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Analysis of Factors Affecting the Resumption of Work and Production Under the Epidemic Based on Statistical Modeling

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ABSTRACT

Based on statistical modeling and big data methods, the factors affecting the resumption of work and production under the epidemic are analyzed. We selected ten prefecture-level cities in China's Liaoning Province, conducted surveys based on different types of enterprises, used statistical software such as SPSS, AMOS, and established Logistic regression models and structural equation models to analyze and quantify the three types of enterprises and society, enterprises and governments, and enterprises themselves. The relationship between the major categories of influencing factors, combined with the Python algorithm to establish a decision tree prediction model, and the factors affecting the resumption of work and production of enterprises are divided into three categories and specific categories, and finally the corresponding specific three types of coordinated countermeasures and solutions are proposed. Provide some practical suggestions for the company's comprehensive resumption of work and production process.

1. Introduction

The global epidemic is continuing. China is focusing on resuming work and production on one hand, and gradually entering a new normalization in the prevention and control of the epidemic. This has not only provided tremendous support and won precious opportunities for the domestic and global response to the epidemic, but also provided other opportunities for others. The country's gradual return to social normalization provides a possible reference. After China has achieved remarkable results in fighting the epidemic, it has gradually entered the conservative stage of epidemic prevention. After a short-term state of "stopping the epidemic + basic social operation", China has now entered the "prevention and control of the epidemic + restoring the normal operation of society" mode, and the direction of "society normalization + long-term epidemic prevention" continues to advance. A large number of enterprises are actively fighting the epidemic. After the abnormal shutdown, production and restart, some enterprises have so far been unable to return to normal business. As a large number of abnormally operating enterprises of economic cells, they need to return to the normal track as soon as possible to promote the efficient operation of the economy and society. At present, the overall level of resumption of work and production of Chinese enterprises has exceeded 95%, of which 100% of industrial enterprises have resumed work and production. However, a few industries and some enterprises are still waiting for the opportunity. Due to various reasons, some of the enterprises that have resumed work are in "organic ischemia" or the state of "partial shock". The resumption of work is the most important link and component of the social system's return to normal operation. What specific difficulties are faced by enterprises in the process of returning to normalization of production and operation? How to classify and solve? What factors are the key factors hindering the resumption of work and production?

The current research on the new crown pneumonia epidemic mainly focuses on the following aspects: urban epidemic transmission models and prediction models, resumption of work and production intensity models, emergency material allocation decision modeling analysis, and operator big data to help resumption of work and production, etc.

GanMi (GanMi et al., 2020) and others built a model based on multi-source big data, analyzed the population migration changes and manpower gap caused by the epidemic in 34 typical cities across the country, and used the migration base to calculate the intensity of

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resumption of work in other cities. The simulation results show that the SEIR warehouse model can better simulate the development trend of this epidemic. Yan Yue (YanYue et al., 2020) and others used epidemic data to determine the parameters of the inversion model, thereby effectively simulating the development of the epidemic and predicting the future trend of the epidemic. Zhu Changbo (Zhu Changbo et al., 2020) and others actively responded to a document issued by the Joint Prevention and Control Mechanism of the State Council that requires localities to "precise prevention and control at different levels, coordinate epidemic prevention and control, and restore economic and social order." Under this premise, China Unicom will give full play to the advantages of multi-source, massive, and integration unique to operators' big data. Four aspects, including real-time insight into the resumption rate from region to post, rasterized risk index assessment, regional population inflow risk analysis, and employee travel mode risk analysis, help companies resume work and resume production. Ge Honglei (Ge Honglei and LiuNan, 2020) et al. put forward five important anti-epidemic material preparation and decision-making issues that need to be considered in different situations. Considering the comprehensive characteristics of the allocation of epidemic prevention materials, the necessary factors that need to be optimized in the modeling of each decision-making problem are discussed. According to the necessary factors, a multi-period Bayesian sequential decision-making model is constructed, and the detailed modeling process and conclusions are given. Chen Wenhe (Chen Wenhe et al., 2020) and others have constructed a corporate epidemic prevention and control risk assessment index system under the background of the new crown pneumonia resumption of work and production, and proposed a set pair evaluation model for corporate epidemic prevention and control risk based on Martin's system . However, it seems that there are still gaps in the research on the factors affecting the resumption of work and production of enterprises. From the perspective of economic recovery, this article focuses on the government, society and enterprises, and selects different types of enterprises in ten prefecture-level cities in Liaoning Province, China. This article applys big data and statistical modeling methods, analyzes the relationship between factors, and provides some practical suggestions for the company's comprehensive resumption of work and production.

2. Model preparation

2.1 Survey design

The first part: the basic situation of employees and the status of the company in Liaoning Province, China, mainly including gender, age, type of company, and the proportion of the local population of employees.

The second part: the scale of factors affecting the resumption of work and production of enterprises, which divides eleven factors into three categories, namely the impact of society, government, and the enterprise itself on the process of resumption of work and production. This article uses the Likert scale to measure.

The third part: subjective attitude issues, employees' attitudes towards the future development of the company, and the severity of the impact of the new crown epidemic on the company.

2.2 Survey object

The questionnaire survey involved in this article is mainly set to all citizens of prefecture-level cities in Liaoning Province, China. Due to the large population, we are going to adopt a sampling survey method. Ten prefecture-level cities are selected, including Shenyang, Jinzhou, Dalian, Huludao City, Anshan City, etc. In order to ensure the accuracy of the data, this study adopts a multi-stage sampling method. Since there are many citizens, and the subject of this study is resumption of work and production, the surveyed population does not involve minors and retirees, so residents aged 18 to 60 in the ten prefecture-level cities in Liaoning Province are the main survey subjects.

2.3 Survey method

This paper adopts the method of Multistage sampling (Zhu Jianming et al., 2016). In the first stage, enterprises from ten prefecture-level cities were selected, and in the second stage, quota sampling was used to select internal employees. So the average sampling error of the second stage is estimated as:

$$\hat{\sigma}_{\bar{x}} = \sqrt{\frac{\hat{\sigma}_1^{\,2}}{n}\left(1-\frac{n}{N}\right)+\frac{\hat{\sigma}_2^{\,2}}{nm}\bullet\frac{n}{N}\left(1-\frac{m}{M}\right)} \quad (1)$$

among them

$$\hat{\sigma}_1^{\,2} = \frac{\sum_{t=1}^{n}\left(\bar{x}_i-\bar{x}\right)}{n-1}\ ,\ \hat{\sigma}_2^{\,2} = \frac{\sum_{j=1}^{m}\sum_{i=1}^{n}\left(\bar{x}_{ij}-\bar{x}_i\right)}{n\left(m-1\right)} \quad (2)$$

2.4 Survey implementation

This survey mainly uses the Star electronic questionnaire. According to the average questionnaires issued by different types of companies, the company’s employees are sampled by quota sampling to fill in the questionnaires. A total of 365 questionnaires are distributed. Due to the incomplete information of some questionnaires or the short filling time, this study regarded it as an invalid questionnaire. Finally, 310 valid questionnaires were obtained, and the questionnaire response rate was 84.9%.

3. Model building

3.1 Descriptive statistics

First, perform a descriptive statistical analysis of the questionnaire questions, as shown in Tab. 1. Among them, in terms of gender, women accounted for 43.2% and men accounted for 56.8%. In terms of education, PhD accounted for 8.7%, postgradutes accounted for 24.8%, undergraduates accounted for 30.3%, and below undergraduates accounted for 36.1%. In industry, agriculture accounted for 17.4%. The service industry accounted for 24.8%, the manufacturing industry 27.4%, and the IT industry accounted for 30.3%. In terms of types of enterprises, state-owned enterprises accounted for 34.5%, foreign-funded enterprises 21.3%, Sino-foreign joint ventures accounted for 17.1%, and others accounted for 27.1%. In terms of the regions where companies are located, the urban area accounted for 34.5%, the suburban area accounted for 30.6%, and the rural area accounted for 34.5%.

Then, this paper conducts a test analysis of the relationship between industry and gender, as shown in Tab. 2. In order to test the correlation between gender and the industry, this paper conducted a

chi-square test analysis, as shown in Tab. 3. Since the statistics P values are all less than 0.05, it can be considered that gender and the industry are significantly related.

Tab. 1. Questionnaire data statistics table

		Frequency	Percentage	Upward cumulative percentage%
Gender	Male	134	43.2	43.2
	Female	176	56.8	100.0
Education	PhD	27	8.7	8.7
	Postgraduate	77	24.8	33.5
	Undergraduate	94	30.3	63.9
	Below undergradute	112	36.1	100.0
Industry	Agriculture	54	17.4	17.4
	Service industry	77	24.8	42.3
	Manufacturing	85	27.4	69.7
	IT	94	30.3	100.0
Type of enterprise	State-owned enterprise	107	34.5	34.5
	Foreign companies	66	21.3	55.8
	Sino-foreign joint venture	53	17.1	72.9
	Other	84	27.1	100.0
Business area	Urban area	107	34.5	34.5
	Suburbs	95	30.6	65.2
	Rural	107	34.5	100.0

Tab. 2. Cross table of industry and gender

Count		Industry				
		Agriculture	Service industry	Manufacturing	IT	Total
Gender	male	32	31	32	57	152
	Female	58	39	24	37	158
Total		90	70	56	94	310

Tab. 3. Industry and gender chi-square test

	Value	Df	Progressive significance (bilateral)
Pearson Chi-fang	13.713[a]	3	.003
Likelihood ratio	13.854	3	.003
Linear correlation	13.264	1	.000
Valid case	310		

a. The expected count of 0 cells (0.0%) is less than 5. The minimum expected count is 27.46.

3.2 Logistic regression analysis

Logistic regression is a generalized linear model (ZhangYu et al., 2020). Although there are many similarities with traditional regression analysis, the dependent variable in this article is to take two values (yes or no). The traditional regression model can not solve the qualitative variables, so the logistic regression analysis method is selected. Based on the collected questionnaire data, whether to resume work and production as the dependent variable, gender, industry, the proportion of the company's location and the local population as covariates, a multivariate logistic regression model was constructed.

It can be seen from Tab. 4. that the P value (significance level) of four factors of industry, the region where company is located, the proportion of local population, and the gender in the model are all less than 0.01, which means that these four factors have a significant impact on the resumption of work and production. The final model is obtained by bringing coefficients in the table into the variables of the corresponding equation. The impact of industry on the resumption of work and production is mainly reflected in the following: the epidemic has a greater impact on industries that require personnel mobility and concentrated operations such as manufacturing and service industries, and relatively less for industries with relatively free workplaces such as IT. The company is located in the impact of regions on the resumption of work and production of enterprises is mainly reflected in the following: For enterprises operating in concentrated urban areas, there may be a greater risk of infection when resuming work and production, and enterprises operating in suburbs, towns and villages are not so densely staffed, the difficulty of prevention and control of the epidemic is relatively small. The impact of proportion of local population on the resumption of work and production of enterprises is mainly reflected in: for the proportion of the local population in the enterprise, the proportion of the local population is high, and the enterprise resumes work and production. The difficulty is less. On the contrary, the proportion of the non-local population is high, and the resumption of labor unions will cause an increase in the proportion of personnel turnover. Therefore, the risk of infection will increase. The impact of gender on the resumption of work and production is mainly reflected in the fact that gender is often related to factors such as the type of industry, which affects the resumption of work and production of enterprises.

Use SPSS17.0 software to do logistic regression analysis and get the following results:

Tab. 4. Variables in the Logistic equation

		B	Standard error	Ward	Df	Significance	Exp(B)
Step 1a	Industry	2.214	.380	33.973	1	.000	9.157
	Business area	2.644	.417	40.169	1	.000	.071
	Percentage of local population	1.376	.254	29.365	1	.000	.253
	Gender	3.077	.550	31.281	1	.000	21.689
	Constant	4.470	1.177	14.426	1	.000	.011

a. The variables entered in step 1: the industry, the area where the company is located, the proportion of the local population, and gender.

3.3 Structural equation model

3.3.1 Reliability and validity test

Use SPSS17.0 to analyze the reliability of the pre-survey data scale to test the reliability of the questionnaire, and use the Cronbach's Alpha index to determine whether the reliability is reliable, as shown in Tab. 5.

Tab. 5. Reliability test analysis

Kronbach Alpha	Kronbach Alpha based on standardized terms	Number of items
.824	.828	11

From the Tab. 5. , the Cronbach's Alpha index is 0.824 greater than 0.8, which means that the reliability is good.

In order to analyze whether the structure of the research questionnaire is reasonable, this paper introduces all the variables in the scale into SPSS17.0 for exploratory factor analysis, and uses the Bartley sphere test to measure the conditions of the factor analysis.

Tab. 6. KMO and Bartlett test

KMO sampling appropriateness number		.809
Bartlett sphericity test	Approximate chi-square	1198.877
	Df	55
	Significance	.000

It is known that when the value of the KMO statistic is closer to 1, the correlation between the variables is stronger, and the partial correlation is weaker, and the effect of factor analysis is better. From the above table, the KMO value is 0.809>0.8, the correlation between the variables is very strong, the P value is 0.00<0.05, and H_0 is rejected, which proves that the correlation between the variables is strong and the factor analysis is valid, and the validity of the scale can be considered better.

3.3.2 Model building

Structural Equation Modeling is a statistical method based on the covariance matrix of variables to simultaneously process and analyze the relationship between multiple variables, thus making up for the shortcomings of traditional statistical models (Xu Chao and Yu Huixin, 2020). Structural equation models include structural models and measurement models. The measurement model reflects the relationship between the observed variable and the latent variable. The basic equation of the measurement model can be expressed as:

$$X = \Lambda_X \xi + \delta \tag{3}$$

$$Y = \Lambda_Y \eta + \varepsilon \tag{4}$$

Where X and Y represent exogenous and endogenous observed variables in turn; ξ and η represent exogenous and endogenous latent variables in turn; among them Λ_x are the factor loadings of X on ξ, Λ_y that is, the factor loadings of Y on η; ε and δ respectively indicate external error of the observed variables X and Y. The structural equation model reflects the relationship between latent variables. The basic equation of the structural model can be expressed as:

$$\eta = B\eta + \Gamma\xi + \zeta \tag{5}$$

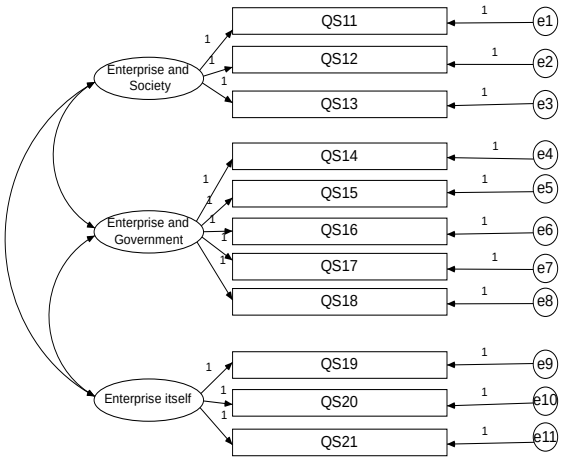

Fig. 1. The initial model of the structural model

Note:

QS11 Foreign countries has a serious epidemic situation. QS12 Students cannot return to school. QS13 Rural areas cannot return to farming. QS14 Epidemic prevention requirements are not up to standard. QS15 Employees return to work and recruitment hard. QS16 Capital turnover is difficult. QS17 Government epidemic prevention supervision is difficult. QS18 Demand and supply are out of balance. QS19 Raw materials are in short supply. QS20 Product transportation is restricted. QS21 Enterprise internal epidemic prevention supervision is difficult.

The eleven factors that affect the resumption of work and production in the scale are classified into three dimensions: enterprise and social synergy factors, enterprise and government synergy factors, and the company's own synergy factors, and then confirmatory factor analysis is carried out. Under the environment of AMOS17.0, construct the first-order CFA model.

(1)Initial model

Basic assumptions:

Hypothesis 1: The enterprise and social dimensions and the enterprise and government dimensions influence each other.

Hypothesis 2: The enterprise and social dimensions and the enterprise's own dimensions influence each other.

Hypothesis 3: The enterprise and government dimensions and the enterprise's own dimensions influence each other.

(2)Model modification

In order to get the final ideal model, the model needs to be revised and try to relax the assumptions. First look at the revised index MI, where MI represents a conservative estimate of the decline in the chi-square value if the corresponding variable is set to
be correlated, so the maximum value in MI is used for correction, and the model is revised based on the actual situation and economic principles.

First, use a two-way arrow to connect e4 with the enterprise and social dimensions, e4 and e9, which means that the factors affecting the resumption of work and production in the corporate and social dimensions are related to the non-compliance of the epidemic prevention requirements, and the non-compliance of the epidemic prevention requirements is related to the shortage of raw materials for the company; in e5 and a double arrow is added between e10, that is, the return of employees and difficulty in recruiting are related to the obstruction of product transportation. So get the model:

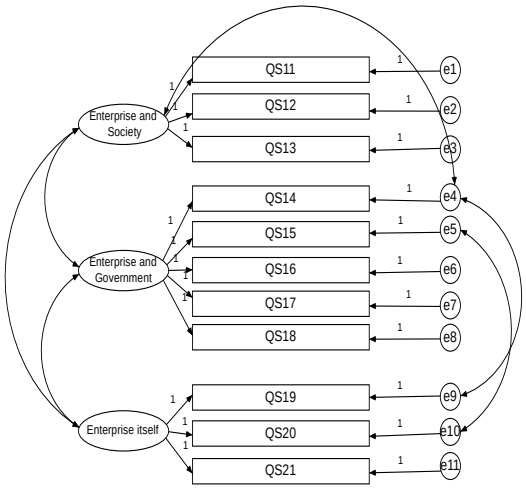

Fig. 2. Modified model

The test results of the fitness of the first-order CFA model are shown in the following table:

Tab. 7. First-order CFA model fitness test

Index	CM/DINF	RMSEA	IFI	TLI	CFI
Evaluation standard	<3	<0.08	>0.90	>0.90	>0.90
Model results	2.959	0.080	0.923	0.907	0.922

In general, when CM/DINF is less than 3, the model can be considered to have acceptable fit. The value of CM/DINF in this model is 2.959, so the model is considered acceptable; the value of the root mean square RMSEA of approximate error is 0.080, Acceptable; IFI value is 0.923, greater than 0.90, indicating that the model fits well; TLI value is 0.907, greater than 0.90, the model fits well; the comparison fitting index CFI value is 0.922, indicating the model assessment is relatively stable. Therefore, the model is acceptable in terms of fitness test indicators. Tab. 8. is the factor loading analysis table:

Tab. 8. Factor loading table

		Estimate	AVE	CR
QS11	Enterprise and Society	0.819		
QS12	Enterprise and Society	0.794	0.605	0.820
QS13	Enterprise and Society	0.719		
QS14	Enterprise and Government	0.649		
QS15	Enterprise and Government	0.714		
QS16	Enterprise and Government	0.629	0.439	0.796
QS17	Enterprise and Government	0.674		
QS18	Enterprise and Government	0.627		
QS19	Enterprise itself	0.694		
QS20	Enterprise itself	0.632	0.411	0.676
QS21	Enterprise itself	0.602		

The factor loads of each factor corresponding to the three latent variables of enterprise and society, enterprise and government, and enterprise itself are all greater than 0.60. It can be considered that the corresponding factors of each latent variable are highly representative. In addition, the average variance variation AVE of each latent variable is close to 0.50, and the combined reliability CR is greater than 0.60, so it can be considered that the convergent validity is ideal. The final model is shown in Fig. 3.

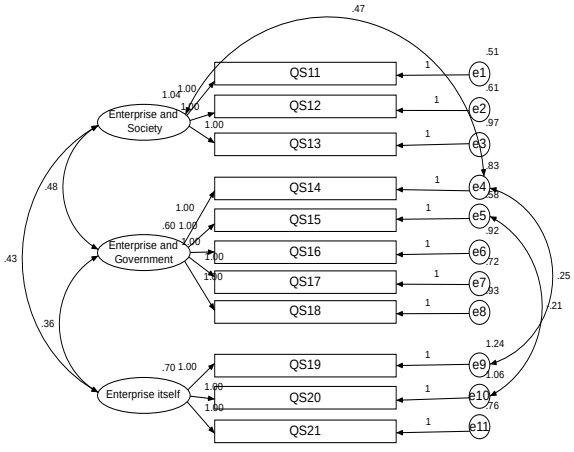

Fig. 3. The final model

3.4 Decision tree

Decision tree is a common machine learning method (Heng Hu et al., 2020). Take the binary classification task as an example, learn a model from a given training data set to classify new examples. The 200 data sets in the questionnaire survey data are used as training data, and the remaining 110 data sets are used as verification data. CART decision tree uses "Gini Index" to select attribute division. The purity of the data set can be measured by the Gini value:

$$Gini\ (D) = \sum_{k=1}^{|y|}\sum_{k' \neq k} p_k p_{k'} = 1 - \sum_{k=1}^{|y|} p_k p_{k'} \qquad (6)$$

Fig. 4. is a CART decision tree trained by Python after processing 200 data, using 110 verification data for verification. Each root node and leaf node in the decision tree are derived from the scale in the questionnaire, and the internal node is whether the company resumes work and production. This decision tree can be used for companies to review their own situation and make simple predictions on whether the company can resume work, so as to avoid greater losses after the resumption of work.

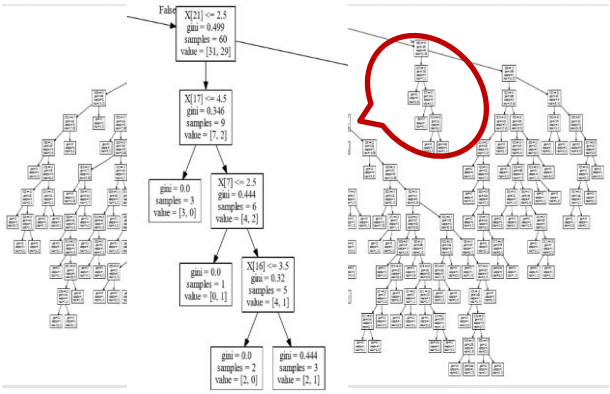

Fig. 4. Decision tree

4. Results

According to the analysis of the above model construction, this article concludes that the factors affecting the resumption of work and production of enterprises can be divided into three categories: corporate and social synergy factors, corporate and government synergy factors, and enterprises' own synergy factors. This article divides the results into two parts to explain the problems and solutions for the resumption of work and production.

4.1 The problem of enterprises resuming work and production

4.1.1 The problem of collaboration between enterprise and society

Resumption of work and resumption of school, as well as the coordination of rural re-cultivation issues. Resumption of work is one of the processes in which the social coordination system returns to a normal state of operation. However, resumption of work is closely related to resumption of school and farming in rural areas. During the outbreak, in order to strengthen the prevention and control of the epidemic, all students were postponed to start school. Therefore, a large number of parents stayed at home and were unable to resume work because they had to look after children who were unable to return to school. In addition, the prevention and control of the rural agricultural epidemic and the "resumption of work and production",

there is an imbalance between them, and there are shortcomings in resuming work and production in rural areas (Yongqiang Zhang et al., 2021). Therefore, based on the system theory perspective, the resumption of work and school and the resumption of farming in rural areas are the three major elements of the resumption of work. Only when the three elements are complete and coordinated can society restore order.

4.1.2 The problem of collaboration between enterprise and government

(1) Epidemic prevention requirements

The shortage of epidemic prevention materials. For companies facing the resumption of work across the country, the supply of masks and temperature measuring devices is in short supply. Therefore, the shortage of epidemic prevention materials is the primary problem that requires the government to cooperate with the resumption of work. The protection of epidemic prevention materials is just around the corner.

Local approval issues. The government should simplify the approval process for resumption of work to help companies resume work. For example, Hangzhou launched "Qinqing Online": policies are paid online, companies do not need to submit any materials, simplifying approval procedures, and helping companies resume work and production.

(2)Operation management

The problem of employees returning to work. The steady reset of the labor force is a relatively long process. Since the outbreak of the epidemic, a large-scale traffic blockade and logistics suspension have prevented workers from returning to work. All localities must follow the principle of one game of chess across the country, prevent excessive control, and strive to ensure that migrant workers return to work in a timely manner.

Difficulties in recruiting companies. Due to the continuous advancement of epidemic prevention and control work, some laborers do not choose to go out for temporary work even if they cannot return to work. One is to avoid the risk of infection, and the other is that temporary work lacks basic protection. Therefore, the resumption of work is facing difficulties in recruiting workers.

The problem of working capital. During the epidemic prevention and control period, companies have no input but only consumption. Companies need to purchase raw materials and pay site rents when they resume work. In addition, water and electricity supply, employee salaries, loan interest rates, equipment depreciation, etc. will be paid as usual, and the loss will increase, so corporate profits and liquidity will be tight. Many companies have accumulated a lot of financial pressure, and then compressed the investment and production plans for the whole year, making it difficult for companies to resume work.

(3)The imbalance between the demand side and the supply side

At present, affected by the epidemic, market demand has shrunk, consumption ability and power has decreased, while the production of enterprises that resumed work continues, and there is an imbalance of supply and demand, which has led to a stagnation in resumption of work and production. Therefore, the key to the real solution to the resumption of work and production of enterprises lies in stimulating consumption from the demand side and achieving a balance between supply and demand.

4.1.3 The problem of collaboration between enterprise and enterprise

(1) Supply chain and industrial chain coordination issues

Insufficient supply of raw materials or excessive prices. All industries have upstream and downstream and end customers, forming their own unique industrial chain. The process of resuming work in non-key areas of epidemic prevention and control across the country needs to be more coordinated and unified. Enterprises that resume work need to open up the entire industrial chain to ensure the normal supply of parts and components.

(2) Collaboration issues within the enterprise

There are four internal problems to be solved for enterprises to resume work and production: First, internal epidemic prevention, which involves the preparation of epidemic prevention materials, epidemic prevention management, and emergency management. The second is the problem of personnel arrival and office production methods during the epidemic, especially the shortage of personnel. The third is the specific development of production and operation management of enterprises, which involves the optimization of specific contracts and business, and is related to the increase or decrease of demand in specific industries during the epidemic. The fourth is the issue of corporate strategy or development planning during the epidemic.

4.2 Countermeasures to the problem of resuming work and production

4.2.1 Coordinated countermeasures between enterprise and society

(1) Coordinated countermeasures for resumption of work and resumption of school.The key to restoring social operations and realizing the normalization of "epidemic prevention + social development" and resuming work and school lies in the realization of everyone's health information networking. Starting from the aspect of information flow, the "passable health identification code" is realized step by step. The first step is to form the unity of each province, the second step is to form the unity of the "large area (such as East China)", and the third step is to realize the national network recognition of the "passable health identification code". By opening up the health identification information network, it will accelerate the flow of people, logistics, and capital flows, and at the same time promote the establishment of mutually recognized "passable health identification codes" with major foreign countries and regions, and gradually restore transactions with major countries.

(2) Coordinated countermeasures for resumption of work and re-cultivation in rural areas.First of all, on the issue of the resumption of work and production of enterprises, the government should shift its focus to rural areas, pay attention to the resumption of farming in rural areas and the resumption of production of enterprises, and do a good job in local work (Yongqiang Zhang et al., 2021). Second, the problem of "road closures" in rural areas must be resolved as soon as possible. Then, government personnel need to disseminate scientific knowledge of epidemic prevention to the rural people. Finally, it is necessary to provide psychological counseling to the rural people, reduce blind panic about the epidemic, achieve scientific epidemic prevention, and achieve a balanced development of rural epidemic prevention and control and "resumption of work and production".

4.2.2 Coordinated countermeasures between enterprise and government

(1) Epidemic prevention requirements

Solve the problem of shortage of masks. In response to the shortage of masks, the following countermeasures are proposed: a) Set up a "mask special class" to arrange uniform production and distribution of masks; b) Survey and scheduling of mask equipment manufacturers. Relevant departments should find out the list of local mask equipment manufacturers as soon as possible, encourage them to use full power and work overtime (equipment manufacturers basically produce in a single shift, and encourage two or three shifts in extraordinary periods), and expand the production of mask equipment; c) mask production outsourcing of equipment. It is possible to consider funding from the provincial and local finances to order and book a batch of mask production equipment in other provinces and cities as soon as possible for the expansion, increase, and upgrading of existing mask production enterprises.

Solve the problem of shortage of disinfection supplies. The resumption of work in enterprises must ensure the safety of the workers' working environment. It is essential to carry out comprehensive disinfection at regular intervals every day. The government should assist enterprises in resuming work and take multiple measures to ensure the supply of disinfection supplies. Specific suggestions include: a) Establish a unified dispatching platform for disinfection supplies in various regions as soon as possible; b) Encourage qualified enterprises to switch production or change production. It is necessary to find out as soon as possible the list of local liquor companies that can switch production of alcohol for disinfection, and if necessary, require the switch to change production within a specified time; c) Encourage other qualified enterprises to switch production and change production of disinfection supplies; d) Formulate disinfection guidelines applicable to different places to guide enterprises to "reasonably disinfect".

Solve the complex problems of local approval procedures. Simplify approval procedures. Carry out regional policies, differentiate regional risk levels, and implement differentiated strategies in key non-epidemic prevention and control areas. Priority is given to the resumption of work for key enterprises that are related to the national economy and the people's livelihood, and for enterprises that can work online, we will vigorously promote the resumption of work online, and promote the resumption of work and production in a flexible and orderly manner.

(2) Operation management

Solve the difficulty of returning employees to work. Regarding the problem of returning to work, one is to do a good job of investigation and statistics; the other is to do a health check; the third is to do a good job in return transportation, and implement "point-to-point" chartered vehicles.

Solve the problem of difficult recruitment of enterprises. First, we must use big data methods to obtain information about people who are currently seeking jobs through recruitment websites, etc., and send recruitment information to those who are interested in seeking jobs, so as to accurately locate and improve the response rate of recruitment; second, we must establish a corporate employment service team to arrange services for the company commissioners, each fixed service to 2-3 companies, to achieve "one company, one commissioner"; third, we must consider the traffic problem, the government department and the transportation department coordinate and cooperate, and adopt a "point-to-point" approach to solve the transportation problem of employees.

Solve the problem of "funding difficulties" of enterprises. The first is to intensify macro policy adjustments (Hui Zhu et al., 2021); second, to encourage cities to help ice and snow projects, travel agencies and scenic spots (hot springs) that are severely affected by the epidemic through loan discounts, rent and utility fee subsidies, etc. Wait for tourism companies to bail out (Hongbo Zhou et al., 2021); third, for individual industrial and commercial households, local governments must formulate rent reduction and exemption policies; fourth, banks stop interest rates to help companies resume production.

(3) Resuming work and production from the demand side

Encourage companies to issue "consumer vouchers" to consumers. The government should encourage enterprises to issue "consumption coupons" and "benefits coupons" to consumers to stimulate consumer demand and stimulate consumption vitality.

Promote a flexible schedule of 2.5 days of vacation a week.

4.2.3 Coordinated countermeasures between enterprise and enterprise

Solve the problem of coordination between the supply chain and the industrial chain. Enterprises in the same industry chain unite to ensure the continuous supply of raw materials or spare parts for the enterprises that resume work, and at the same time open up the corresponding logistics and transportation.

Collaboration issues within the enterprise. First, organize employees to take body temperature measurements and health checks on a daily basis; second, strengthen the popularization and education of health and epidemic prevention knowledge for corporate employees; third, implement a shift-to-get off work system.

5. Main conclusions and recommendations

Based on the method of statistical modeling, this article analyzes the factors affecting the resumption of work and production under the epidemic. First, the logistic regression model is used to combine various structural variables such as gender, industry, business area, local population percentage, and whether to resume work, etc., to construct a regression model to quantify the relationship between them, so as to solve the countermeasures. It is proposed to provide a strong basis; secondly, this paper constructs a structural equation model to analyze and quantify the intricate relationship between the three latent variables of enterprise and society, enterprise and government, and enterprise itself and the observed variables contained therein, thereby helping enterprises to implement efficient solutions for the resumption of work and production; finally, this article builds a decision tree model that can predict whether the company can resume work and production, and then play a guiding role in the resumption of work and production.

From the perspective of system theory, the resumption of work and production of enterprises and the resumption of farming in rural areas are elements of the social system. Therefore, the problem of resumption of work and production of enterprises will still exist before the resumption of school and farming in rural areas is completely resolved. In summary, the first is to solve the problem at different levels and types. The government, enterprise consortiums, enterprises and social organizations coordinate with each other, and it is fundamental to divide the work from different levels to solve the

problems that they can solve. The second is to innovate to solve problems. Passing off-peak commuting and off-peak office not only solves congestion and exhaust pollution, but also saves a lot of time wasted on the road; implement a four-hour or half-day work system, thereby promoting employment and consumption. The third is to properly handle the problems of enterprise survival and development. Under the premise of gradually adapting to the normalization of epidemic prevention, enterprises need to plan for medium and long-term development issues in long-term epidemic prevention with the mindset of seeking change in the crisis after ensuring that they will survive in the short term.

6. Research deficiencies and prospects

There are still some shortcomings in the model in this paper. The logistic regression model cannot solve the multicollinearity problem, so it may cause the singularity of the information matrix, thereby increasing the error of the model. The data in this article is the result of personal research conducted by the members of the team, so it is impossible to avoid the error of the respondent's answer. The decision tree has many branches. This may be because the training samples are "too good", so that some of the characteristics of the training set itself are regarded as general properties of all data, which may lead to overfitting.

In addition, this article is from the perspective of economic recovery, with the government, society, and enterprises as the three main influencing factors for modeling and analysis, but other factors such as medicine and virus transmission will also affect the resumption of work and production of enterprises. Therefore, future research can focus on other perspectives and conduct multi-faceted analysis, such as local government's perception and preference of risks, medicine and virus transmission, etc.

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References

Gan Mi, Tian Yunyi, Zhang Wenchang & Zhao Xihan. (2020). Modeling and correlation analysis of urban epidemic spread and resumption of work intensity. Journal of System Simulation (11), 2258-2271. doi: 10.16182/ j.issn1004731x.joss.20-0305.

Yan Yue, Chen Yu, Liu Keji, Luo Xinyue, Xu Boxi, Jiang Yu & Cheng Jin. (2020). Modeling and prediction of the novel coronavirus pneumonia epidemic based on a kind of time-lag dynamic system. Chinese Science: Mathematics (03), 385-392. doi:.

Zhu Changbo, Cheng Xinzhou & Gao Jie. (2020). The exploration and application of operator big data to help resume work and production. Post and Telecommunications Design Technology (05), 1-6. doi:CNKI:SUN:YDSJ.0.2020-05-002 .

Ge Honglei & Liu Nan. (2020). Modeling analysis of emergency supplies allocation decision in the evolutionary context of major infectious disease epidemics: Taking the new crown pneumonia epidemic as an example. Journal of Management Engineering (03), 214-222. doi: 10.13587/j .cnki.jieem.2020.03.022.

Chen Wenhe, Chang Zhipeng & Gong Xiaohong. (2020). Enterprise epidemic prevention and control risk set pair assessment model based on Martin system. Soft Science (11), 137-144. doi:10.13956/j.ss. 1001-8409.2020.11.22.

Zhu Jianming, Liu Zhuojun & Sun Junhong. (2016). Research on multi-stage sampling method for product quality and safety based on prior information. China Work Safety Science and Technology (02), 159-163. doi:CNKI:SUN:LDBK.0.2016- 02-036.

Zhang Yu, Shu Xiaoli, Zhong Bo, Li Rongzhi, Liu Qian, Zheng Sisi & Liu Yang. (2020). Logistic model combined with ROC curve method and Bayes discriminant function to distinguish the severity of new coronavirus pneumonia. Chinese Journal of Disease Control (07), 851-855.doi:10.16462/j.cnki.zhjbkz.2020.07.020.

Xu Chao & Yu Huixin. (2020). Research on the psychological capital structure of disabled college students based on grounded theory and structural equations. Journal of Management (04), 82-91.doi:10.19808/j.cnki.41-1408/f .2020.04.008.

Heng Hu, Mingwen Yan, Hongyu Cao, Jiaqi Zhang & FWu Shuai. (2021). Research on Multi-module smart meter based on edge computing(1-8).

Yongqiang Zhang, Bo Lv & Meilin Song. (2021). Research on garbage image classification method based on ResNet-34 deep network(9-17).

Hui Zhu, Aiping Pang & Huan Feng. (2021). HAVC System modeling and fault simulation research based on Modelica(25-31).

Hongbo Zhou, Junjie Zhou & Aiping Pang. (2021). Adaptive control design for a class of systems with modal uncertainty(40-45).

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