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The Relationship between Germany Female Social Participation Rate and the Economy Development

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ABSTRACT
The issue of gender equality is an essential topic in the whole world, and promoting gender equality is of great significance to economic development. The aim of this study is to explore the link between the social participation rate of women in Germany and economic development. The study uses the German female political participation rate, the German female labor force participation rate, and the German female primary and secondary school enrollment rate to represent the female social participation rate and uses GDP data to represent the German economic development. The study uses a ridge regression model for analysis. The result shows a long-term relationship between female labor force participation, primary and secondary school enrollment, and economic growth. Specifically, the female labor force participation rate positively correlates with economic growth, while the female primary and secondary school enrollment rate negatively correlates with economic growth. As for the female political participation rate, the current data shows that it has no apparent relationship with the long-term development of the German economy.

Keywords: *Germany, Female, Economic Growth, Political Participation, Labor Force, GPI*

1. INTRODUCTION

Gender equality is an issue that has existed for a long time. Whether in Asia or Europe or the United States, women are not uncommonly regarded as disadvantaged. This problem limits women's development and hurts the economic growth and development of a country or region. However, with the awakening of female consciousness and women's continuous struggle for rights, since the 21st century, women have played an indispensable role in the political stage, and their role in a country's economic development has become increasingly prominent. Some scholars have begun to study the impact of female political participation rates on economic growth. Most studies focus on developing countries in Asia and rarely involve mature European developed countries.

Germany is a good example. Germany has a very well-known female leader, Angela Merkel. During her administration, Germany's economic aggregate has always been among the best in the world. Merkel is one of the few women in power compared to other economic powerhouses. Moreover, in her 16 years in power, Germany's total GDP has never fallen out of the top five in the world. This figure shows the excellent development of Germany during the period when its female leader was in power. As expressed by the World Bank, if a more level playing field can be created where women and men can participate in social and political affairs and even influence policy, there will be a more representative and inclusive development system [1]. There is no doubt that this will lead to a better path for German development. Of course, there must be other driving factors behind Germany's economic prosperity.

As a result, the study focuses primarily on the impact of Germany's female political participation rate, female labor force participation rate, and female primary and secondary school enrolment ratio on long-term economic development. It uses the ridge regression model to prove the importance of German women to German economic growth or the significance of gender equality to economic development. Germany is a very representative developed country. Compared with developing countries, developed countries have relatively lower economic growth vitality. The study explores some elements that can help boost economic development in developed countries.

This study analyzes the significant impact of gender equality on economic development, enriching the research content of factors influencing economic development. With its diversity, culture, and experience,

women's groups can respond positively to the development of the country's economy. Meanwhile, improving the economic status of women can also help address gender inequality and increase the resilience of the global economy.

2. LITERATURE REVIEW

Duflo tried to study the relationship between women's empowerment and economic development from two different perspectives, which is a comparative study. Duflo explores whether development alone can play an essential role in reducing gender inequality. On the other hand, Duflo takes a women's empowerment approach to study economic development. Through exploration, Duflo found that the two-way relationship between empowerment and development is relatively weak and cannot sustain long-term self-development. Therefore, more emphasis should be placed on the meaning of equality itself. The above statement implies that equality between men and women is crucial to achieving economic development [2].

Diebolt and Perrin study the role of gender equality in long-term economic development in industrialized countries through a cliometric growth model for women's empowerment. Their model demonstrates that changes in gender relations is a crucial factor in economic development. The findings suggest that changing gender relations have transformed economic development from slow technological progress and low incomes to a modern growth regime with improved living standards. The rise of these shifts has created a positive feedback loop [3].

Xu used cross-country and panel regressions to investigate whether gender disparities in political participation in 30 Asian countries affected economic development from 1991 to 2013. The findings suggest that the increase in female political participation has boosted Asian economic development since the 21st century [4].

DL Peterson and T Powers also argue that women are drivers of economic growth. Data and analysis show that creating a fairer system of international social relations impacts the sustainable development of the global economy. Efforts to increase women's economic participation may drive global economic growth and positively impact global citizenship [5].

Laura Cabeza-García, Esther B. Del Brio, and Mery Luz Oscanoa-Victorio analyzed the endogenous relationship between gender factors and economic growth in a sample of 127 countries using dynamic models dedicated to panel data. The conclusion is that high female fertility hurts economic development. When women have access to more secondary education and opportunities to participate in the labor market, the effect will be positive. At the same time, when women's groups are actively involved in political activities, economic growth is also remarkable [6].

Zhang explored the impact of female labor force participation on economic development through panel data from 1990 to 2014 in 146 countries. On the other hand, the study also raised the concept of a significant U-shaped relationship between the female labor force participation rate and economic development [7].

Despite the fact that the numerous works of literature cited above have emphasized the importance of women to economic development, none of them have addressed the German female political participation rate or the empirical relationship between female labor force participation rate and economic growth. Much of the above literature addresses economic and social relations globally or within a broad area rather than a specific country. This research will build on this literature and remove the effects of quantitative disparities between national and local or global economies. Based on these documents, this study will analyze the factors affecting the economic development of Germany.

3. CONCEPT OF POLITICAL PARTICIPATION AND ECONOMIC GROWTH

According to Tianguang Meng and Jing Ning's paper, political participation means that citizens voluntarily participate in activities related to national politics. It aims to solve community problems, change systemic patterns of social behavior, commit to collective action that affects polities, or induce significant social change [8]. It is an activity designed to influence government actions and decisions. Political participation affects participants' authority in society through their attitudes.

Economic growth can be defined as the increasing ability of an economy to produce goods and services from one period to another [9]. According to David E. Bloom, David Canning, Günther Fink, and Jocelyn E. Finlay, the number of women in the labor force increases during demographic transitions with declining female fertility [10]. Furthermore, this change has made a significant contribution to economic growth. The proportional relationship between the number of women in the labor force and economic growth means that for gender equality, we must give women the same education, empowerment, and benefits as men because their contribution to economic development cannot be ignored.

To better show the impact of German women's political participation rate on German GDP, the author retrieved German GDP and the proportion of women's seats in Germany's national parliament from the World Bank database and plotted them in time series [11].

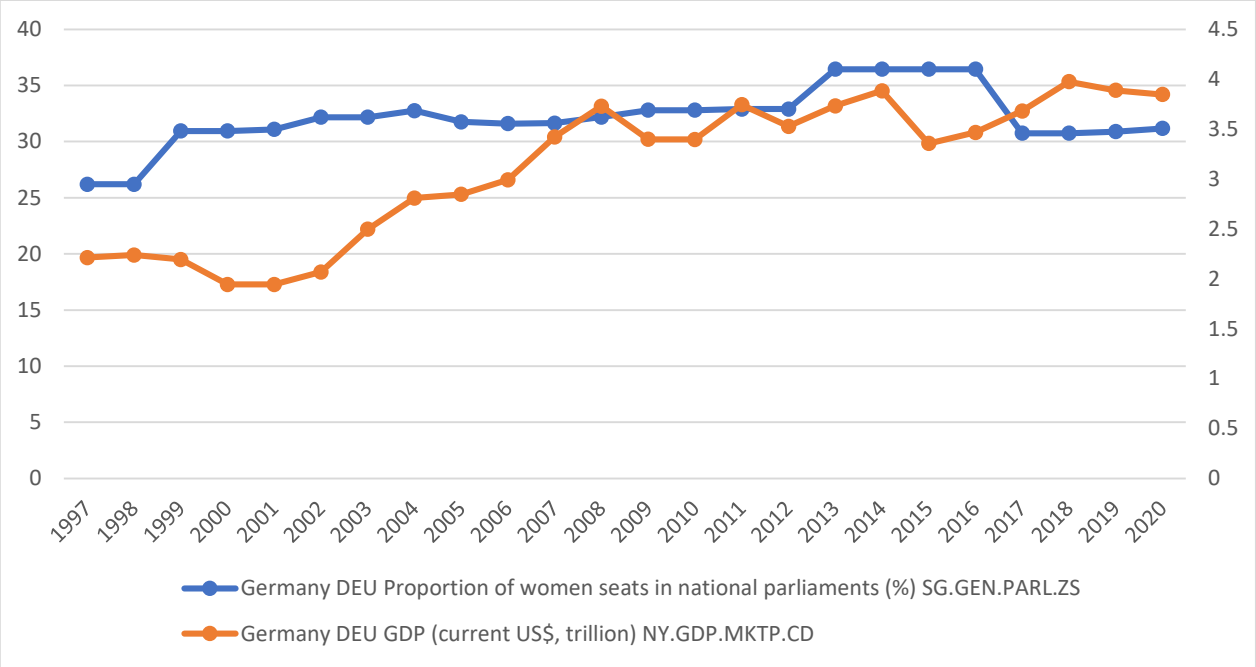

Figure 1 Curves of GDP and the proportion of women's seats in National Parliaments

According to figure 1, from 1999 to 2004, Germany's total GDP rose significantly, with women's seats in the national parliament increasing slightly. Although the proportion of women's seats in parliament leveled off from 2004 to 2007, The total GDP of Germany still maintains a good upward momentum. The volatility in aggregate GDP in 2008 can be attributed to the global financial crisis. The decline in the proportion of women's seats in parliament in 2017 was because Germany was in the context of the refugee crisis and the rise of populism. At this time, German political parties were fragmented, and the political structure was very chaotic.

4. ECONOMIC MODEL

4.1. Regression Model

Regression analysis is a method used for predictive modeling, and its core is the study of various potential relationships between the target and the predictor variables. This technique is used to forecast, time series models and discover various underlying relationships between variables. The dependent variable data is often continuous in a linear regression model, while the independent variable is either continuous or discrete. Regression is linear, and the regression line establishes some connection between the dependent and independent variables. Its expression is $\boldsymbol{Y = a + b * X + \varepsilon}$, where a is the intercept of the line, b is the slope of the line, and ε is the error term. The specific value of the dependent variable Y can be obtained by bringing the independent variable X into the equation. Regarding the determination of a and b, the least-squares method is often used. The least-squares method is a common standard algorithm for fitting regression lines. The solution is computed by minimizing the sum of squares of the vertical errors for each data point in the predicted line. The point of linear regression is to:

- There must be some kind of linear relationship between X and Y.
- Using the metric R-squared as a criterion for evaluating the model's performance.
- Multiple regression suffers from multicollinearity, autocorrelation, and heteroscedasticity.
- The existence of outliers has a significant impact on linear regression and will harm the accurate prediction of the final value.
- Multicollinearity increases the variance of the coefficient estimates, making the coefficient estimates less stable and more sensitive.

The definition of multiple regression is the use of regression equations to analyze the association between multiple X's and one Y. Multiple regression mainly refers to multiple linear regression analysis. Linear is a straight line which is simple and simple is proportional to cause and effect. Furthermore, theoretically speaking, nonlinear relationships can also be transformed into linearization through functions. Multiple linear regression can solve many problems:

- Determine mathematical equations between variables.
- Based on several values of X, control or predict the value of Y, and explore the accuracy that the control can achieve.

- Perform factor analysis. Specifically, it is to find out the influence of different factors on the dependent variable and the relationship between different factors.

The basic expressions, sample expressions, and matrix expressions of the multiple regression model are as follows:

$$Y = \beta_0 + \beta_1 * x_1 + \beta_2 * x_2 + \beta_3 * x_3 + \cdots + \beta_z * x_z + \varepsilon \quad \varepsilon \sim N(0, \sigma^2)$$

$$Y_i = \beta_0 + \beta_1 * x_{i1} + \beta_2 * x_{i2} + \beta_3 * x_{i3} + \cdots + \beta_z * x_{iz} + \varepsilon_i \quad \varepsilon_1, \varepsilon_2, \cdots, \varepsilon_n i.i.d. N(0, \sigma^2)$$

$$Y = X\beta + \varepsilon \quad \varepsilon \to N_n(O, \sigma^2 I_n) \quad Y \to N_n(X\beta, \sigma^2 I_n) \tag{1}$$

4.2. Model Specification

Considering that the research object is Germany, a specific country on the relationship between female political participation rate, labor force participation rate, and economic growth, the data regression model would be suitable. The study assumes that the factors influencing German economic growth include the female political participation rate, the female labor force participation rate, and the ratio between women and men regarding school enrollment rate. Therefore, the mathematical model can be expressed as:

GDP=F(female political participation rate, female labor force participation rate, ratio between women and men regarding school enrollment rate)

Replacing complex text with alphabetic abbreviations:

FPPR = female political participation rate

FLFPR = female labor force participation rate

GPI = ratio between women and men regarding school enrollment rate

GDP = gross domestic product

$$GDP = F(FPPR, FLFPR, GPI) \tag{2}$$

The econometric model of this model can be expressed as:

$$GDP = \beta_0 + \beta_1 * FPPR + \beta_2 * FLFPR + \beta_3 * GPI + \varepsilon \tag{3}$$

Where:

$\beta_0, \beta_1, \beta_2, \beta_3$ = Coefficients of model (Assume $\beta_1, \beta_2, \beta_3 > 0$)

Due to the characteristics of economics itself, the model's formula is in another form convenient for calculation, that is, in the form of a logarithm:

$$lnGDP = \beta_0 + \beta_1 * FPPR + \beta_2 * FLFPR + \beta_3 * GPI + \varepsilon \tag{4}$$

Such a pattern will be beneficial to the subsequent data analysis. The data presented above are all derived from the World Bank indicator, and the time period covered by the four critical data points about Germany chosen for this study is 1997-2020 [11].

Due to multicollinearity issues, this study will use ridge regression. Ridge regression is an improved version of the least-squares method that sacrifices the accuracy of the information to obtain more accurate predictions. The approach is to add a small perturbation λI to the original least squares estimate of β to stabilize the problem and solve it. The mathematical model for this model can be expressed as:

$$\beta^{ridge} = argmin\left\{\sum_{i=1}^{N}(y_i - \beta_0 - \sum_{j=1}^{p} x_{ij}\beta_j)^2 + \lambda\sum_{j=1}^{p}\beta_j^2\right\}$$

$$\beta^{ridge} = argmin\sum_{i=1}^{N}(y_i - \beta_0 - \sum_{j=1}^{p} x_{ij}\beta_j)^2$$

$$\text{Subject to } \sum_{j=1}^{p}\beta_j^2 \le t \tag{5}$$

In general, the R-squared value of the ridge regression equation will be relatively low, and the significance of the regression coefficients will be higher than that of the ordinary linear regression equation. The algorithm setting of ridge regression can better deal with multicollinearity problems.

5. RESULTS AND ANALYSES

Table 1. Descriptive statistics table

	lnGDP (Trillion, US$)	FPPR (%)	FLFPR (%)	GPI (%)
Mean	1.115398297	32.0995	45.49108333	97.13478261
Standard Error	0.049007364	0.535900735	0.220829234	0.19168575
Median	1.222892646	31.9655	45.6945	97.6
Standard Deviation	0.240086071	2.625366707	1.081837885	0.919292562
Sample Variance	0.057641321	6.892550348	1.17037321	0.845098814
Kurtosis	-0.866556514	1.185889854	-0.929409958	-1.866222114
Skewness	-0.756033646	-0.24459496	-0.532019207	-0.115409976
Range	0.715791578	10.26	3.57	2.5
Minimum	0.66423317	26.19	43.412	95.8

Maximum	1.380024748	36.45	46.982	98.3
Sum	26.76955913	770.388	1091.786	2234.1
Count	24	24	24	23

According to the results, the coefficient of skewness for all four groups of data is negatively skewed. In terms of graphical representation, they have long tails in the negative direction on the number line, which means the means of the data are to the left of the peak. About the kurtosis, because the absolute value of kurtosis in the four sets of data is less than the number 3, they are platykurtic. Graphically, the platykurtic is flatter than the standard normal distribution. The average female political participation rate is 32.10, the standard deviation is 2.63, the median is 31.97, and the maximum and minimum values are 36.45 and 26.19, respectively. The mean female labor force participation rate is 45.49, the standard deviation is 1.08, the median is 45.69, and the maximum and minimum values are 46.98 and 43.41, respectively. The mean ratio between women and men regarding school enrollment rate is 97.13, the standard deviation is 0.92, the median is 97.6, and the maximum and minimum values are 98.3 and 95.8, respectively. The natural logarithm of GDP data is 1.12, 0.24, 1.22, 1.38, and 0.66, respectively. The standard deviation rate is the ratio of the standard deviation to the mean and is used to measure the degree of variation in data values. As can be seen from the table, the standard deviation of the four groups of data is much smaller than the average, so the standard deviation rate of the variable will be minimal.

Table 2. Correlation coefficient table

Pearson Related		
	Correlation coefficient	GDP (Trillion, US$)-Germany
Proportion of seats held by woman in national parliaments (%)-Germany		0.436*
p-value	0.033	
Female labor force of total labor force (%)-Germany		0.890**
p-value	0	
School enrollment, primary and secondary, gender parity index (%)-Germany		-0.779**
p-value	0	
* p<0.05 ** p<0.01		

The correlation coefficient value between GDP and FPPR is 0.436, and it is significant at the 0.05 level, thus indicating a significant positive correlation between GDP and FPPR. The correlation coefficient value between GDP and FLFPR is 0.890, and it is significant at the 0.01 level, thus indicating a significant positive correlation between GDP and FLFPR. The correlation coefficient between GDP and GPI is -0.779, which is significant at the 0.01 level, indicating that there is a significant negative correlation between GDP and GPI.

Furthermore, the above table information shows no multicollinearity problem between GDP and FPPR, and the multicollinearity problem between GDP and GPI is not severe. However, since the absolute value of the correlation value between GDP and FLFPR exceeds 0.8, reaching 0.89, there is a multicollinearity problem [12]. This problem can be attributed to a common trend in economic variables or that FLFPR is introduced as a lagged variable. Generally speaking, the way to solve the multicollinearity problem is to increase the amount of data, but for objective reasons, the amount of data obtained here is limited. Therefore, ridge regression for data analysis is needed.

Table 3. Normal Distribution test form

Normality Test Analysis Results						S-W test	
	Size	Average	SD	Skewness	Kurtosis	W value	p
GDP (Trillion, US$)-Germany	24	1.115	0.24	-0.756	-0.867	0.864	0.004**

Proportion of seats held by woman in national parliaments (%)-Germany	24	32.1	2.625	-0.245	1.186	0.866	0.004**
Female labor force of total labor force (%)-Germany	24	45.491	1.082	-0.532	-0.929	0.926	0.078
School enrollment, primary and secondary, gender parity index (%)-Germany	23	97.135	0.919	-0.115	-1.866	0.84	0.002**
* p<0.05 ** p<0.01							

For normality tests, the S-W test is used for small samples, and the K-S or Jarque-Bera test can be used for large samples. Since the sample size of the data is all less than or equal to 50, the S-W test was used. Specifically, GDP, FPPR, and GPI showed significant (p<0.05), meaning that GDP, FPPR, and GPI did not have normality characteristics. In addition, FLFPR did not show significance (p>0.05), which means that FLFPR has normality characteristics.

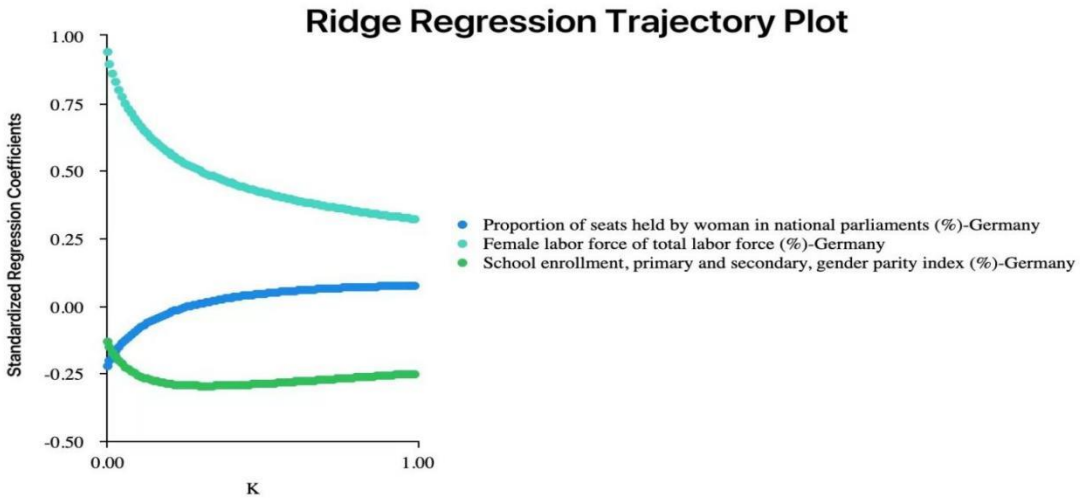

Figure 2 Ridge Regression Trajectory Plot

The above figure is a ridge trace plot obtained by ridge regression analysis with FPPR, FLFPR, and GPI as independent variables and GDP as the dependent variable. It can be seen from the figure that when the K value is 0.99, the standardized regression coefficient of the independent variable will tend to be stable. Therefore, the K will be set to 0.99 and perform ridge regression model estimation.

Table 4. Model summary

Model Summary			
Sample size	R^2	Adjusted R^2	RMSE
23	0.685	0.635	0.132

As can be seen from the above table, when the K value is 0.990, the model R-square value is 0.685, which means that FPPR, FLFPR, and GPI can explain 68.46% of the change in GDP.

Table 5. ANOVA form

ANOVA Form					
	Sum of square	df	Mean square	F	p
Regression	0.869	3	0.29	13.744	0
Residual	0.401	19	0.021		
Total	1.27	22			

Ridge regression ANOVA test, also known as the F test, determines whether the model is meaningful. If the p-value is less than 0.05, the model is meaningful. When the F-test was performed on the model, it was found that the model passed the F-test (F=13.744, p=0.000<0.05). That is to say, at least one of FPPR, FLFPR, and GPI will impact GDP.

Table 6. Ridge Regression analysis results

Ridge Regression Analysis Results		
	Regression coefficients	t
Constant	3.943*	-2.729
Proportion of seats held by woman in national parliaments (%)-Germany	0.007	-1.254
Female labor force of total labor force (%)-Germany	0.073**	-6.43
School enrollment, primary and secondary, gender parity index (%)-Germany	-0.066**	(-4.420)
Sample size	23	
R^2	0.685	
Adjusted R^2	0.635	
F-value	F (3,19)=13.744, p =0.000	
Dependent variable: GDP		
* p<0.05 ** p<0.01		

From the table above, the model formula is: $GDP = 3.943 + 0.007 * FPPR + 0.073 * FLFPR - 0.066GPI$. The regression coefficient value of FPPR is 0.007 (t=1.254, p=0.225>0.05), which means that FPPR does not affect the relationship. The regression coefficient value of FLFPR is 0.073 (t=6.430, p=0.000<0.01), which means that FLFPR has a significant positive impact on GDP. The regression coefficient value of GPI is -0.066 (t=-4.420, p=0.000<0.01), which means that GPI will have a significant negative impact on GDP. The data also shows that increasing female political participation has no substantial impact on economic development in Germany. For the country's economy to continue to grow, Germany needs to increase its female workforce while reducing female primary and secondary school enrolment.

6. DISCUSSION

Conclusions can be drawn from the research. Firstly, the tested data proves that Germany's female political participation rate has little to do with Germany's economic development. Secondly, there is a negative correlation between female enrollment in German primary and secondary schools and economic development. According to the conclusion of most literature, female enrolment rate and economic development should be positively related, but in Germany, it is the opposite. The reason here may be that Germany's female enrollment rate and female labor force participation rate are negatively correlated. Entering school may lead to a significant decrease in the efficiency of the social labor force, thereby affecting the long-term development of the economy. The phenomenon may also be possible due to the gradual reduction in the marginal rate of return on female education in primary and secondary schools, which affects the contribution of human capital and thus slows economic growth in Germany. There is little relationship between Germany's female political participation rate and Germany's economic development, which the insufficient amount of retrieved data may cause. Ridge regression cannot make a clear judgment due to the limited amount of data, and the accumulation of data amount will be an important factor in changing this result.

In addition, the data show that the increase in the female labor force participation rate in Germany has a significant effect on economic development. According to reports, in 2021, the average hourly wage of German women was 18% less than that of men, which means that there is a large gap between the income levels of men and women in Germany [13]. From another perspective, this also means that Germany has more significant potential for economic growth. If the female labor force participation rate can be appropriately handled, Germany's economy will have the opportunity to improve again. Moreover, in German society, most women lack a sense of security in big cities full of all kinds of criminal acts, and women will not choose to actively participate in the labor market out of self-protection actively. This situation also proves that Germany has great potential for economic growth, and efforts must be made to improve the female labor force participation rate.

7. CONCLUSION

This paper aims to study the relationship between the social participation rate of German women and the long-term development of the German economy. The research results show that Germany's female labor force participation rate positively correlates with economic development, the female primary and secondary school enrollment rate is negatively correlated with economic development, and the female political participation rate has no apparent impact on economic development. According to the results of this study, Germany should promote the increase of the female social labor force and at the same time provide guarantees for female social security [14]. Regarding the female political participation rate, although the data shows that it does not have a significant positive impact on economic development, it should continue to be supported, which will help improve gender equality and reduce discrimination against women.

A limitation of the study is that the data selected is limited, so it cannot prove the exact relationship between female political participation and economic development. The impact of women on economic development is reflected in the three aspects of the data in this paper which cannot fully reflect the impact of gender equality on the economy. Future research can obtain sufficient data from other areas like female fertility rate and female unemployment rate to conduct more thorough analysis.

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