A Study Based on Qualitative Comparative Analysis: Multi-Cause Analysis and Mechanism Exploration of "Underachieving Students Against COVID-19" in Europe

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Abstract: The COVID-19 epidemic has been spreading around the world for three years. Europe, which has the highest concentration of countries with a high human civilization index, has shown extremely poor performance against the pandemic. I paid attention to this phenomenon and conducted qualitative comparative analysis on the cases of 58 European countries, to explore the reasons and mechanisms for the European region to become the concentration area of "underachieving students against COVID-19". The analysis results showed that there were four parallel combinations of causes that made European countries "underachieving students against COVID-19": (1) "Loose lockdown" * "Democratic regime" * "High population density"; (2) "Loose lockdown" * "Democratic regime" * "High tertiary GDP share"; (3) "Loose lockdown" * "Non-democratic regime" * "Low vaccination rate" * "Low tertiary GDP share"; (4) "Democratic regime" * "High vaccination rate" * "High population density" * "High tertiary GDP share". Combinations of four causes comprehensively, Europe as "underachieving students against COVID-19" has concentrated the main mechanism for: Europe's high democracy index under the voice of the people for freedom and the demands of the development of the third industry and traffic control measures, had to give up severely coupled with a high population density helped the spread of the virus, finally led to COVID-19 outbreak of a pandemic. In addition, the results show that high vaccination rates did not become a major factor in the success of the European epidemic, while the adoption of stringent containment measures had a very crucial impact on the success of the European epidemic.

1 INTRODUCTION

According to the World Health Organization, as of 19 September 2022, COVID-19 has infected 250,786,965 and killed 2,086,940 people in Europe, making it the world region with the highest cumulative total number of cases and the second highest total number of deaths. Even now (19 September 2022), Europe is still one of the most severely affected regions in the world, with 1,205,467 infections and 2,897 deaths per day. (World Health Organization) It is truly a concentration area of "underachieving students against COVID-19".

At the same time, however, European countries have begun to relax their containment measures and adopt a strategy of "living with the virus" despite the severity of the COVID-19 pandemic at home. In Europe, for example, the government response index has fallen below 25 in Britain, France, Canada, Italy and so on, the lowest level since April 2020, (University of Oxford) according to Oxford University. Another example is the EU Council's adoption on 30 June 2020 of a recommendation on the possible phasing out of temporary restrictions on non-essential travel into the EU and the implementation of an "Open EU" plan to allow non-essential travel for vaccinated persons as well as those recovering from COVID-19 from 1 March 2022. (European Union)

So what are the mechanisms that make Europe such a concentration area of "underachieving

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students against COVID-19"? And what is the process of mechanism? To answer the above two questions, this paper will select 58 European countries as study cases and analyze them through computer technology.

2 LITERATURE REVIEW

The study of the COVID-19 pandemic has already yielded rich results. I conducted a literature review and found that scholars have mainly investigated the study of the COVID-19 pandemic from three perspectives:

The first perspective is the study of the pathogen of COVID-19, which explores the origin of the virus, its ability to infect cells, its ability to mutate, and its safety. This part of the research has received sufficient attention since the early stages of the epidemic and has produced numerous notable achievements. For example, Marco Ciotti and Massimo Ciccozzi and others have conducted an excellent literature review on the spread and latency of the COVID-19 virus in the early stages of the epidemic. (Ciotti, 2020) Alessandro Vespignani and Tian Huaiyu and others have modeled the spread of COVID-19. (Vespignani, 2020) The second perspective is the prevention and control measures of the COVID-19 pandemic. This perspective investigates how to effectively block and control the virus, emphasizing the pre-positioning of virus prevention and control methods and the evaluation of prevention and control measures. For example, Arefi Maryam Feiz and Poursadeqiyan Mohsen argue that strict virus detection and social distancing will effectively prevent the COVID-19 pandemic. (Arefi, 2020) Roy M. Anderson, Hans Heesterbeek and others. evaluated epidemic prevention measures in China, Japan, and South Korea, and argued that closing schools and closing public places are the main pillars of epidemic containment. (Anderson, 2020) The third perspective is the impact of the COVID-19 pandemic. This perspective focuses on the changes that occur at all levels, from society to individuals, under the pandemic, and also examines the impact of the COVID-19 pandemic outside of human society. For example, the team of Yao Hua, Chen Junhua and Xu Yongfeng started from the impact of the pandemic on social mental health and argued that the COVID-19 pandemic has caused a range of illnesses such as fear, anxiety and depression, and people with mental illnesses may be more affected. (Yao, 2020) From an environmental perspective, Saeida Saadat, Deepak Rawtani and others found that COVID-19 lockdown significantly improved air quality in numerous global cities and reduced water pollution in some parts of the world. (Saadat, 2020)

In summary, we found that academic research on COVID-19 pandemic tends to focus on immediacy or predictability, but lacks retrospective studies. For example, the academic community has yet to come up with a clear answer and explanation for the cause of the COVID-19 pandemic. Even if there are attribution studies on the COVID-19 pandemic, they are commonly focused on a single country and single-cause studies (such as Tim Colbourn's study on the possible failure of British public policies under the epidemic situation) (Colbourn, 2020), rather than regional integrated analysis and multi-cause induction from the perspective of comparison. But the lack of research in this area will be somewhat supplemented in this paper.

Finally, I think it is necessary to explain the logical structure of this paper. The third section after the introduction and literature review is devoted to the experimental methods, the selection of the experimental samples, the selection of the experimental variables, and the measurements used in this study. This section will be designed in strict accordance with the standards of computer experiments to ensure the accuracy of the experimental results. The fourth section mainly expounds the experimental procedure using SPSS, fsQCA3.0 and other computer software. In this section, I also proceed with the drawing of a clear set of data table, the necessary conditional tests, analysis of causes combinations, and robustness inspection. The objective and accurate multi-cause pathways and mechanisms are explored through the application of techniques related to data science. The main content of fifth section is the empirical analysis of the experimental results. I will first modify our assumptions on the variables, and then perform empirical analysis on four multi-cause paths with specific typical cases to enhance the empirical plausibility of the experimental results. The last section is the conclusions.

3 EXPERIMENTAL DESIGN

In this part, I present the experimental methods, experimental sample and variable selection of this study. Later, I will also perform experimental measurements and encoding.

3.1 Experimental Methods

I will adopt the Experimental method of qualitative comparative analysis, namely qualitative comparative analysis (hereinafter referred to as QCA) method.

According to Arend Lijphart, a political scientist, a large number of cases should be studied statistically, while a small number of cases should be studied comparatively. If a small number of cases suffer from the difficulty of "too many variables but too few cases", we should expand the number of cases to make it into a large sample. (Lijphart, 1971) However, limited by the conditions of the study, it is difficult to expand the number of samples in some specific condition. For example, the number of European countries studied in this paper is relatively stable. At the same time, although my research accommodates 58 samples, due to the complexity and great differences among European countries, when applied to statistical methods, there are often too many variables to deal with and the problem of "multicollinearity" exists. Therefore, my research is also faced with the difficulty of "too many variables but too few cases", which makes it difficult to conduct statistical analysis.

The QCA method can effectively solve the problems encountered in my study. It is a method that integrates the logic of quantitative analysis into qualitative inference, with the use of set theory and Boolean algebra at its core. The methodology of QCA requires the researcher to manipulate or assign values to variables. In fact, it can be regarded as judging whether a case is affiliated to (clear set analysis, where "1" and "0" are commonly used to represent "belong to" and "don't belong to" respectively) or to what extent (fuzzy set analysis, where the value is usually between "0" or "1"), For example, 0.5 is a set of intermediate values between "completely affiliated" AND "completely unaffiliated". (Hao, 2016) At the same time, the computational system of Boolean algebra is adopted, which is mainly represented by logical AND (denoted by symbol "*", which is equivalent to "conjunctive" in logic), logical OR (denoted by symbol "+", which is equivalent to "disjunction" in logic) and logical negation (denoted by symbol "~"). For example, "A*B+~C=D" means "the presence of both A and B or the absence of C can lead to the appearance of D". Therefore, the QCA method can help us to compare and analyze multiple cases through the logic of Boolean algebra on the premise that the effect of a single variable on the result is known, and finally obtain the "configuration" explanation or multiple causal path analysis on the occurrence of a specific result. It has particular advantages over quantitative analysis and comparative analysis in general. (Gao, 2014)

However, the method of QCA is too complicated in practice, so here I think it is worth introducing the computer software that will be used in the following analysis, fsQCA3.0, which was developed by Charles Ragin's team and is commonly used in QCA software for clean and fuzzy set analysis. (Charles Ragin) The software greatly improves the usability and feasibility of the QCA method, as it can efficiently simplify and analyze complex truth tables and accurately output the resulting combinations of causes. The usage process is shown in Figure 1.

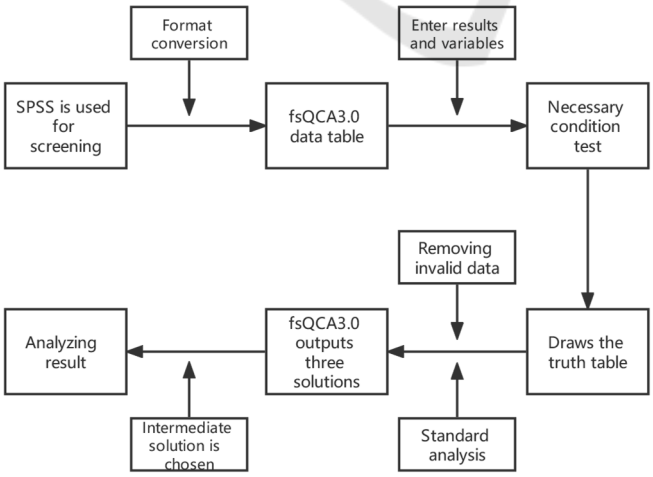

Figure 1: The flowchart of using fsQCA3.0.

3.2 Selection of Experimental Samples

The experimental samples were mainly selected from countries whose COVID-19 epidemic data were kept by the World Health Organization (WHO), with 59 eligible samples. However, the sample data of the country "Montenegro" was abnormal, therefore it was removed, leaving 58 eligible samples. Among them, there were 48 positive cases ("underachieving students against COVID-19") and 10 negative cases ("non-underachieving students against COVID-19").

3.3 Selection of Experimental Variables

In this paper, we mainly select the following factors as independent experimental variables to investigate: the degree of democracy in the country, the severity of epidemic containment and management measures, the vaccination rate, the size of the population density, and the proportion of the GDP of the country's tertiary industries.

3.3.1 Degree of Democracy in the Country

The first experimental variable is related to the democracy of the country's actual political system, which is based on the research of Joseph H. Anson and Haijie Wang's team. According to Joseph H. Anson, dogmatic authoritarianism can get additional support under the epidemic, while the epidemic prevention and control of authoritarianism is more recognized. On the contrary, the democratic regime is mired in an epidemic. (Manson, 2020) This view is also borne out by Wang's team's study of 143 countries from 1 January 2020 to 31 January 2021, which concluded that the daily number of new COVID-19 cases and deaths increases when the ruling party's ideology is more liberal and democratic. (Wang, 2021) In this paper, I will use The Economist's 2021 Democracy Index assessment (The Economist, Democracy Index 2021) as a measure of how democratic European countries are during a pandemic. At the same time, based on the conclusions of previous studies, I also put forward a hypothesis -- Hypothesis 1: European countries with higher democracy index (democratic countries) are more likely to be "underachieving students against COVID-19".

3.3.2 Severity of Epidemic Containment and Management Measures

The second experimental variable is related to the measures taken by countries during the pandemic, which is based on the research of Roy MAnderson, Hans Heesterbeek and Wei Liu's team. Roy M Anderson and Hans Heesterbeek argue that strict epidemic prevention and management measures are essential to stop the COVID-19 pandemic and urge the government to close schools and strictly lock down public places. (Anderson, 2020) Liu's team, which has studied China's success, believes that strict containment and efficient management of huge data are the country's "magic weapons". (Liu, 2020) In this paper, I will use the response index from Oxford University, (University of Oxford) OAG global flight frequency data, (OAG) and Bloomberg's ranking of COVID-19 lockdown intensity (Bloomberg) to measure the severity of epidemic prevention, control and management measures in European countries during the pandemic. At the same time, based on the conclusions of previous studies, I also propose a hypothesis here -- Hypothesis 2: European countries that take strict prevention and control measures are less likely to be "underachieving students against COVID-19".

3.3.3 Vaccination Rate

The third experimental variable, which is related to vaccination outcomes in European countries, was based on research by Mangalakumari Jeyanathan's team and Enahoro A.Iboi's team. Mangalakumari Jeyanathan's team believes that once vaccines are widely administered around the world, human societies will develop strong resistance to the virus. (Jeyanathan, 2020) Meanwhile, Enahoro A.Iboi's team is adamant that only 82 percent vaccine coverage and 80 percent vaccine effectiveness will stop the COVID-19 pandemic. (Iboi, 2020) In this paper, I use a combination of incomplete vaccination rates and complete vaccination rates (incomplete vaccination rates are used for statistical needs in the temporal dimension, as detailed below) (World Health Organization) from WHO statistics as indicators of vaccination rates across countries during the pandemic. At the same time, based on the conclusions of previous studies, I also propose a hypothesis -- Hypothesis 3: European countries with higher vaccination rates are less likely to be "underachieving students against COVID-19".

3.3.4 Size of the Population Density

The fourth experimental variable, which is related to the population and area ratio of European countries, is based on research by Joacim Rocklov, Henrik Sjodin and Arunava Bhadra's team. Joacim Rocklov and Henrik Sjodin pointed out in their study that high

population density will catalyze the spread of COVID-19, because under conditions of high population density, it is difficult for people to maintain proper social distance, making the virus more contagious. (Rocklöv, 2020) Arunava Bhadra's team, in order to test the Johns Hopkins Bloomberg School of Public Health's conclusion that the spread of COVID-19 is not related to population density, modeled population density in relation to COVID-19 infection and death rates in India and concluded that population density is positively related to COVID-19 infection and death rates. (Bhadra, 2021) In this paper, I will use the population density of European countries based on World Population Reviews statistics (World Population Review, 2022) as an indicator of the size of the population density of European countries. At the same time, based on the conclusions of previous studies, I also put forward a hypothesis -- Hypothesis 4: European countries with high population density are more likely to be "underachieving students against COVID-19".

3.3.5 Proportion of the GDP of the Country's Tertiary Industries

The fifth experimental variable is related to the country's industrial structure system. The setting of this variable mainly refers to the research of Naveen Donthu, Anders Gustafsson and Abid Haleem, Mohd Javaid. Naveen Donthu and Anders Gustafsson conducted a study on all walks of life under the epidemic. Among them, a series of tertiary industries such as business and tourism are facing great difficulties and are even on the verge of collapse, while countries with tertiary industry as the main industrial structure are the most affected by the epidemic. (Donthu, 2020) The study by Abid Haleem and Mohd Javaid highlights the fragmentation of socio-economic ties caused by the COVID-19 pandemic, which is triggering a range of responses, making it necessary and imperative for countries to focus on real economic development. (Haleem, 2020) While the two studies do not explicitly identify a relationship between the tertiary sector's share of GDP and the failure to respond to the pandemic, they do suggest that it is the sector most affected by the pandemic. If a country takes the tertiary industry as its pillar, it will have to make a choice between "controlling the epidemic" and "stabilizing the economy". According to related studies, European countries generally have a high proportion of tertiary industries in their economic structure, so I have reason to believe and assume - Hypothesis 5: European countries with a higher share of GDP from tertiary industries are more likely to be "underachieving students against COVID-19". Second, in this paper I will use the rate of service sector contribution to GDP of European countries calculated by the World Bank (World Bank) as an indicator of the proportion of tertiary industries in the GDP of European countries.

3.4 Experimental Measurement and Coding

According to the principle of QCA analysis method, we need to use the language of "set theory" to redefine the experimental variables. In this paper, clean sets are used. As mentioned above, in the analysis of clear sets, researchers commonly use dichotomous values such as "0 and 1" to indicate whether a variable is "completely affiliated" or "completely unaffiliated" to a set. Table 1 shows my criteria for assigning values to experimental variables (will become the screening standard of SPSS).

Table 1: Experimental variable coding standard.

Variable type	define	Label	Coding standard		Data source
			Completely affiliated （1）	Completely unaffiliated （0）	
Result	"underachieving students against COVID-19"	ud	Infection rate ≥35% or fatality rate ≥1%	Infection rate <35% and fatality rate <1%	World Health Organization
Causative condition	Democratic country	dr	Democracy index ≥6.1	Democracy index ≤6.0	The Economist

	Taking strict control and managemen t measures	sp	Long and severe lockdown measures were taken	Short or loose lockdown measures were taken	Oxford University, OAG, Bloomberg
	Having a high vaccination rate	hv	Incomplete vaccination rate ≥35% in 2021 and complete vaccination rate ≥75% in 2022	Incomplete vaccination rate < 35% in 2021 or complete vaccination rate < 75% in 2022	World Health Organization
	Having a high population density	hd	Population density ≥115/㎡	Population density＜115/㎡	World Population Reviews
	Tertiary industry has a higher proportion of GDP	hp	The tertiary industry accounts for ≥60% of GDP	The tertiary industry accounts for <60% of GDP	World Bank

It should be noted that the criteria for judging "underachieving students against COVID-19" are not strict or harsh, but most countries in Europe still become "underachieving students against COVID-19". Secondly about whether "the strict control and management measures" of the decision, I will be by Oxford University to index (University of Oxford) to judge the duration of the epidemic prevention and control measures are strictly, and based on the global flight data observation of OAG (OAG) Europe through the channels of flight attendants the actual number of entry and exit, finally to bloomberg control strength ranking (Bloomberg) as a reference. Finally, I would like to explain the reason for the introduction of the indicator "incomplete vaccination rate in 2021" in the judgment of "Having a high vaccination rate". Because I believe that the indicators for 2022 alone ignore the time variable, which may lead to the inaccurate presentation of the results, I added the data for 2021 as the judgment criterion (incomplete vaccination rate refers to the vaccination rate with one shot or more, and the statistical objects in 2021 are mostly incomplete vaccination rate).

The statistics of the above data sources all ended on 19 September, 2022.

4 DATA ANALYSIS

After the screening of SPSS, we can draw a data table based on a clear set as the basis of our analysis, such as Table 2 (is generated after screening by SPSS and converted to CSV format). In this table, all experimental variables are changed to the value "1" or the value "0", indicating the relationship of "Completely affiliated" or "Completely unaffiliated" to a certain set.

Table 2: Data table of causative conditions and results (based on clear sets).

Case	dr	sp	hv	hd	hp	ud	Case	dr	sp	hv	hd	hp	ud
France	1	1	1	1	1	1	Lithuania	1	0	0	0	1	1
Germany	1	0	1	1	1	1	Croatia	1	0	0	0	1	1
The United Kingdom	1	0	1	1	1	1	Slovenia	1	0	0	0	0	1
Italy	1	1	1	1	1	1	Belarus	0	1	0	0	0	0
Russian Federation	0	0	0	0	0	1	Latvia	1	0	0	0	1	1
Türkiye	0	1	0	0	0	0	Azerbaijan	0	0	0	1	0	1
Spain	1	1	1	0	1	0	Estonia	1	0	0	0	1	1
Netherlands	1	0	0	1	1	1	Republic of Moldova	1	0	0	0	0	1
Poland	1	0	0	1	1	1	Cyprus	1	0	0	1	1	1
Portugal	1	0	1	1	1	1	Armenia	0	0	0	0	0	1
Ukraine	0	0	0	0	0	1	Bosnia and Herzegovina	0	0	0	0	0	1
Austria	1	0	0	0	1	1	North Macedonia	1	0	0	0	0	1
Greece	1	0	0	0	1	1	Albania	1	0	0	0	0	1
Israel	1	0	0	1	0	1	Luxembourg	1	0	0	1	1	1
Belgium	1	0	1	1	1	1	Montenegro	1	0	0	0	0	1
Czechia	1	0	0	1	0	1	Kosovo	1	0	0	1	0	1
Switzerland	1	0	0	1	1	1	Uzbekistan	0	1	0	0	0	0
Denmark	1	1	1	1	1	1	Kyrgyzstan	0	0	0	0	0	1
Romania	1	0	0	0	0	1	Iceland	1	0	1	0	1	1
Sweden	1	0	0	0	0	0	Jersey	1	0	1	1	0	1
Serbia	1	0	0	0	0	0	Andorra	1	0	0	1	1	1
Hungary	1	0	0	0	0	1	Isle of Man	1	0	1	1	1	1
Slovakia	1	0	0	1	0	1	Faroe Islands	1	0	1	0	1	1
Georgia	0	0	0	0	0	1	Guernsey	1	0	1	1	0	1
Ireland	1	1	1	0	0	0	San Marino	1	0	0	1	1	1
Kazakhstan	0	0	0	0	0	1	Gibraltar	1	0	1	1	1	1
Norway	1	1	1	0	0	0	Liechtenstein	1	0	0	1	1	1
Finland	1	1	1	0	0	0	Tajikistan	0	1	0	0	0	0
Bulgaria	1	0	0	0	1	1	Monaco	1	0	0	1	0	1

4.1 Necessary Condition Test

Before the combinations of causes analysis is carried out, we need to conduct the necessary condition test on the single condition variable first (through the computer software fsQCA3.0). The necessary condition refers to the condition that occurs in all cases with results or occurs frequently. Generally speaking, if the consistency of a condition is greater than 0.9, it is regarded as a necessary condition. (Schneider, 2012) The result of necessary condition test are shown in Table 3.

Table 3: Result of necessary condition test.

Conditional Variable	Consistency	Coverage
dr	0.833333	0.869565
~dr	0.166667	0.666667
sp	0.0625	0.272727
~sp	0.9375	0.957447
hv	0.270833	0.764706
~hv	0.729167	0.853659
hd	0.520833	1
~hd	0.479167	0.69697
hp	0.541667	0.962963
~hp	0.458333	0.709677

As shown in Table 3, only the consistency of "~sp" (no "strict prevention and control measures") is greater than 0.9, which is a necessary condition for the emergence of "ud" (became "underachieving students against COVID-19"). While the consistency of other conditions is less than 0.9, which is not a necessary condition.

4.2 Analysis of Causes Combinations

In terms of result output, fsQCA3.0 will output three kinds of solutions, which are complex solutions, parsimonious solution and intermediate solution. Complex solutions are not solvable by Boolean algebra reduction procedures and often exhibit multiple and complex combinations of causes, so they are not commonly used in QCA methods. Parsimonious solutions are the most simple combinations of causes generated by a Boolean algebra reduction procedures, containing the least amount of information. Intermediate solution is the most commonly used one, which can balance the difference between the theory and the actual facts by certain Boolean algebra reduction procedures, and is the main multi-factorial path chosen in the QCA approach. Therefore, in this paper, I choose the intermediate solution as the result of the study. Table 4 shows the intermediate solution output by fsQCA3.0.

Table 4: Analysis of causes combinations (based on intermediate solution).

Combinations of Causes	Raw Coverage	Unique Coverage	Consistency
dr*˜sp*hd	0.4375	0.145833	1
dr*˜sp*hp	0.479167	0.1875	1
˜dr*˜sp*˜hv*˜hp	0.166667	0.166667	1
dr*hv*hd*hp	0.1875	0.0625	1
Solution Coverage: 0.854167 Solution Consistency: 1			

As shown in Table 4, the intermediate solution gives four different combinations of causes, indicating that there are four different multi-cause paths for the emergence of "ud" (became "underachieving students against COVID-19"), and these causal paths are parallel to each other and can be combined with Boolean "+" sign:

dr~sp*hd+dr*~sp*hp+~dr*~sp*~hv*~hp+dr*hv*hd*hp*

4.3 Robustness Inspection

QCA is similar to quantitative analysis in that it is necessary to check the robustness of the results. As shown in Table 4, fsQCA3.0 outputs coverage and consistency, except for combinations of causes.

The coverage are divided into raw coverage, unique coverage, and solution coverage. Raw coverage refers to how many positive cases can be explained by a single combination of causes. For example, the raw coverage of the first combination of causes "dr*~sp*hd" in Table 4 is 0.4375, which means that this combination of causes can explain 43.75 percent of the positive cases (21 cases). The unique coverage excludes cases that accord with more than two reasons. For example, the unique coverage of the first combination of causes "dr*~sp*hd" is only 0.145833, which means that this combination of cases can explain 14.5833 percent of the positive cases (7 cases). If the unique coverage is smaller than the raw coverage, multiple causes exist. And the solution coverage shows how many positive cases can be explained by the combination of causes as a whole (dr*~sp*hd+dr*~sp*hp+~dr*~sp*~hv*~hp+dr*hv*hd*hp). The results showed that the combination of causes could explain 85.4167 percent of the positive cases, and the remaining cases were considered as special cases, which were not included in the study of the causes for "Europe becomes a concentration area of underachieving students against COVID-19".

Consistency is divided into consistency and solution consistency. Consistency is commonly used to determine whether a single combination of causes is a subset of the result and the degree of subordination. As shown in Table 4, the consistency of each combination of causes is 1, meaning each combination of causes is a sufficient condition or a subset of the conditions for the occurrence of results. The solution consistency is to judge whether the combinations of causes as a whole (dr*~sp*hd+dr*~sp*hp+~dr*~sp*~hv*~hp+dr*hv*hd*hp) belongs to the subset of the results and the degree of affiliation. As shown in Table 4, when the four combinations of causes as a whole, the coincidence degree of the solution is still 1, which shows that the combination of causes as a whole is also a sufficient condition or a subset of the conditions for the occurrence of results.

5 MULTI-CAUSE PATHS AND MECHANISM OF "UNDERACHIEVING STUDENTS AGAINST COVID-19" IN EUROPE

I will further explore the results of the above studies and analyses in the following. However, first of all, we need to modify hypothesis 3 of our study, because in addition to the third cause combination (~dr*~sp*~hv*~hp), when "~hv" (lower vaccination rate) is combined with other cause conditions, it will lead to the emergence of "ud" (became "underachieving students against COVID-19"), and the raw coverage and unique coverage are both low. Even in the fourth cause combination (dr*hv*hd*hp), "hv" (higher vaccination rate) became one of the cause conditions that led to the emergence of "ud" (became "underachieving students against COVID-19"). Therefore, hypothesis 3 is modified here: higher vaccination rates do not make European countries less likely to be "underachieving students against COVID-19". At the same time, in the necessary condition test, we found that "~sp" (no "strict prevention and control measures") was necessary for the emergence of "ud". Therefore, the failure to take strict control and management measures has become the core reason for the emergence of "ud" ("became "underachieving students against COVID-19""), which has been verified by four reasons and conditions (" ~sp "has become the Causative condition for three of the four reasons combinations).

And according to the experimental results, we can obtain the multi-cause mechanism model of "underachieving students against COVID-19" as shown in Figure 2. In the following, I will analyze this model empirically using specific typical cases.

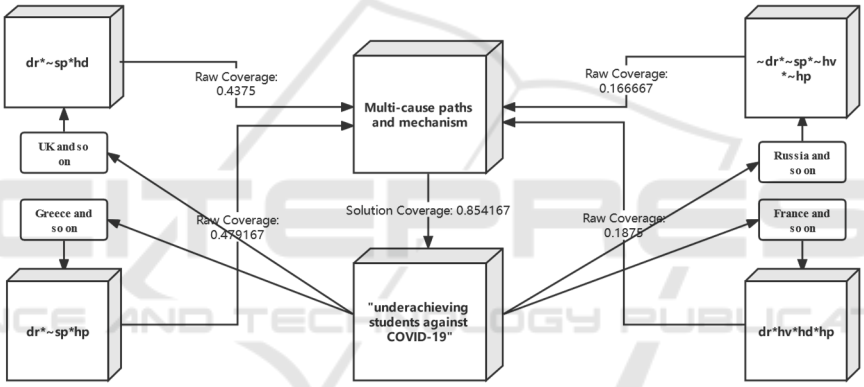

Figure 2: The multi-cause mechanism model of "underachieving students against COVID-19".

5.1 First Multi-Cause Path of "Underachieving Students Against COVID-19" in Europe

The first Multi-cause path of "underachieving students against COVID-19" in Europe is to have all three causative condition: "Loose lockdown" * "Democratic regime" * "High population density". The underlying mechanisms may be that strong restrictions on freedom during the pandemic triggered an upsurge of opposition that forced governments in countries with high democratic indices to abandon strict lockdown measures, while high population density helped spread COVID-19, leading to the countries as a "underachieving students against COVID-19".

I will take the UK as a typical case to illustrate this path. Up to April 2021, the UK government response index remained at a high level (UK government response index: 87.96) (University of Oxford), and the demonstrations from April 2020 to April 2021 put the UK government under great pressure. In April 2021, the Prime Minister's Office issued a press release announcing the easing of COVID-19 containment measures from 12 April 2021, (Government.UK) and the government's response index dropped off a cliff in the following months. (University of Oxford) At that time, the epidemic in Europe was still at its most severe, just as France was constantly increasing epidemic prevention and control measures (the French government response index increased from 70.37 in March to 75 in April) (University of Oxford). And the UK's extremely dense population, which makes it easier for people to gather, helped to spread COVID-19, leading to a small peak in the UK in June 2021 (daily new diagnoses increased from 17,335 on 12

April to 323,272 on 12 June) (World Health Organization). Even at the height of the outbreak in the UK in December 2021 (1,292,034 new cases per day, 27 December 2021) (World Health Organization), the UK government response index remained at its lowest since the introduction of the containment measures (UK government response index: 44.06, 26 December 2021) (University of Oxford). Finally, the UK is one of Europe's "underachieving students against COVID-19".

5.2 Second Multi-Cause Path of "Underachieving Students Against COVID-19" in Europe

The second Multi-cause path of "underachieving students against COVID-19" in Europe is to have all three causative condition: "Loose lockdown", "Democratic regime" and "High tertiary GDP share". The underlying mechanism may be that the shutdown of the tertiary industry caused by the pandemic overwhelmed countries with a high proportion of GDP from the tertiary industry. Protests by a large number of workers in the tertiary sector forced the governments of a countries with high democracy index to abandon strict lockdown measures. But the reopening of the tertiary sector accelerated the population flow, provided excellent conditions for the spread of the epidemic, and finally made the country an "underachieving students against COVID-19".

I will take Greece as a typical case to illustrate this path. Greece's tertiary industries account for 67.49% of its GDP. (World Bank) It can be said that the tertiary industry, especially tourism, is the economic pillar and foundation of Greece, which also makes a large number of tertiary industry workers take to the streets to fight against the lockdown of the government. Knowing that too severe a lockdown would devastate the entire Greek industrial chain, the government announced in March 2021 that Athens would be open to holidaymakers from May 14, while border controls would be eased in April and designated airports would be allowed to receive traffic from abroad. (Keep Talking Greece, 2021) We can also find that the Greek government response index also decreased from 87.96 on 16 April 2021 to 41.67 on 4 July 2021. (University of Oxford) As a result, the epidemic situation in Greece has become more severe since May 2021. By 27 December 2021, the number of confirmed cases of COVID-19 had risen from 2,710 on 4 May to 1,240,862, (World Health Organization) and since then, the number of newly confirmed cases has been extremely high, and finally Greece has become one of the "underachieving students against COVID-19" in Europe.

5.3 Third Multi-Cause Path of "Underachieving Students Against COVID-19" in Europe

The third Multi-cause path of "underachieving students against COVID-19" in Europe is to have all four causative condition: "Loose lockdown", "Non-democratic regime", "Low vaccination rate" and "Low tertiary GDP share". The underlying mechanism may be that non-democratic countries in Europe have generally not made great industrial transitions and have low per capita GDP levels. Countries have too little social support to bear the cost of higher vaccination rates or the economic stagnation that severe lockdowns bring. As a result, countries relaxed lockdown measures, allowing COVID-19 to spread among people with low vaccination rates, leading to become "underachieving students against COVID-19".

I will take Russia as a typical case to illustrate this path. The non-democratic countries of Europe are usually the political and economic outcasts of Europe. Although Russia has a strong national mobilization capacity, its GDP per capita lags far behind that of the developed economies of Western Europe, and its economic market is too fragile to withstand severe shocks. At the same time, due to the underdeveloped economy, the government cannot afford the high cost brought by the high vaccination rate. For example, according to the statistics of WHO, only 52.38 percent of the total population of Russia has been completely vaccinated. (World Health Organization) At the beginning of the outbreak, Russia also took very severe epidemic containment measures (on 30 March 2020, the government response index of Russia was 87.04) (University of Oxford), but after two months of lockdown, the Russian government found itself unable to bear the impact of the severe control measures, so in May 2020, Government officials said in a meeting with President Vladimir Putin that COVID-19 actions and restrictions imposed on certain industries should be phased out and then eased until 1 September 2020. (The Moscow Times, 2020) After that, Russia's government response index had fallen to 37.04. And to keep the response index between 40 and 60 for the rest of the year, a low level. (University of Oxford) The combination of lax epidemic control measures and low vaccination rates has led to an increase in the number of infections. And because of low level of medical conditions, resulting in a high number and

proportion of cases and deaths in Russia (as of 19 September 2022, there were 385,837 deaths in Russia, with a case-fatality rate of 1.90%) (World Health Organization). In the end, Russia became one of Europe's "underachieving students against COVID-19".

5.4 Fourth Multi-Cause Path of "Underachieving Students Against COVID-19" in Europe

The fourth Multi-cause path of "underachieving students against COVID-19" in Europe is to have all four causative condition: "Democratic regime", "High vaccination rate", "High population density" and "High tertiary GDP share". The underlying mechanism may be that Democratic countries with strict quarantine policies increased vaccination rates and then eased measures to some extent, but after the relaxation of measures, high population density aggravated the epidemic situation in the countries. When democracies tried to return to their own draconian containment measures, they faced pressure from popular resistance and a depressed tertiary industry, which resulted in the final lockdown measures being too lax to contain the spread of the disease in a highly concentrated and mobile population, making them become "underachieving students against COVID-19".

I will take France as a typical case to illustrate this path. In fact, France took severe measures at the beginning of the epidemic (the French government response index in March and April 2020 was 87.96) (University of Oxford) and only began to relax in May 2020. In October 2020, France was hit by a backlash (new cases per day went from an average of less than 4,000 to 334,455 on 26 October), after (World Health Organization) which it intensified its epidemic control measures again (the French government response index on 6 November 2022 was 78.70) (University of Oxford). And for a long time after that, the French government's response remained between 60 and 70. In November 2021, Omicron swept across Europe. The initial intensity of anti-epidemic measures was difficult to resist effectively, and it was difficult to adopt severe epidemic prevention and control measures as in the early stages of the epidemic due to the pressure of public resistance and the depression of tertiary industries. Finally, the epidemic in France went out of control (on 17 November 2022, there were 2,427,005 new confirmed cases daily in France) (World Health Organization), making France to become one of the "underachieving students against COVID-19" in Europe.

Above, we have summarized the core mechanisms that make Europe such a dense district of "underachieving students against COVID-19", and analyzed the multi-cause paths. Combined with the coverage of multi-cause path (as shown in Table 4), we can sum up the main mechanism characteristics and main mechanisms of Europe becoming the concentration area of "underachieving students against COVID-19": Europe's high democracy index under the voice of the people for freedom and the demands of the development of the third industry and traffic control measures, had to give up severely coupled with a high population density helped the spread of the virus, finally led to COVID-19 outbreak of a pandemic.

6 CONCLUSION

This paper aims to explore the reasons why Europe has become the concentration area of "underachieving students against COVID-19", and through qualitative comparative analysis of 58 European countries, summarizes four Multi-cause paths for European countries to become "underachieving students against COVID-19": (1) "Loose lockdown" * "Democratic regime" * "High population density"; (2) "Loose lockdown" * "Democratic regime" * "High tertiary GDP share"; (3) "Loose lockdown" * "Non-democratic regime" * "Low vaccination rate" * "Low tertiary GDP share"; (4) "Democratic regime" * "High vaccination rate" * "High population density" * "High tertiary GDP share".

We can draw conclusions from these four Multi-cause paths，the most important condition that makes the "underachieving students against COVID-19" is "Loose lockdown". And "High vaccination rates" did not become a major factor in the success of the European epidemic. The "Democratic regime", "High tertiary GDP share" and "High population density" become important factors of "underachieving students against COVID-19". All of these are worthy of our and all of European countries' reflections.

Finally, it can be predicted that the COVID-19 epidemic has also deeply affected the world. The future course of the epidemic remains highly uncertain. On the premise of keeping a clear understanding of the epidemic situation, all countries should gather the voices of the people to jointly fight the epidemic. Countries should also adopt and adhere to the policy of dynamic zeroing. At the same time, people should avoid gathering, and public health security should be paid attention to prevent the

occurrence of public health emergencies. What is most imperative is to steadily develop the domestic economy and promote international cooperation on epidemic prevention and control, so that all countries in the world can get out of the shadow of the epidemic and jointly promote the development of the world in a better direction.

REFERENCES

Arefi, M. F., & Poursadeqiyan, M. (2020). A review of studies on the COVID-19 epidemic crisis disease with a preventive approach. Work, 66(4), 717-729.

Anderson, R. M., Heesterbeek, H., Klinkenberg, D., & Hollingsworth, T. D. (2020). How will country-based mitigation measures influence the course of the COVID-19 epidemic?. The lancet, 395(10228), 931-934.

Bloomberg, The Best and Worst Places to Be as World Enters Next Covid Phase, https://www.bloomberg.com/graphics/covid-resilience-ranking/?leadSource=uverify%20wall

Bhadra, A., Mukherjee, A., & Sarkar, K. (2021). Impact of population density on Covid-19 infected and mortality rate in India. Modeling earth systems and environment, 7(1), 623-629.

Colbourn, T. (2020). Unlocking UK COVID-19 policy. The Lancet Public Health, 5(7), e362-e363.

Charles Ragin, fs/QCA3.0, https://www.socsci.uci.edu/~cragin/fsQCA/software.shtml

Ciotti, M., Ciccozzi, M., Terrinoni, A., Jiang, W. C., Wang, C. B., & Bernardini, S. (2020). The COVID-19 pandemic. Critical reviews in clinical laboratory sciences, 57(6), 365-388.

Donthu, N., & Gustafsson, A. (2020). Effects of COVID-19 on business and research. Journal of business research, 117, 284-289.

European Union, Re-open EU, https://reopen.europa.eu/en

Gao Q.Q. (2014). From single-cause explanation to multi-cause analysis: The turn in the study of comparative methods. Study of political science, (3), 3-17.

Government.UK, Further easing of Covid restrictions confirmed for 12 April, https://www.gov.uk/government/news/further-easing-of-covid-restrictions-confirmed-for-12-april

Haleem, A., Javaid, M., & Vaishya, R. (2020). Effects of COVID-19 pandemic in daily life. Current medicine research and practice, 10(2), 78.

Hao S.N. (2016). Qualitative comparative analysis and its application in political science research. Foreign theoretical Trends, (5), 58-67.

Iboi, E. A., Ngonghala, C. N., & Gumel, A. B. (2020). Will an imperfect vaccine curtail the COVID-19 pandemic in the US?. Infectious Disease Modelling, 5, 510-524.

Jeyanathan, M., Afkhami, S., Smaill, F., Miller, M. S., Lichty, B. D., & Xing, Z. (2020). Immunological considerations for COVID-19 vaccine strategies. Nature Reviews Immunology, 20(10), 615-632.

Keep Talking Greece, 2021, Greece to ease restrictions on flights from UK in April, says Tourism Minister, https://www.keeptalkinggreece.com/2021/03/23/greece-uk-flights-april/

Liu, W., Yue, X. G., & Tchounwou, P. B. (2020). Response to the COVID-19 epidemic: the Chinese experience and implications for other countries. International Journal of Environmental Research and Public Health, 17(7), 2304.

Lijphart, A. (1971). Comparative politics and the comparative method. American political science review, 65(3), 682-693.

Manson, J. H. (2020). Right-wing authoritarianism, left-wing authoritarianism, and pandemic-mitigation authoritarianism. Personality and individual differences, 167, 110251.

OAG, Analyser Analytics Platform, https://www.oag.com/

Rocklöv, J., & Sjödin, H. (2020). High population densities catalyse the spread of COVID-19. Journal of travel medicine, 27(3), taaa038.

Saadat, S., Rawtani, D., & Hussain, C. M. (2020). Environmental perspective of COVID-19. Science of the Total environment, 728, 138870.

Schneider, C. Q., & Wagemann, C. (2012). Set-theoretic methods for the social sciences: A guide to qualitative comparative analysis. Cambridge University Press.

The Economist, Democracy Index 2021: the China challenge, https://www.eiu.com/n/campaigns/democracy-index-2021/

The Moscow Times, 2020, Russia Moves to Gradually Relax Coronavirus Lockdown: Officials, https://www.themoscowtimes.com/2020/05/06/putins-approval-rating-drops-to-historic-low-poll-a70199

University of Oxford, Oxford Covid-19 Government Response Tracker, https://www.bsg.ox.ac.uk/research/research-projects/covid-19-government-response-tracker

Vespignani, A., Tian, H., Dye, C., Lloyd-Smith, J. O., Eggo, R. M., Shrestha, M., ... & Leung, G. M. (2020). Modelling covid-19. Nature Reviews Physics, 2(6), 279-281.

Yao, H., Chen, J. H., & Xu, Y. F. (2020). Patients with mental health disorders in the COVID-19 epidemic.

Wang, H. J., An, K., & Zheng, M. (2021). Who has done a better job in fighting the COVID-19 epidemic? Left or Right?. Emerging Markets Finance and Trade, 57(8), 2415-2425.

World Health Organization, WHO Coronavirus (COVID-19) Dashboard Table View, https://covid19.who.int/table

World Population Review, 2022 World Population by Country, https://worldpopulationreview.com/

World Bank, Services and value added (current US$), https://data.worldbank.org.cn/indicator/NV.SRV.TOTL.CD

World Health Organization, WHO Coronavirus (COVID-19) Dashboard, https://covid19.who.int/

World Bank, GDP per capita (current US$), https://data.worldbank.org/indicator/ny.gdp.pcap.cd