent of each other. Through the correlation analysis, we found that there is a strong correlation between the various elements. After Random Effect Test and Fixed Effect Test combined with Hausman Test, the data panel conforms to fixed effect model. Population change and enterprise vitality have a positive impact on economic vitality, the influencing factors are 0.01 and 0.07 respectively. We put forward the strategy of adjusting the overall structure of enterprises to improve economic vitality.

34 For the second problem, the paper select the section data of Beijing city and construct the VAR-VEC model. Based on ADF unit root test and Johansen cointegration test, we find that there are at least three cointegration relationships between time series. We use Ais-Sc Criterion to determine the order of delay as the third order. We use OLS estimation method to get the coefficients of VEC Model. Through the IRF response, we find that the long-term impact of economic policy on economic vitality is positive correlation effect. Due to the effect of experience accumulation, the economic vitality presents a W-shaped trend.

40 For the third problem, the paper use the minimum average deviation method to preprocess the index data, and get 9 representative indexes. We extract two main factors by factor analysis and build an index system of economic vitality. The economic vitality of each city from 2009 to 2017 is calculated according to the index system. Beijing, Shanghai, Guangzhou and Shenzhen often rank first, while Kunming and Dongguan often rank last. Based on the same data, the panel data model test results are similar to index system.

6 1) DATA SELECTION PRINCIPLE

45 For the fourth problem, we review the previous conclusions and put forward the ORT development strategy
46 to improve economic vitality based on the established model.

47 2 Introduction

48 Regional economic vitality is an important part of regional comprehensive competitiveness. In recent years,
49 in order to improve economic vitality, some regions have introduced a lot of preferential policies to stimulate
50 economic vitality, such as reducing the approval steps for investment, providing financial support for entrepreneurship,
51 and lowering the threshold for settling down in order to attract talents. However, due to different resource
52 endowments, these policies have different effects in different regions. How to grasp the key factors and effectively
53 improve the regional economic vitality is a worthy research topic.

54 In order to study how to improve regional economic vitality, given some data. Based on these data and my
55 own survey data, this paper established an appropriate model to solve the following problems: Problem 1, it is
56 necessary to take a certain region (or city or province) as an example, and combine the data collected in the
57 attachment to establish the appropriate relationship model of the influencing factors of economic vitality, and
58 give the action plan to improve the regional economic vitality. The influence of population change trend and
59 enterprise vitality change on regional economic vitality change is analyzed.

60 Problem 2, selecting a region (or city or province) and investigating the appropriate data analyze the short-
61 term and long-term impact of economic policy transformation on the economic vitality of the region (or city or
62 province). Under the background of new age, China's economic, social, cultural, ecological, political and other
63 fields are coruscate gives new vigor and vitality, at the same time the good life is people's increasing need to
64 inadequate and imbalance of the contradiction between the development of become the main social contradiction,
65 and the unbalanced economic development between different regions is the concentrated reflection of imbalance
66 is not fully developed; To accelerate the narrowing of the gap in regional economic development, promote the
67 vitality of regional economic development, and promote the coordinated development of regional economy is the
68 basis and key to solve the main social contradictions in the new age, and is also the driving force of economic and
69 social development axis. U Problem 3, this paper collects relevant data, selects appropriate indicator system,
70 establishes mathematical model to analyze and measure regional (or city or provincial) economic vitality, and
71 ranks urban economic vitality.

72 3 II.

73 4 Models a) The model of problem

74 Based on the panel data model, collects data from various provinces and cities, performs correlation test and
75 principal component analysis on the data. The fixed effect test and random effect test were carried out for the
76 obtained factors, and the influence of policy and enterprise vitality on economic vitality was analyzed based on
77 the established relationship model between each factor and economic vitality during the COVID-19 epidemic.

78 5 i. Data analysis and processing

79 Based on the collected data has certain error and deficiencies, in order to reduce the invalid, the influence of
80 the error data of the following model, improve the reliability of data, need to collect the data pretreatment,
81 firstly the filtered data, remove abnormal data, secondly, proper supplement of incomplete data, finally, has
82 strong correlation data linear regression analysis forecasting and slight fluctuation data using the moving average
83 method to fill the missing value, to further improve the accuracy and the integrity of the data.

84 6 1) Data selection Principle

85 This paper needs to collect various indicator data describing economic vitality and influencing economic vitality,
86 and the following classical indicators can be obtained according to the expert method and the literature
87 ??10][11][13] [14].

88 Dependent variable. In the existing economic vitality research and analysis, more choose gross domestic
89 product (GDP) as a measure of regional economic vitality. In this paper, in order to measure regional economic
90 vitality, main factors from the effects of the economic vitality, that reflects the GDP growth rate as the level
91 of economic development during the period of change degree of dynamic indexes, namely whether a national
92 economic basic index of the dynamic, and USES the linear regression analysis and panel data model analysis,
93 the main measures for regional economic vitality.

94 Independent variables. Based on the existing literature research results and the aforementioned analysis, this
95 paper selects 9 aspects including population growth rate, fiscal expenditure and employment rate (mainly used
96 to reflect the main influencing factors of regional economic vitality and its growth trend).

97 The employment rate is expressed by the number of unemployed; At the same time, in the establishment of
98 the model, for the negative value of population growth rate, in order to reduce the error in the large number
99 region, dummy variables can be used instead of the original statistical samples, which are reset to zero in this
100 paper.

101 Control variables. Based on the analysis of the comprehensive evaluation index system of urban economy, and
102 considering the availability of data, this paper introduces independent innovation ability, per capita length of
103 education, professional and technical talent inflow and other irrelevant variables as control variables. Through
104 certain analysis, the variables other than independent variables that can affect the change of dependent variables
105 should be well controlled and regarded as constants, so as to obtain appropriate causal relationship and obtain
106 the most true and accurate value. 2) Independence Test In the analysis of the relationship between the factors
107 affecting economic vitality, in order to fully understand whether there is an internal relationship between the
108 factors, according to the processed data, this paper carries out an independence test for each factor.

109 The data source is the national bureau of statistics, and the independence test is conducted on the pre-
110 processed data. See the appendix for the specific data. Make the following assumptions about the research
111 hypothesis:

112 ? The factors that influence positive energy are independent of each other Alternative Hypothesis: ? The
113 factors influencing economic vitality are not independent Firstly, chi-square independence test was conducted
114 and SPSS was used to conduct independent test for each influencing factor to observe whether there was any
115 correlation between each factor. The test results are as follows: It can be seen from Table 2 that the cross relation
116 between each factor and the year, and the cross table shows the availability of different influencing factors, all of
117 which occupy a complete percentage, indicating that the selected data are valid values with high accuracy, which
118 can be further compared in pairs to test the independence of judgment factors. The significance analysis is used
119 to determine whether there is independence between factors. The chi-square significance test results are shown
120 in Table 3. It can be seen from Table 3 that the degree of freedom is the probability of Person chi-square, which
121 is less than 0.05, so the null hypothesis is rejected, that is, the influencing factors are not independent of each
122 other.

123 **7 3) Correlation Analysis**

124 Each factor in the collection is the indicator data of each city in the country, which belongs to the panel data.
125 There may be a certain correlation between the data. Considering the correlation among various factors, the
126 linear strength relationship diagram of each factor is obtained based on the data as follows: As can be seen from
127 the observation in figure 1, there is a correlation among all factors, as well as the expression form and strength
128 of the relationship among all factors. The closer the data is to 1, the stronger the correlation is.

129 Local GDP is positively correlated with Government expenditure? Gross income from international
130 tourism?Consumer price index?Education funds?Total corporate profits?Population? Unemployment and added
131 value of the tertiary industry, and negatively correlated with the number of patent applications. SPSS was used
132 to conduct correlation analysis on the data, and the results were shown in Table 4. According to the above
133 correlation analysis Table 5, there is a correlation among all factors, and the positive correlation coefficient is
134 distributed between 0.5 and 1, reflecting a strong correlation; And then according to the significance test of the
135 correlation coefficient, the significance values are all less than 0.05, indicating that the correlation coefficient has
136 reached a high level of significance. Therefore, there is a strong correlation between various factors influencing
137 economic vitality.

138 **8 b) Establishment of model**

139 This Based on the data and problem in this question, it is obvious that the panel data model is a better
140 choice. The panel data model includes both the cross-section and the time dimension. Here, the factors affecting
141 economic vitality are taken as the cross-section, and the year is taken as the time dimension. Among them,
142 $i(i=1?8)$ represents the following linear model set for the year: $y_{it} = \beta_0 + \beta_1 t + \beta_2 x_{it} + \epsilon_{it}$.

143 The panel data model can be further divided into fixed effect model and random effect model.

144 **9 1) Fixed effect model**

145 The individual effect is regarded as a fixed factor that does not change with time, then equation 1 can be expressed
146 as a vector $y_{it} = \beta_0 + \beta_1 A_{it} + \beta_2 T_{it} + \beta_3 x_{it} + \epsilon_{it}$.

147 In the formula; A_{it} is a column direction where all elements are 1, and the others have the same meaning as
148 the original model.

149 **10 2) Random effect model**

150 The individual effect β_0 is regarded as a random factor that changes with time. By using the random effect
151 model, the long-term factors and short-term factors in the variance can be separated. The basic setting of the
152 model is as follows: $y_{it} = \beta_0 + \beta_1 t + \beta_2 x_{it} + \beta_3 A_{it} + \epsilon_{it}$.

153 **11 3) Model determination based on Hausman test**

154 Because the missing related variables are not excluded, there will be dependent variable-local GDP will change
155 with the same period correlation of random interference items, and the constraint conditions of exogenous
156 variables are not satisfied, so that the OLS estimator is biased and different. OLS is used to test the fixed

15 HYPOTHESIS 1 HYPOTHESIS 2 HYPOTHESIS 3 HYPOTHESIS 4 HYPOTHESIS 5

157 effect model and GLS is used to test the random effect model. According to the reference [13], the difference
158 between the random effect model and the fixed effect model is that it is difficult to try to make a high degree of
159 distinction on the description of individuals. The fixed effect will cost more degrees of freedom, while the random
160 effect is more universal. The proposed Hausman test can be used to distinguish them to some extent. It can be
161 seen from the output result that the parameter estimation variance of random and fixed effect models under this
162 test is a positive definite matrix, which satisfies the test conditions. Under the 95% confidence interval, the P
163 value is much less than 0.05. Therefore, the fixed effect model should be selected as the explanation model for
164 the influence of economic vitality, while the random effect model should be selected instead.

165 12 i. Model solving process

166 In this section, stability analysis is conducted on the existing panel data, fixed effect test and random effect test
167 are conducted on the whole data based on the panel mathematical model, and Hausman test is used to determine
168 the applicable model for the panel data. Finally, the analysis results are obtained based on the panel regression
169 model.

170 13 1) Data stability and reliability analysis

171 The data of this paper comes from China National Statistical Yearbook, which includes the local government's
172 financial expenditure, the total income of local international tourism, consumer price index, total profits of
173 enterprises, population, unemployment, tertiary industry, total patents and local GDP. The inconsistency of the
174 order of magnitude of each part will cause trouble to the model fitting. According to the statistical yearbook,
175 the city is divided into 1-31, and the distribution of various data is shown in Figure 3. The? in Hypothesis one
176 is the independent variable interference term. Hypothesis 1: Assume that the ?has no effect on the observed
177 value, unobserved value and post observed value. Hypothesis 2: The general test of homovariance, Ensure that
178 the model satisfies the blue estimate of OLS. And organize data into long data types.

179 The year (2009-2018) is the cross-section marker, the province (1-31) is the research individual, and each type
180 of independent variable is the influencing factor.

181 The solution is based on Stata software, and the results are shown in Table 7. Among them, the F value is
182 very close to 0, indicating that the fixed effect is very significant in this case. Among the seven independent
183 variables, the consumer index and unemployment rate are not significant within the 95% confidence interval. ()
184 B © 2021 Global Journals . () ni ni x X MAX Y ? ? [,] 0. i i i E x a ? ? 2 [,] i i i

185 Local government expenditure, total tourism income, total profits of enterprises, resident population and
186 tertiary industry income all have strong statistical significance. The statistics are shown in Table 8. Among
187 them, the third industry has the most significant impact on GDP, and the consumer index has the least impact
188 on GDP.

189 We can know that all the selected indicators have positive significance for GDP growth within the statistical
190 range. It shows that this test has passed hypothesis one and hypothesis two for panel data, and both of them
191 are true.

192 14 3) Random effect model test based on GLS estimation

193 The number of indexes (N) is 10, and the time span (T) is 10 years. In this case, it is also possible to meet the
194 random effect model, further test of the random effect model is needed.

195 15 HYPOTHESIS 1 HYPOTHESIS 2 HYPOTHESIS 3 HYPOTHESIS 4 HYPOTHESIS 5

196 According to the above assumption, suppose that the distribution of each independent variable is constrained
197 in a specific case, and the effect of each independent variable obeys the mean value of 0. The second is the
198 description of random interference, which has no correlation with explanatory variables. The third term makes
199 the two coefficients independent of each other.

200 Based on the above description, GLS estimation method can be used to obtain whether the panel data model
201 conforms to the random effect test when the collected variables are close to the time span.

202 Organize data into long data types. The year (2009-2018) was used as the cross-section marker, the province
203 (1-31) as the study individual, and each type of independent variable as the influencing factor. Use Stata software
204 to solve the problem, and get the results as shown in Table 9. The third industry has the most significant impact
205 on GDP, and the resident population has the least impact on GDP. We can know that all the selected indicators
206 have positive significance for GDP growth within the statistical range. At the same time, it shows that the test
207 has passed all the hypotheses of panel data and satisfies the random effect. According to the reference [13],
208 the difference between the random effect model and the fixed effect model is that it is very difficult to try to
209 distinguish them in a high degree in the description of individuals. The fixed effect will consume a large degree
210 of freedom, while the random effect is more universal on this basis. The proposed Hausman test can be used to
211 distinguish them to some extent. () B [,] 0, i i i E x a ? ? 2 [,] , i i i T Var x a I ? ? 2 ~ (0 ,), i a a IID ? (,
212) 0, i i Cov a x ? 2 2 ' ~ (0, 1). i i T a T T u x IID A A ? ?

214 The test of the advanced random effect model will store the test results, then test the fixed effect of the model
215 and save the result. Hausman test is used to get the final model, and then the method to test the two models
216 simultaneously is established. It is known from the output that the variance of parameter estimation of random
217 and fixed effect models under this test is a positive definite matrix, which satisfies the test conditions. Under
218 95% confidence interval, P value is far less than 0.05. Therefore, we should choose fixed effect model as the
219 explanation model of economic vitality.

220 **16 5) Analysis of model test results**

221 Using Hausman test, the fixed effect model is determined as the interpretation model of economic vitality, and the
222 results are shown in Table 12. Among them, the factors that have a positive impact on economic vitality (GDP)
223 are the local government financial expenditure, the total annual revenue of local tourism, the total annual profit
224 of local enterprises, the local permanent population and the GDP of the tertiary industry. According to figure
225 7, based on the fixed effect model, it can be concluded that the tertiary industry has the largest impact on the
226 estimated vitality, followed by the annual income of enterprises (enterprise vitality), the input expenditure of local
227 government (policy bias), the total income of local tourism, and finally the permanent population. Among them,
228 the influence of the tertiary industry on economic vitality is more than 7 times that of enterprises, indicating
229 that the third vitality can occupy most of the influence among the factors influencing economic vitality.

230 **17 6) Activation scheme proposed based on fixed effect model**

231 According to the fixed effect model shown in figure 4, the explanation degree of each factor to economic vitality
232 has been given, and the following Suggestions are given according to the influence degree.

233 1. To increase the proportion of the tertiary industry in the overall economy, the tertiary industry plays an
234 important role in the influencing factors, so it is necessary to strengthen the overall proportion of the tertiary
235 industry in the current stage of social construction. Raising the economic proportion of the tertiary industry
236 will greatly promote the improvement of economic vitality. 2. In the process of development, the region should
237 combine its resource endowment and industrial foundation to find the optimal ratio of enterprise structure,
238 complete the adjustment of enterprise structure as soon as possible, and develop appropriate leading industries
239 to promote economic growth. Will be conducive to a steady increase in economic vitality. 3. Local government
240 expenditure has a greater impact on economic vitality. The government needs to be tightly managed to make its
241 spending transparent.

242 We will increase government support for enterprises. 4. Entrepreneurship is encouraged. The government
243 takes the lead in encouraging entrepreneurship, and social practices are carried out to transform enterprises.

244 According to the influence of individual factors on economic vitality obtained from the fixed model, the
245 influence law of factors is summarized, among which policy adjustment (government expenditure) and enterprise
246 vitality (annual total profit of enterprises) have a greater positive impact on economic vitality, and the
247 implementation of policies in this respect should also be intensified.

248 7) The influence of changing trends of population and enterprise vitality on economic vitality Seven variables
249 were selected, GDP was taken as the expression of economic vitality, and the fixed effect model in the panel data
250 model was used to draw the following conclusions:

251 The growth rate of permanent resident population has a positive impact on economic vitality, that is, the
252 increase of permanent resident population will increase economic vitality in a small extent.

253 If the population grows too fast, it will increase the rate of job competition and lead to the rise of
254 unemployment, which will have a negative impact on economic vitality. However, the growth decline of enterprise
255 vitality directly affects the change of economic vitality and presents a positive correlation change.

256 **18 The establishment of VAR-VCE dynamic volatility model**

257 Based on the panel data in the first question, this section intercepts the local government expenditure of Beijing
258 as a representation of economic policy and establishes a vector autoregressive model (VAR). It is not obvious
259 that GDP is affected by the fluctuation of various factors. To understand the dynamic influence of various factors
260 on GDP, we need to carry out vector auto regression for this group of data.

261 **19 The establishment of vector auto regression (VAR) model**

262 Based on the statistical properties, a function containing the lag value of exogenous and endogenous variables is
263 established to construct the model, which properly explains the influence of the dynamic changes of variables on
264 the dependent variables.

265 VAR model is essentially a model of multi equation class. Based on the dynamic changes of multiple variables,
266 the interaction between various variables is investigated. Any endogenous variable in the equation system is
267 constructed as the expression of the lag term of any variable. Its general expression is Where Y_t is the
268 endogenous variable vector of K dimension, Y_{t-i} ($i=1,2,\dots,p$) is the vector of lag endogenous variable, X_{t-i}
269 is the d-dimensional exogenous variable vector or lag exogenous vector. P and R are the lag orders of endogenous
270 and exogenous variables, respectively. A_i is k-order coefficient, B_i is k-row-d-column coefficient matrix, these
271 matrices need to be estimated by specific methods. The last term is a vector composed of k-dimension random

26 2) JOHANSEN CO INTEGRATION TEST OF VARIABLES

272 error terms. According to the solution of the following figure, we can get the estimation coefficient. .t t t p t p t
273 r t r r t r t Y AY A Y A Y B X B X B X ?

274 Firstly, the lag order of AVR model is determined according to AIC information criterion and SC criterion
275 when the minimum value is taken, then the lag order is substituted into the meta model, and the coefficient of
276 AVR model can be obtained by OLS estimation.

277 20 The establishment of VEC

278 When multiple time series are unstable, Johansen method is used to test whether there is co integration
279 relationship. If there is co integration relationship, VEC model can be established to analyze the dynamic
280 relationship of its multi pass model.

281 In the formula, ECMT-1 is the error correction term. Compared with AVR model, the error correction term is
282 an important feature to distinguish the two.

283 The error correction term reflects the long-term equilibrium relationship of each variable, and the deviation
284 of long-term equilibrium can be corrected by quick short-term adjustment. Before establishing VEC model,
285 Johansen test is needed to determine the stability and reliability of the model.

286 21 a) Model summary

287 To determine the regression type of a group of vectors, we need to conduct multiple tests, and finally we can
288 determine whether the model has a correction term. Next, we summarize the model to construct a complete
289 VAR-VEC model.

290 22 b) Solution of the model

291 In this section, we first judge the stability of time series, and then do ADF test on vector series to judge its
292 stability.

293 Then, the first-order second-order difference is used to judge its stability. The cointegration test of the original
294 data is carried out, and the satisfied model type is obtained.

295 Finally, the stability of the model is judged, and the dynamic influence of policy implementation on economic
296 vitality is obtained.

297 23 1) ADF unit root test of vector sequence

298 First, all the time data are tested by ADF test, and the difference order is 0. The lag order is 1-2, and the test
299 results are shown in Table 13. It can be seen from Table 13 that under the time test of order 0 raw data, the
300 t-values of six kinds of ttests are greater than the comparison data under the confidence interval of 95%, shows
301 that the time series of this group of data do not pass the ADF test of the original data, and further differential
302 test is needed. Carry out difference differentiation on the original data, and continue ADF test on the data
303 after difference, and the results are shown in Table 14. It can be seen from table 14 that under the ADF time
304 series test, the T value of lnpopulation t test in six species is less than the comparison data under the confidence
305 interval of 95%.

306 24 T-Statistic

307 P

308 Among the six kinds of data, only the population has passed the first-order difference test. The first-order
309 difference of this group of data is not zero, so further difference test is needed.

310 Carry out the second-order difference differentiation on original data, and continue the ADF test on the data
311 after the difference, and the results are shown in Table 15. It can be seen from Table 15 that all the data after
312 the second-order difference have passed the ADF test, that is to say, this group of data is zero in the second
313 order, and then the inter group cointegration test is carried out. Year 2021 () B 1 1 1 1 p t t i t Y ECM Y ?
314 ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ?

315 25 Figure 12: Visualization of three tests

316 Figure 12 shows the visual information of three points of each variable under three tests. The confidence intervals
317 of the middle three levels are 1%, 5% and 10% respectively. After the first-order difference, only lnpopulation
318 passed the test; After the secondorder difference, all the data pass the test, that is, the group of data is the
319 second-order zero integer data.'

320 26 2) Johansen co integration test of variables

321 According to ADF test, the original variable is a second-order zero integer sequence, that is to say, the original
322 variable is an unstable sequence. First, Johansen co integration test is carried out to find out whether there is a
323 co integration relationship between its combinations.

324 The test method is to calculate the trace statistics trace and the maximum eigenvalue Max eigenvalue. Using
 325 the cyclic statistical hypothesis, the existence of cointegration logarithm is assumed. Table 16 shows the Johansen
 326 co integration test results. From the trace statistics trace in Table 16, it is assumed that none is the sequence
 327 without cointegration.

328 Under this assumption, the trajectory value is 255.6213, which is greater than the critical value of 95.7537, if
 329 the original hypothesis is rejected, there is at least one co integration relationship.

330 In the case of 5% confidence level, the original assumption is that there are at least four sets of co integration
331 relationship whose trajectory value is less than the critical value, and the determination of the fourth set of co
332 integration relationship is rejected by the assumption.

333 There are at least three cointegration relations in the linear combination of time series with surface instability.

334 27 c) Establishment and solution of VEC Model

335 When the original data series are non-stationary time series and Johansen co integration test shows that there are
336 at least three co integration relationships in the series. In order to establish a proper VEC model, it is necessary
337 to determine the optimal lag order of the model. The stability of the model is explained by AR root graph and
338 Roland causality analysis.

Finally, the impulse response chart is given, and the long-term and short-term effects of policy implementation on economic vitality are analyzed.

341 28 1) Determination of lag period based on AIS-SC minimiza-
342 tion criterion

When the model is not integrated and stable, multiple VAR models with different lag periods can be established first.

According to the relationship of multiple research variables, the values of each AIC and SC can be recorded and compared.

347 The optimal lag period of the model can be selected according to the principle of reaching the minimum at
 348 the same time. The results in Table 17 are calculated by Eviews software. It can be seen from Table 17 that
 349 AIs value decreases with the increase of VAR (N) lag period, presenting a monotonic decreasing state, SC has a
 350 minimum at VAR (3). According to AIS information standard and SC standard, the optimal lag time is selected
 351 as the third-order lag time.

352 2) Determination of VEC model parameters integration relationships between time series, which can be used
353 to build EVC model.

354 According to AIS-SC criterion, this model is a third-order lag model, and VAR (3) model should be established.
 355 The parameters of the model based on OLS estimation are shown in Table 18.

356 29 B

357 According to the above analysis, through the co integration test, there are at least three groups of co Table 18
358 shows the cointegration formula with the maximum log likelihood. Thus, the final co integration equation can
359 be written as Through the co integration relationship, we can see that the long-term equilibrium relationship
360 between economic vitality and local government expenditure, local tourism revenue and local resident population
361 is positive;

362 There is a long-term negative correlation between economic vitality and local residents' living index and local
 363 unemployment rate. According to the test results (see ??ppendix 1), write the VEC model as?1 ?Y t = ?ECM
 364 t ?1 + ? \hat{I}^n i ?Y t ?1 + ? t i=1

365 The specific coefficients are described as follows:

366 In the formula It can be seen from Figure 16 that the promotion effect of economic policies on economic vitality
 367 gradually declines after 1-3 periods, and the economic vitality has increased since the third period, Because the
 368 experience of implementation after the implementation of economic policies can be applied, which has a secondary
 369 effect. After the fourth period, the promoting effect gradually decreased, the decreasing trend was relatively slow,
 370 and the long-term positive correlation effect continued. $LY_t = (LY1_t, LY2_t, LY3_t)',$

³⁷¹ 30 d) The model of problem 3

372 This section aims at question 3. Firstly, we establish a scientific economic vitality index system as the standard
373 of data selection. Secondly, the minimum average difference method is used to screen the data, and the index is
374 initially extracted; Further, the factor analysis method is used to select the main influencing factors, and finally
375 the comprehensive score of each factor is weighted to give the ranking of urban economic vitality.

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379 Before analyzing the model, we need to use the AR root graph method to test the stability of the model,
380 Then, according to the experimental results, the impulse response of VEC model is given, and the long-term
381 and short-term effects of policy implementation on economic vitality are given under certain circumstances.
382 The construction principle of index system of economic vitality In order to select effective data to measure the
383 economic vitality of each city, the following five principles are given in this paper, and the general process is
384 as follows: indicators must be based on scientific principles, and can truly and objectively reflect the impact
385 of various factors on urban economic vitality. The scientific comprehensive index evaluation system of urban
386 economic vitality is the basis of correct analysis and evaluation of regional economic vitality.

387 32 2) Principle of Practicability:

388 The construction of evaluation index system is mainly theoretical analysis, which will be affected by the data
389 sources of each index in practical application. Therefore, the availability and reliability of data sources should
390 be ensured in the process of re selecting indicators.

391 33 3) Systematic Principle:

392 There should be a certain logical relationship between indicators, which should not only reflect economic vitality
393 from different aspects.

394 34 4) Principle of Comparability:

395 The data of each city should conform to comparability, so the data of each city can be compared horizontally
396 and vertically.

397 35 5) Principle of relevance:

³⁹⁸ The comprehensive evaluation index system of regional economic vitality should be an organic combination of a series of related indexes.

400 36 i. Data filtering

401 The minimum mean square deviation method is used to screen the preliminary data. The observation, value is x
 402 ij , where i is the number of evaluation objects, i.e. the number of cities, j is the number of evaluation indexes,
 403 there are 19 cities, each city has 14 indexes. First, the average value and mean square deviation of index j are
 404 calculated.

405 Then the minimum mean square deviation of all indexes is calculated, such as:

If the minimum mean square deviation is close to 0, then the index be eliminated and calculated in turn.

407 x_j corresponding to S_j can Finally, 9 indexes meeting the requirements can be selected from 14 indexes,
 408 namely, local GDP, financial expenditure, added value of the primary industry, added value of the tertiary
 409 industry, real estate investment, number of college students, population, per capita wage and road traffic noise
 410 level.

411 37 e) Factor Analysis

412 Using factor analysis method, the extracted nine indicators, including 190 sample data from 19 cities in 2009-
413 2018, are dimensioned down, and then the coefficient matrix is multiplied by the standardized factor to calculate
414 the score and find out the factors that have the greatest impact on economic vitality.

414 the score and find out the factors that have the greatest impact on economic vitality.
 415 Where F_i is the score of the i factor; x_1, x_2, x_p is the standardized value of the index; the corresponding
 416 coefficient is the component score coefficient; The total factor score is equal to the weighted arithmetic mean
 417 of the scores of each factor, that is:

418 Where is the total factor score, F_i is the score of the first influencing factor; B_i is the contribution of the
 419 first factor, and factor contribution = variance contribution rate / total variance interpretation after the factor
 420 rotation.

421 38 (

422) .n j i j i n j i j j i x x n S x x n ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? 0 1 min{ } j j j j m s s ? ? ? 1 1 2 2
 423 , (1, 2, ,) .i i i p p F x x x p m ? ? ? ? ? ? ? ? ? ? ? 10 1 i i i F b F ? ? ? f)

Measurement of economic vitality of regional cities Before measuring the economic vitality of each city, the relationship between variables and factor analysis is further verified through the variance of common factors. The common factor variance can effectively reflect the strength of its interpretation ability.

427 The larger the common factor variance extracted between variables, the stronger the ability to be interpreted
428 by the common factor.

429 Most of the variable factors proposed by the extracted common factor variance are explained to a higher degree
430 than 70%.

431 Therefore, the extraction effect is better, the information of the original data loss is less, and the data extracted
432 is more reliable.

433 For the factor whose characteristic root is greater than 1, data analysis is carried out based on SPSS software,
434 and two factors are finally obtained, as shown in the table below, with the explanation of total variance. From
435 Table 20, it can be seen that the cumulative variance contribution rate is 73.174%, indicating that the first
436 two factors contain 73.174% of all indicator information, and the extracted information is large and highly
437 representative. Therefore, it can be seen that factor analysis is effective in extracting original variable information.

438 **39 Figure 18: Gravel map**

439 It can also be seen from the gravel map that the information contributed by the first two factors in the overall
440 influence factors represents that the broken line is relatively steep, and the slope of the broken line is relatively
441 gentle after that, so it can be considered that the two factors extracted are relatively reasonable. It can be
442 seen that the primary industry, tertiary industry, college students, population and road traffic noise level are
443 factor 1, which reflects the level of social production and security. Therefore, factor 1 can be named as social
444 production and security factor; local GDP, financial expenditure, real estate investment and per capita wage
445 are factor 2, which reflects the government regulation and control. Therefore, the Factor 2 is called government
446 regulation factor. The contribution rate of factors is analyzed by the method of normal maximization variance,
447 and the conversion correlation coefficient is obtained, which shows the correlation of two factors. According to
448 the component score coefficient matrix, local GDP, fiscal expenditure, tertiary industry, tertiary industry and
449 real estate investment have a positive impact on the ranking; the primary industry has a negative impact on the
450 ranking. The expression of each influence factor is given according to Table 23. Taking the variance contribution
451 rate of each factor as the weight, the weighted analysis is carried out. After weighted average, the growth index
452 scores are as follows: $F_1 = 0.269x_1 + 0.273x_2 + 0.1x_3 + 0.281x_4 + 0.000x_5 = 0.42315F_1 + 0.31859F_2$.

453 The final weight value of each influencing factor is obtained by factor analysis, and the comprehensive score of
454 each factor is obtained by factor score 24. It can be seen from the ranking table that the cities such as Beijing,
455 Shanghai and Guangzhou rank the second, third and fourth respectively in the ranking, which indicates that
456 the central economic zone of the country has high stability and is not easy to change. The highest ranking is
457 Chongqing. Shenyang is ranked next, and the transfer of its industrial center may be one of the reasons for this
458 result. It can be seen from Figure 19 that the ranking of Kunming and Ningbo fluctuates greatly. Considering
459 that the local industrial structure is not obvious enough, it is necessary to strengthen the industrial structure
460 adjustment to improve its economic vitality. Shenyang's ranking is declining year by year, which may also be
461 related to local policies and development strategies, so it needs to be noticed in time.

462 **40 g) Comparative analysis of factors affecting economic vitality**

463 In the above, according to the factor analysis method, two main factors that affect economic vitality are
464 social production and security factors and government regulation factors, which have a positive correlation with
465 economic vitality.

466 According to the 9 influencing factors selected above, the secondary industry, house price, total retail sales of
467 social goods, number of hospitals and number of post offices all have a positive impact on the economic vitality.
468 Comparative analysis is made on each factor to see if there is any difference.

469 **41 1) Model Establishment**

470 In order to test the accuracy of the index system established to measure economic vitality, considering that the
471 individual effect of each index is not observable and the time effect is not observable, a panel data model is
472 established to test it, and the following model is established: $eco_{it} = \beta_0 + \beta_1 x_{it} + \beta_2 t + \beta_3 it + \beta_4 x_{it}t + \beta_5 x_{it}^2 + \epsilon_{it}$.

473 In the formula, eco_{it} is a comprehensive index system to measure economic vitality, x_{it} is an independent
474 variable of N rows and K columns. The factors affecting economic vitality can be divided into 2. Social security
475 system: Number of hospitals and Post offices. 2. Processing and production: The secondary industry.

476 1) Consumption level: house price, total retail sales of social goods.

477 2) Descriptive statistics In order to analyze the regional economic vitality more specifically, it is necessary to
478 understand the distribution characteristics of each data.

479 Through descriptive statistical analysis of the data, the basic information of each variable (including sample
480 number, mean value, standard deviation, minimum value and maximum value) is obtained as shown in the Table
481 25.

482 In order to analyze the regional economic vitality more specifically, it is necessary to understand the distribution
483 characteristics of each data.

484 Through descriptive statistical analysis of the data, the basic information of each variable (including sample
485 number, mean value, standard deviation, minimum value and maximum value) is obtained as shown in the Table
486 25. It can be seen from Table 25 that the average value of eco is close to 0, indicating that the statistical effect is
487 very good. The fluctuation of house price is large, which is in line with China's national conditions. The number
488 of hospitals is quite different, which deserves the attention of local government. The number of post offices is on
489 the high side in some areas, resulting in waste of resources.

490 **42 3) Correlation analysis**

491 Table 25 is the basic situation of the data. After the description and statistics of the data, the correlation
492 analysis of the data is carried out. If the correlation of some indicators is too low, it may lead to the low chi
493 square significance value, which needs to be screened. Then, Pearson correlation coefficient is selected to measure
494 the correlation between the variables.

495 If the correlation between the explained variables and the explained variables is high, the study of the model
496 is intentional. However, if the correlation between explanatory variables is too high, it may lead to collinearity
497 among variables, which may affect the results of the model. The following studies the correlation between
498 the two variables, analyzes the correlation between the two variables and tests its significance. From the
499 correlation analysis results of Table 26, it can be concluded that the correlation coefficients between all explanatory
500 variables and the interpreted variables are significant, and there is no strong correlation between the explanatory
501 variables. Therefore, there is no multicollinearity between the explanatory variables. In order to further study
502 the collinearity among the validation variables, the model was validated by using the VIF test, and the results
503 are shown in the Table 27. Which chose the per capita GDP, fiscal revenue, education and human capital, income
504 levels, employment, innovation and intellectual property rights protection for data collection, processing, modeling
505 and analysis, and it can analysis indicators and economic vitality all remain positive correlation, therefore, we
506 can analysis from the perspective of the above and advise the sustainable development of the economic vitality
507 of benign and stronger regional competitiveness.

508 **43 Suggestions on the benign sustainable development of Bei-
509 jing's economic vitality**

510 Economic vitality includes not only the speed, stability and results of economic growth, but also the average
511 quality of life of the people, such as the level of education and health standards, as well as the overall progress of
512 the economic structure and social structure. The third industry is an important indicator of a country's economic
513 development. And the tertiary industry has the characteristics of less investment, short cycle, quick effect and
514 high wages of employees. Vigorously developing the tertiary industry can rapidly expand employment fields and
515 jobs, avoid labor surplus, and improve residents' income. For modern cities, residents not only have material
516 needs, but also pursue spiritual level. This development trend promotes the region to continuously develop new
517 industries to meet the needs of the people, so as to improve residents and to improve the quality of life. Therefore,
518 we vigorously develop the tertiary industry, which has a significant role in promoting the sustainable development
519 of economic vitality.

520 **44 c) Strengthening the development of primary and secondary
521 industries**

522 For the adjustment of Beijing's economic structure and the promotion of its regional competitiveness, it is
523 necessary to develop the tertiary industry while strengthening the primary industry and expanding the scale of
524 the secondary industry. The first industry is the basic industry of the national economy, strengthening the first
525 industry, and laying the foundation for the development of the second industry and the third industry.

526 **45 d) Reasonable control of investment**

527 Investment is an important part of GDP, but also an element of economic vitality. The growth of investment is
528 of great significance to the promotion of economic vitality. In China, investment is mainly divided into private
529 investment, government investment and foreign investment. From the perspective of Beijing, as a first-tier city,
530 a large number of foreign enterprises and state-owned enterprises invest in Beijing in various forms. However,
531 unreasonable investment may cause the princess of resources, leading to the imbalance of social and economic
532 development. Therefore, Beijing ¹

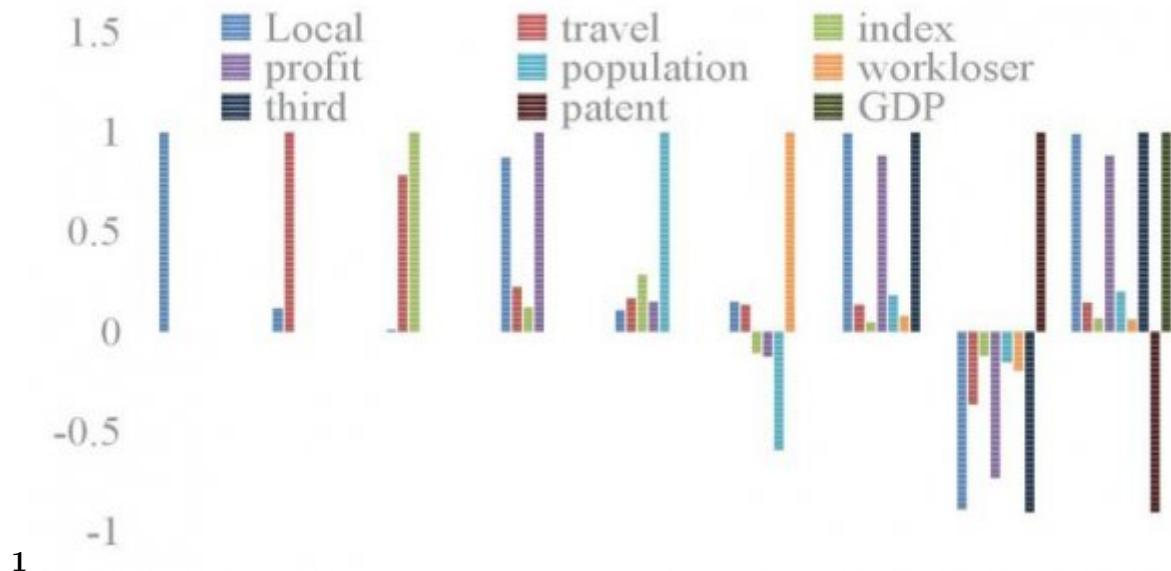


Figure 1: Figure 1 :

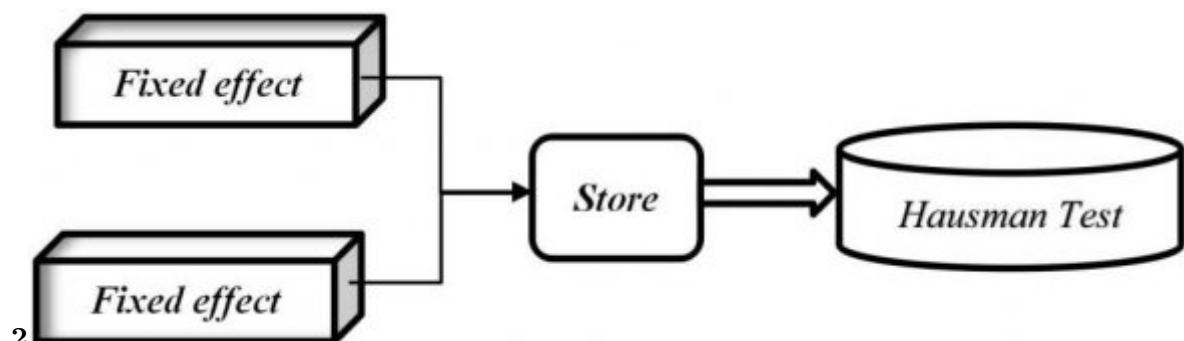
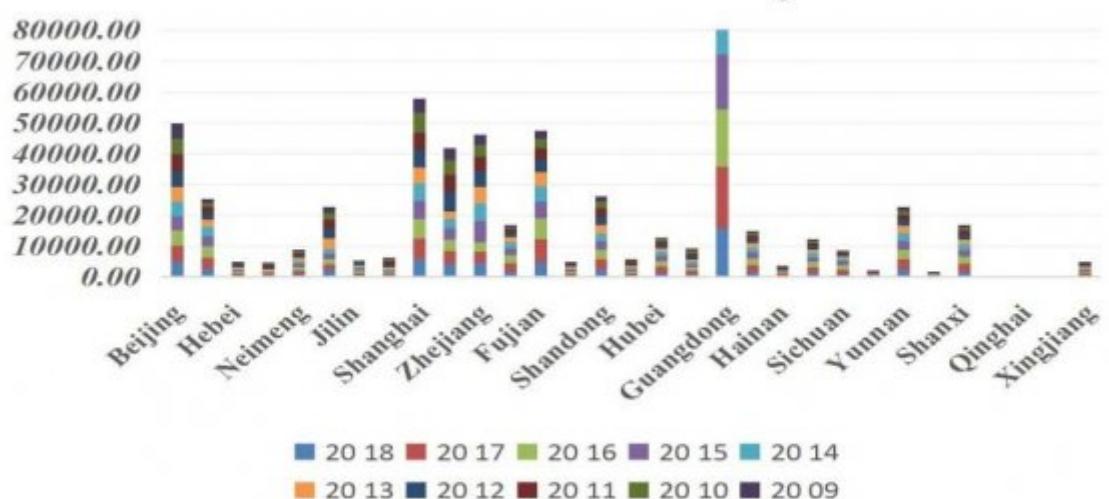


Figure 2: Figure 2 :



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Figure 3: Figure 3 :

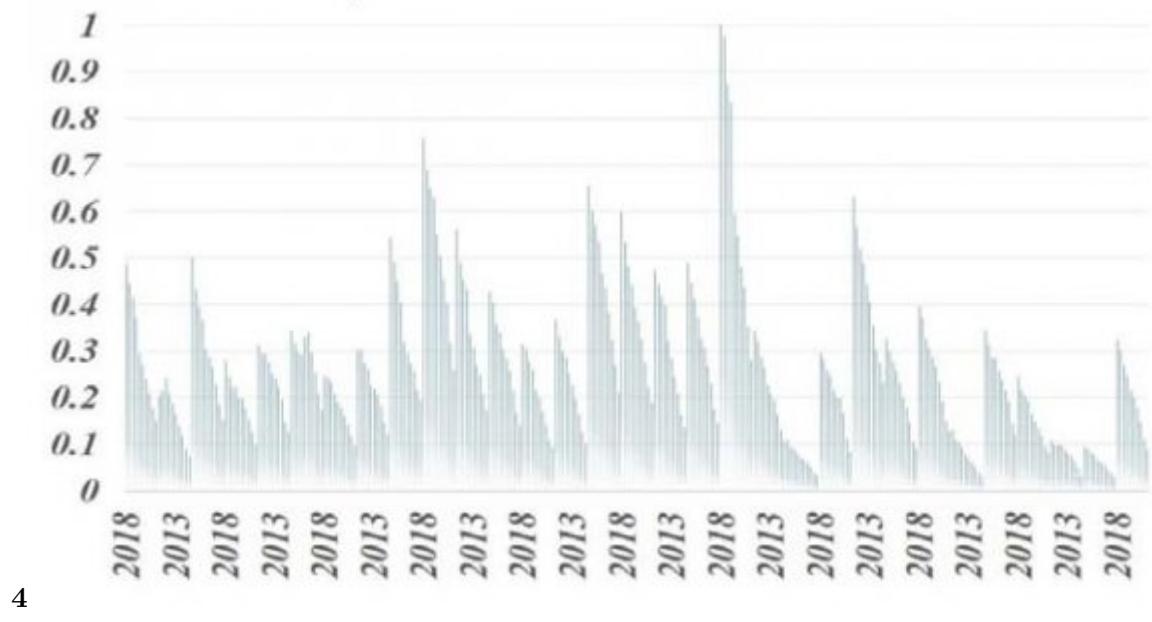


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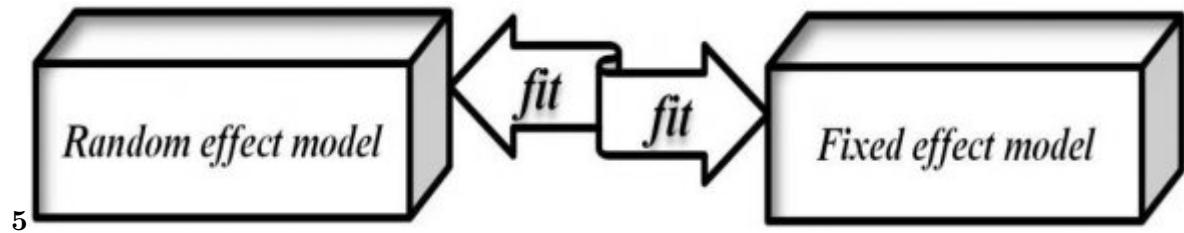


Figure 5: Figure 5 :

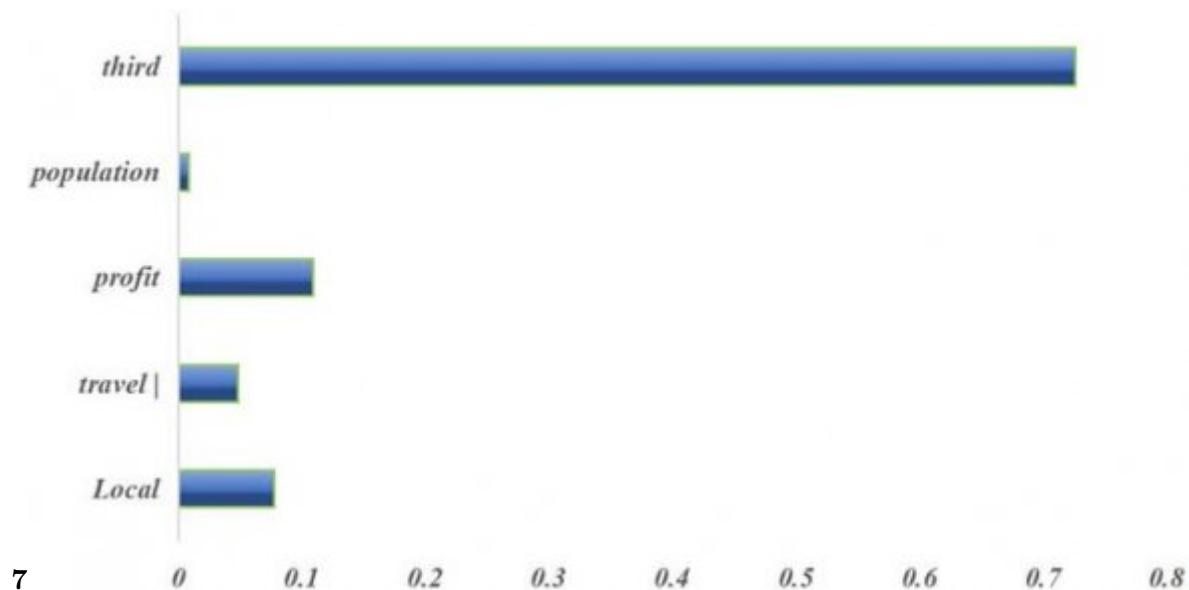


Figure 6: Figure 7 :

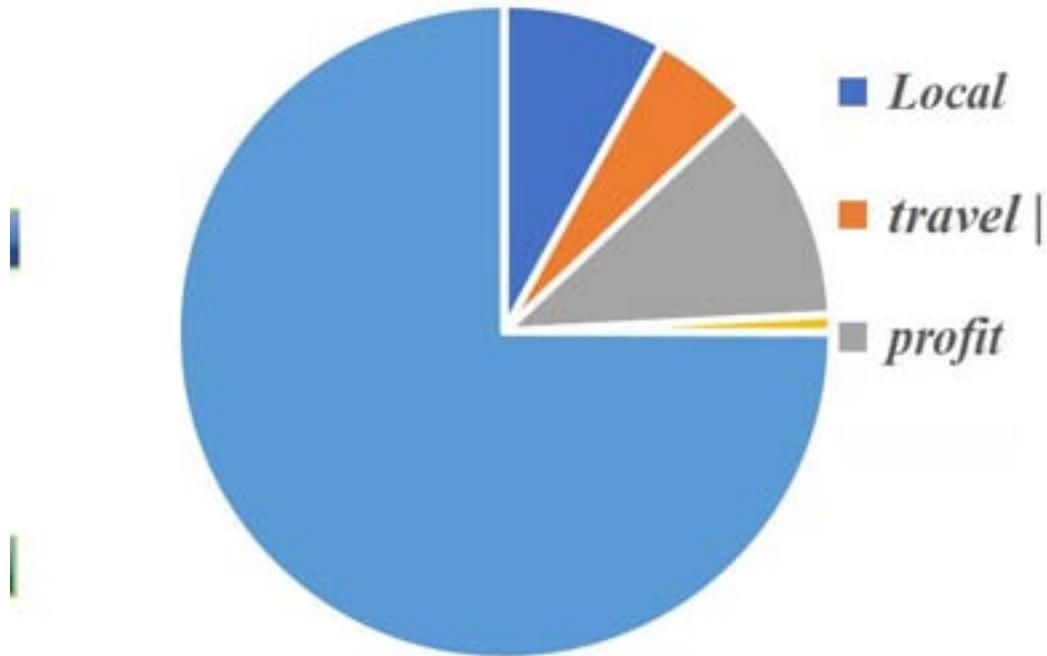
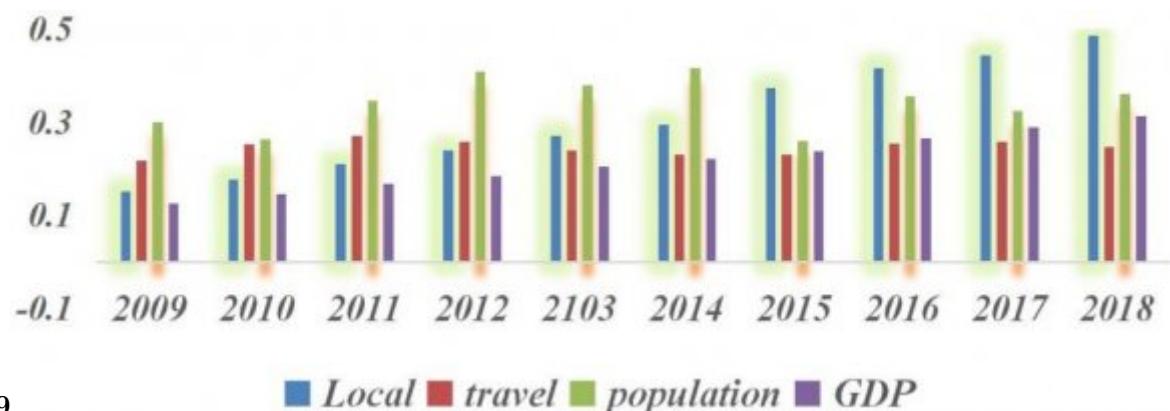
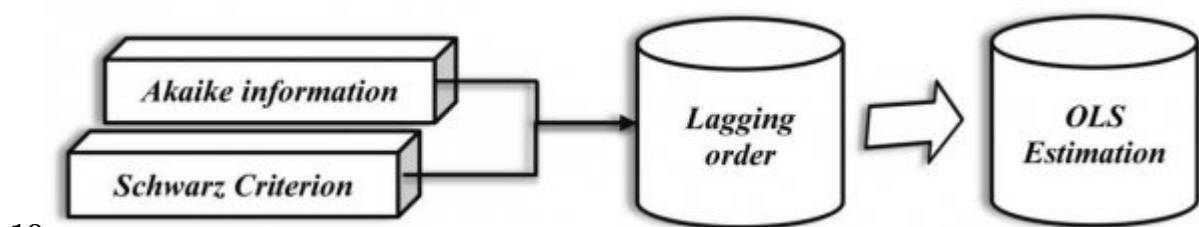


Figure 7: GlobalB



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Figure 8: Figure 9 :



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Figure 9: Figure 10 :

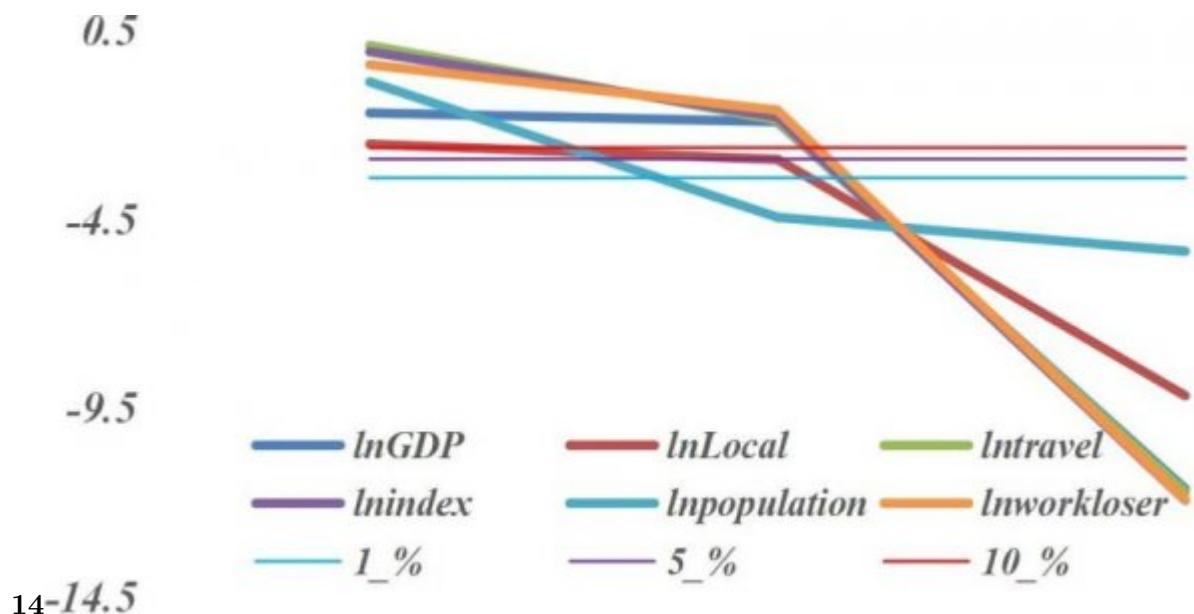


Figure 10: Figure 14 :

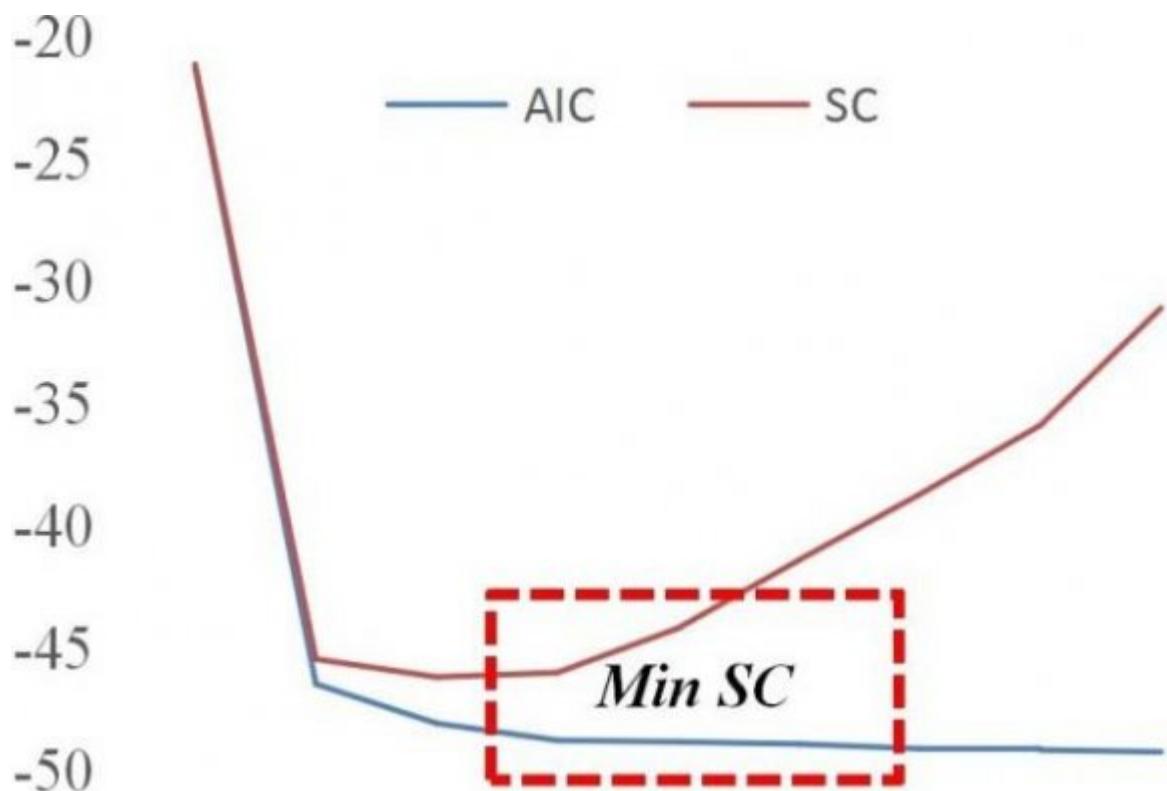
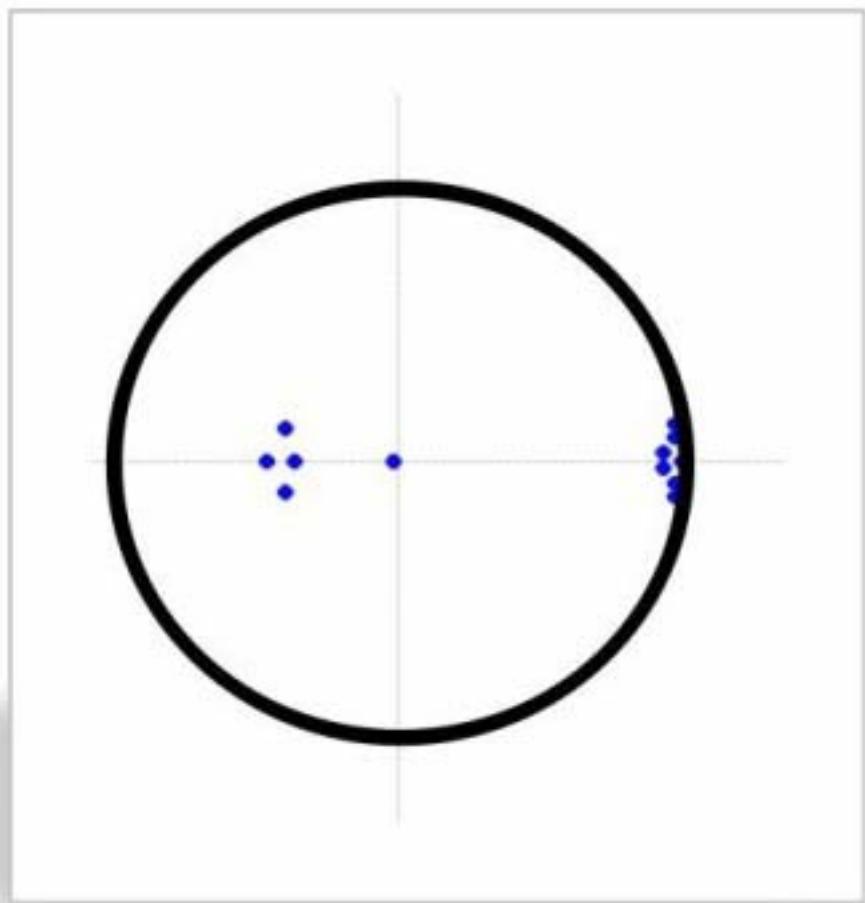
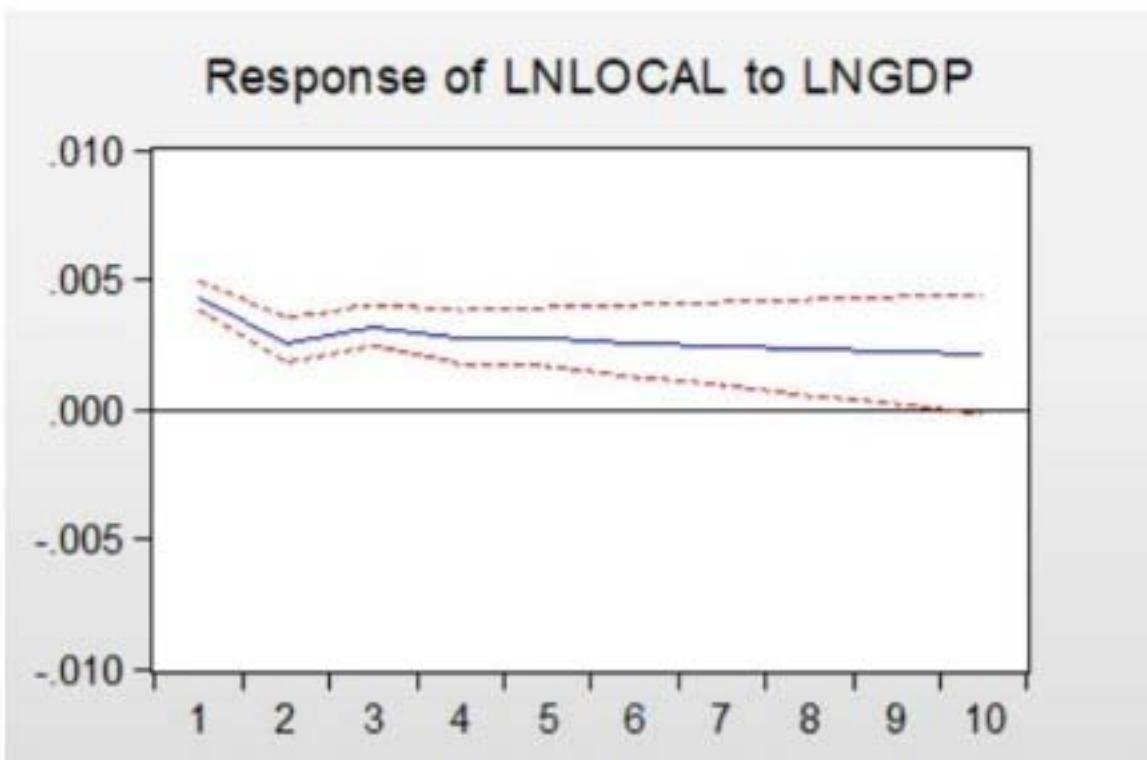


Figure 11:



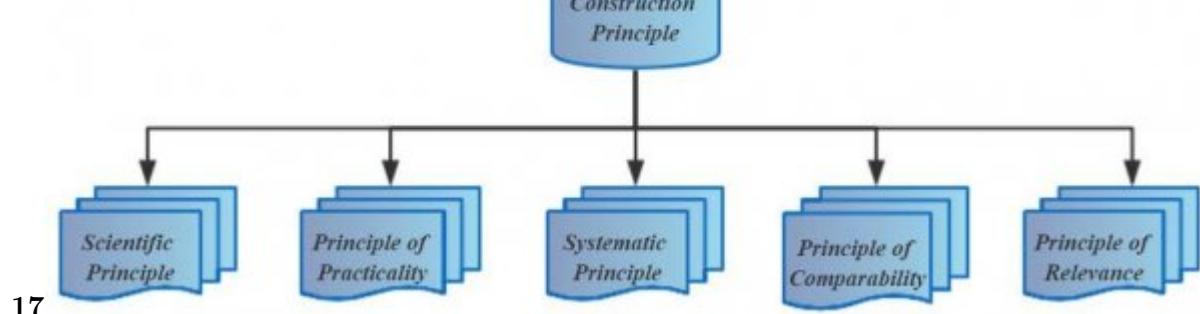
15

Figure 12: Figure 15



15

Figure 13: Figure 15 :



17

Figure 14: Figure 17 :

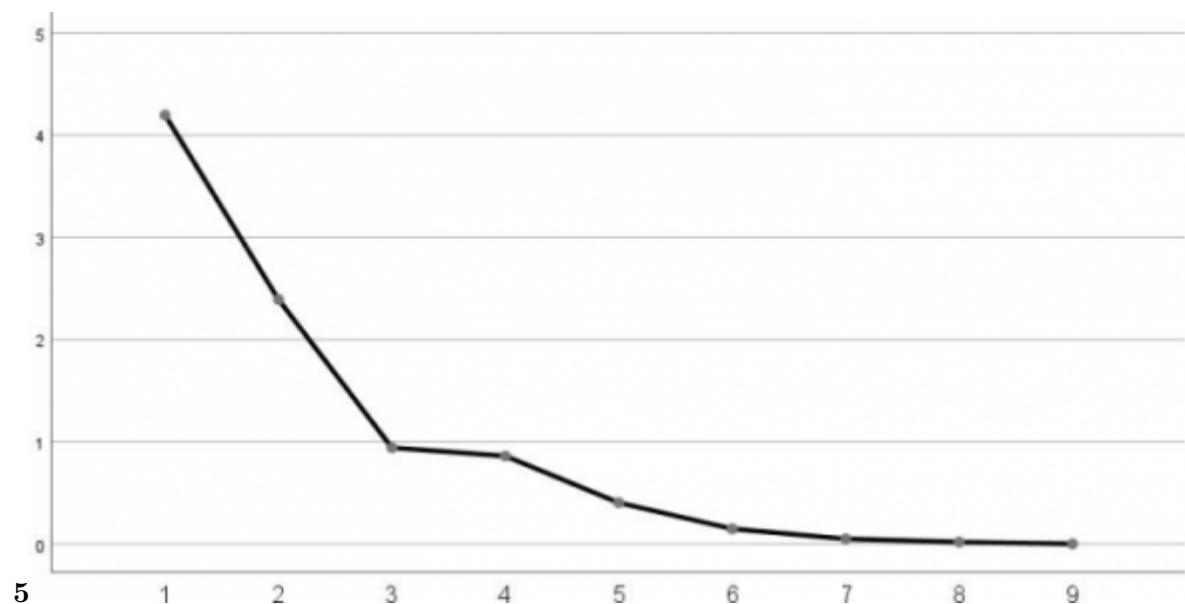
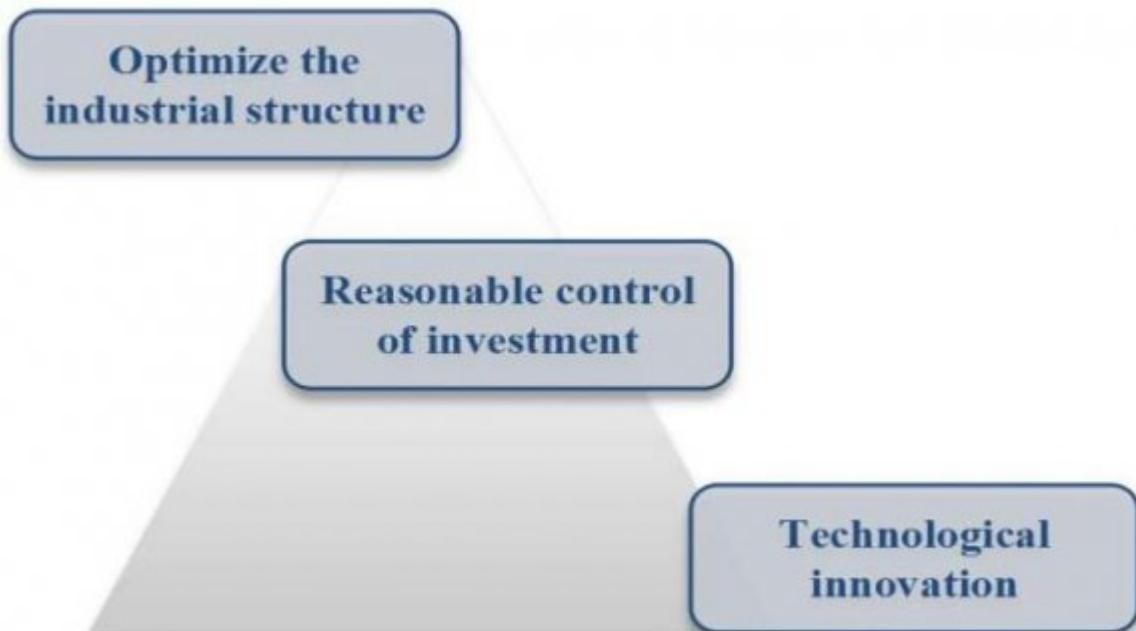


Figure 15: 198x 5 ?



Figure 16:



19

Figure 17: Figure 19 :

1

Variable Name	Definition
	The local GDP?Added value of tertiary industry?Education funds?LGE?Government expenditure ? Gross income from international tourism ? Consumer price index?Population?Unemployment?Number of patents filed
Dependent variable	
Independent variables	Population growth rate?Fiscal spending
Control variables	Independent innovation ability?Total corporate profits?Per capita years of education?The inflow of professional and technical personnel

Figure 18: Table 1 :

2

	Effective	Observations			Missing	Percentage
		N	Percentage	N	Percentage	
Local	309309	100.0%	0	0.0%	309309	100.0%
Travel	309309	100.0%	0	0.0%	309309	100.0%
Index	309309	100.0%	0	0.0%	309309	100.0%
Profit	309309	100.0%	0	0.0%	309309	100.0%
Population	309309	100.0%	0	0.0%	309309	100.0%
Workloser	309309	100.0%	0	0.0%	309309	100.0%
Third	309309	100.0%	0	0.0%	309309	100.0%
Patent	309309	100.0%	0	0.0%	309309	100.0%
GDP	309309	100.0%	0	0.0%	309309	100.0%

Figure 19: Table 2 :

3

	Numerical	Df	Asymptotic significance (2 ends)
Person square test	2753847.871 a	2745	.000
Likelihood ratio	1416065.090	2745	.000
Linear to linear	13402.742	1	.000
The number of Valid observations	309309		.000

Figure 20: Table 3 :

4

	Average	Standard deviation	95% confidence interval (lower bound upper bound)	Significant
Local	4047.2789	2473.46062	(3788.2312?4321.1274)	0.047
travel	2071.1539	3068.79243	(1732.0034?2455.2115)	0.00
index	102.306	1.5306	(102.134?102.473)	0.006
profit	2024.9450	2138.79648	(1793.7463?2264.6996)	0.011
population	5.42268	2.847803	(5.12150?5.74611)	0.017
Work loser	24.8066	14.06292	(23.3868?26.4238)	0.00
third	9627.7616	8985.16139	(8672.1902?10640.3587)	0.007
Correlation coefficients can quantitatively describe the closeness of linear relationships among factors, and SPSS is used for correlation analysis to obtain the correlation coefficients among the influencing factors, as shown in Table 5.				

Figure 21: Table 4 :

5

	Local	travel	index	profit	Pop	Work	third	patent
Local	1	0.602	-0.113	0.777	-0.155	0.570	0.921	0.911
travel	0.602	1	-0.022	0.592	-0.034	0.217	0.709	0.656
index	-0.113	-0.02	1	0.011	0.034	-0.057	-0.092	-0.073
profit	0.777	0.592	0.011	1	-0.145	0.589	0.875	0.935
pop	-0.155	-0.034	0.034	-0.145	1	-0.478	-0.153	-0.160
Work	0.570	0.217	-0.057	0.589	-0.478	1	0.515	0.625
third	0.921	0.709	-0.092	0.875	-0.153	0.515	1	0.972
GDP	0.911	0.656	-0.073	0.935	-0.160	0.625	0.972	1
patent	0.399	0.656	-0.034	0.662	-0.108	0.390	0.566	0.608

Figure 22: Table 5 :

6

section is based on the panel data of various factors collected from 31 provinces and cities in China from 2009 to 2018. Considering the influence of multiple factors on economic vitality, a variety of methods can be used, such as multiple linear regression and panel data model. Here, a rough comparison

is made before further mod

establishment. Compare the panel data model with the multiple linear regression model, as shown in Table 6.

Multiple linear regression

Panel data model

Independent variables must be mutually exclusive

No special requirements

variable

More description
Two-dimensional

Selection

Observations Less description
Analysis One-dimensional

of the dimension

Predictive accuracy

Relatively accurate

Information Less contained

More

Controllability No

Yes

Figure 23: Table 6 :

7

Variables	GDP	P> t [95% Conf.Interval]
Local	0.07766356	0.000
travel	0.04812193	0.007
index	0.01040376	0.116
profit	0.10857042	0.001
population	0.00840291	0.011

[Note: Global Journal of Management and Business Research Volume XXI Issue I Version I Year 2021]

Figure 24: Table 7 :

8

Variables

Figure 25: Table 8 :

9

Variables	GDP	P> t [95% Conf. Interval]
Local	0.07772621	0.000
travel	0.03259963	0.051
index	0.00628094	0.123
profit	0.14530897	0.000
population	0.00921631	0.332
workloser	0.06423435	0.000
third	0.71987214	0.000
sigma_u	0.03622232	F =0.
rho	0.91812864	F(30,272)=29.86
sigma_e	0.01081659	Prob > F = 0.0000

Figure 26: Table 9 :

10

Variables

Figure 27: Table 10 :

11

Variables	Value
Chi2(7)	382.02
Prob	0.0000

Figure 28: Table 11 :

12

Variables

Figure 29: Table 12 :

14

	T-Statistic	P	state
lnGDP	-1.911	0.325	Uneven
lnLocal	-2.911	0.049	Uneven
lntravel	-1.871	0.345	Uneven
lnindex	-1.785	0.359	Uneven
lnpopulation	-4.444	0.004	Even
lnworkloser	-1.608	0.475	Uneven

Figure 30: Table 14 :

13

Figure 31: Table 13 :

15

	T-Statistic	P	state
lnGDP	-11.634	0.000	Even
lnLocal	-9.1682	0.000	Even
lntravel	-11.720	0.000	Even
lnindex	-11.937	0.000	Even
lnpopulation	-5.342	0.000	Even
lnworkloser	-11.918	0.000	Even

Figure 32: Table 15 :

16

Hypothesized	No.	of	Trace Statistic	0.05 Critical Value	Prob.**
CE(s)					
None *			255.6213	95.75366	0.0000
At most 1 *			161.7542	69.81889	0.0000
At most 2 *			100.2905	47.85613	0.0000
At most 3 *			41.58610	29.79707	0.0014
At most 4			7.115546	15.49471	0.5642
At most 5			0.998791	3.841466	0.3176

Figure 33: Table 16 :

17

D	AIC	SC
VAR(0)	-21.2662	-21.1206
VAR(1)	-46.448	-45.4286
VAR(2)	-48.0552	-46.16191
VAR(3)	-48.7483	-45.98121
VAR(4)	-48.81	-44.16917
VAR(5)	-48.9	-41.38534
VAR(6)	-49.09	-38.70157
VAR(7)	-49.1406	-35.87832
VAR(8)	-49.2197	-31.0836

Figure 34: Table 17 :

18

	lngdp	lnlocal	lntravel	lnindex	lnpop	lnworklose
C	1	-0.7287	-0.76511	1.809693	-0.23384	0.892205
V	0	-0.00682	-0.08337	-0.34303	-0.02693	-0.1565

[Note: © 2021 Global Journals 27 Global Journal of Management and Business Research Volume XXI Issue I Version I Year 2021 ()]

Figure 35: Table 18 :

ln	gdp?	0.73ln	travel	?	0.77	travel
				ln		
		?	0.23ln		0.89	worklose
				pop	?	ln
Year 2021	0.005 0.089		-0.459 -0.061		0.004 0.082	
Volume XXI Issue t	0.234 0.043 0.077 -0.018		-0.052 -0.201 0.130 0.125	t LY	-1	0.233 0.042
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Figure 36:

13

Initial Extraction

Figure 37: Table 13 :

20

Component	Total	Cumulative%	Cumulative%
1	4.196	46.618	41.315
2	2.390	73.174	73.174
3	0.940	83.622	
4	0.859	93.168	
5	0.403	97.641	
6	0.147	99.271	
7	0.048	99.807	
8	0.017	100.00	
9	2.134E-16	100.00	

Figure 38: Table 20 :

21

Level	1	2
Local GDP	0.877	-0.418
Financial expenditure	0.837	-0.472
Primary industry	0.338	0.785
The tertiary industry	0.838	-0.511
Real estate investment	0.907	-0.058
College Students	0.328	0.221
Population size	0.700	0.647
Per capita wage	0.700	0.647
Noise level	0.002	-0.475

Figure 39: Table 21 :

22

Component	1	2
1	0.858	0.514
2	-0.514	0.858

It can be seen from Table 22 that in the component transformation matrix, the value of component one has changed, and the value of component two has also changed. It is necessary to extract the component matrix of the factor load matrix.

Figure 40: Table 22 :

23

Name	1	2
Local GDP	0.269	-0.043
Financial expenditure	0.273	-0.067
Primary industry	-0.100	0.323
The tertiary industry	0.281	-0.081
Real estate investment	0.198	0.090

Figure 41: Table 23 :

24

Ranking	Region	F1	F2	ECO
1	Shanghai	3.6862	-0.39976	1.395594
2	Beijing	3.29621	-0.30356	1.265118
3	Shenzhen	1.74076	-1.65827	0.190887
4	Guangzhou	1.44806	-0.04957	0.582473
5	Tianjin	0.95879	-0.03063	0.386366
6	Chongqing	0.71899	4.61688	1.767943
7	Wuhan	0.6182	0.05686	0.273524
8	Chengdu	0.41483	0.93521	0.469336
.
13	Changsha	-0.08978	-0.2578	-0.11923
14	Qingdao	-0.11201	-0.13905	-0.09058
15	Ningbo	-0.2036	-0.56477	-0.26405
16	Dongguan	-0.45746	-0.10278	-0.22174
17	Shenyang	-0.55388	-0.49867	-0.38771
18	Kunming	-0.72876	-0.11422	-0.33748
19	Suzhou	-0.8454	-0.05926	-0.36816

Figure 42: Table 24 :

25

Variable	N	Mean	Std.Dev	Min	Max
ECO	190	0.0378	0.52172	-0.69594	1.76794
The secondary industry	190	4121.7130	1882.6090	824.59	9732.54
housing price	190	10072.9401	6383.3838	3442.00	47936.00
Total retail sales	190	4194.3943	2340.76137	956.40	12668.70
Number of hospitals	190	402.517	279.8720	101.0	1606.0
Number of post offices	190	1048.345	1847.4835	131.0	16374.0

Figure 43: Table 25 :

533 It can be seen from the table that the VIF value of the explanatory variable and the control variable is less
534 than 5, that is to say, the multicollinearity among the the results of the model. Therefore, the following modeling
535 and regression analysis can be continued. Continue with the residual analysis From the analysis of variance,
536 it can be seen that the F value is far greater than 1, which shows that the differences among the factors are
537 statistically significant, that is, the interaction effect among the factors is more significant. According to the
538 model test results, if the p value corresponding to the F test is 0, less than 0.05, it means that the fixed effect
539 model is due to the mixed model;

540 If the p value corresponding to the BP test is also 0, less than 0.05, it means that the random effect model is
541 better than the mixed model;

542 If the p value corresponding to the Hausman test is 0, it means that the fixed effect model tends to be selected.
543 See Table ??0 for regression results of fixed effect model to be selected after inspection: From Table ??0, we
544 can see the regression results of the model, and the fixed effect model is selected after the test. The correlation
545 coefficients of the first principal component, the second principal component, the second industry, the house
546 price, the retail sales of social goods, the number of hospitals and the number of post offices are all positively
547 correlated with Eco, indicating that they all have a positive impact on economic vitality. From the perspective
548 of economic vitality, the secondary industry, house price, retail sales of social goods, number of hospitals and
549 number of post offices are all positively related to economic vitality. In these variables, when one variable changes,
550 the other variables remain unchanged, then the economic vitality changes in the same direction. Therefore, it
551 can be further proved that the economic vitality index system

552 .1 e) Technology innovation

553 Science and technology are the primary productive forces, and innovation is a force that can not be ignored to
554 drive economic development. Innovation is conducive to the optimization and transformation of China's economic
555 growth mode. Economic vitality comes from the sound growth of economy.

556 We should strengthen the policy support for the investment in science and technology of enterprises, guide the
557 flow of resources such as projects, funds and talents to enterprises, and establish an innovation support system
558 with enterprises as the main body. Cultivate and develop the next generation Internet, new generation mobile
559 communication, Internet of things, navigation and location services, biomedicine and other high-tech strategic
560 emerging industries. Accelerate the construction of high-end talents gathering special zone, and actively introduce
561 and cultivate high-end talents.

562 V.

563 .2 Model Evaluations a) Advantages

564 The advantages and disadvantages of model factor analysis and panel data model are analyzed. Oil price
565 evaluation. International oil has been affected by many aspects, among which the fluctuation of international
566 political content has a great impact. The VAR model can highlight the impact of oil price changes in the short
567 term and make adjustments at any time.

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