

# ***Empirical Study of Gender Differences and Regional Economic Development***

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**Abstract:** With the widening of gender differences in modern society, the unequal treatment of women has also gradually deepened. On average, females are less educated than males in most of the provinces in China. This paper analyzes the relationship between educational levels of males and females in different regions and the regional economic development by using the gross regional product per capita during the last five years and annual data of male and female population with a college degree and above, which is sampled by province, and discusses whether gender differences will affect the local economic development.

Through the analysis of existing data, it can be concluded that regions with a higher degree of gender discrimination have a lower GDP, and the gender discrimination rate is negatively correlated with GDP. Finally, this research summarized possible explanations for this phenomenon from the aspects of education level, labor participation rate and so on. So, because of gender the average education level of women might be negatively affected by discrimination, thus affecting the quantity and quality of work undertaken by women in society. Similarly, labor participation rates can also be affected by discrimination against a particular sex, where discrimination against men in a particular area or industry prevents male from entering the factory and contributing to the labor force. These phenomena will definitely bring about an undervalued development potential for the industry or area.

**Keywords:** gender differences, regional economic development, educational level, regression, gross domestic product

## **1. Introduction**

Gender inequality has always been controversial as a widely concerned social issue. Although some people claim that the problem of gender discrimination has gradually diminished with the development of society, there are still opponents who believe that implicit gender discrimination still exists and even is deepening [1]. That is because, the phenomenon that the average educational level of females is lower than males has been going on for a long time. Though the gender difference in lower-level education has gradually diminished through time, the gender gap is still non-negligible in the enrollment rates in higher education. By Chau and Kanbor, such inequality on gender has negatively affected the economic development as gender discrimination deprives the opportunity of certain part of the population, thus suppressing the potential of the discriminated group [2]

This paper aims to determine whether the severity of gender discrimination is related to regional economic development. If such a correlation exists, this paper will explore whether this correlation is negative or positive. To test the conjecture, regression lines are applied to the gross regional product per capita during the last five years and annual educational level data of male and female population, which is sampled by province.

This paper looks at the negative effects of gender discrimination from different angles, and tries to provide new ideas for eliminating the obstacles to social and economic development at the present stage by analyzing the reasons affecting economic development.

## **2. Literature Review**

When it comes to the reasons why gender discrimination is related to economic development, the study have summarized the following points.

Dollar and Gatti proposed an opinion that the average amount of working force has been reduced by the gender discrimination, and thus impede the economic development [3]. Blecker and Seguino holds the same view, they suggest that such inequality prevents countries to gain competitive advantage on “export-led growth strategies” by using female labour as they are relatively cheaper [4]

Another point raised by Tiago de Cavalcanti and Tavares is mentioned in the article of Stephan Klasen, their model suggests that, gender inequality on the labor market is closely associated with the fertility, where severe discrimination on hiring female always accompany with higher fertility rate, and higher fertility reduces economic growth [5].

Also, Stephanie Seguino has mentioned a view that Alderman et al, Hill and King raised, which concerns that the marginal returns to education for girls are higher than for boys, partly reflecting selection effects -- only the most able girls end up in education. [6]

Lastly, Anand Swamy and his partner claims that, on average, female less prone to corruption and nepotism than male. And if such point confirmed, allowing women to participate in the workplace would also be profitable for the economy [7].

## **3. Analysis**

### **3.1. Analysis of the Relationship Between Female Education Level and Sex Discrimination**

Gender inequality is reflected in numerous aspects, including gender wage differences and employment rates, paid and unpaid hours of work, unemployment rates, educational attainment, and other more specific measures of well-being such as life expectancy and the ratio of men to women in the population. [6]. And for the choice of data, it is considered that the ratio of male to female education in each province is very representative. Here this research compare the proportion of the population of male and female in each province with the proportion of men and women receiving higher education. We assume that if there is no gender discrimination in a region, then the proportion of men and women receiving higher education should be the same as the proportion of men and women in the population.

It is worth mentioning that the employment rate of males and females is also a representative variable, but it is accompanied by many endogenous problems. It is difficult to calculate and exclude the wage difference of different genders in the same position, and the preference of certain genders in many specific occupations cannot be eliminated. For example, there may be a bias in favor of men in some jobs that require a lot of physical strength, or a bias in favor of women in some jobs that require a lot of manual labor, but there are objective biological reasons for this, rather than outright gender discrimination.

### 3.2. Gender Disparities in Higher Education and GDP

In this section, the educated females and males ratio in 2019 is separated by province and compared with the local highly educated females and male ratios in the same year to test whether there is a gap between males and females in receiving higher education. This variable is considered as the basic calculator of gender discrimination level in the following study.

The GDL(gender discrimination level) calculation formula for the degree of gender discrimination in this paper is:

$$GDL = \left| \frac{FE}{ME} - \frac{HFE}{HME} \right| \quad (1)$$

FE: current female educated population in the province

ME: Current male educated population in provinces

HFE: Number of women currently in higher education in the province

HME: Number of males with higher education in the current province

In this test, provinces where the absolute difference between the ratio of educated female and male and the ratio of highly educated female and male is greater than 0.053794 is considered as "province with at least mild discrimination" .

The test results are shown in TAB.1:

Table 1: Existence of gender discrimination in China by province.

province	GDP	Gender ratio	Higher educated	discrimination level	If discriminate
Beijing	164563	0.9846392	0.9619941	0.022645123	FALSE
Tianjin	90058	0.8118352	0.8340659	0.022230728	FALSE
Hebei	46182	0.959118	0.9016544	0.057463625	TRUE
Shanxi	45549	0.9773037	0.960076	0.017227662	FALSE
Inner Mongolia Autonomous	67852	0.9373957	0.9917012	0.054305503	TRUE
Liaoning	57067	0.9929245	0.9391304	0.053794094	TRUE
Jilin	43475	0.9809839	0.9862385	0.005254615	FALSE
Heilongjiang	36001	0.9730187	0.934824	0.038194687	FALSE
Shanghai	156587	0.9271645	0.9369274	0.009762867	FALSE
Jiangsu	122398	0.9672811	0.8738706	0.093410445	TRUE
Zhejiang	107814	0.9289901	0.9503192	0.021329116	FALSE
Anhui	58072	0.9791151	0.8069835	0.172131576	TRUE
Fujian	106966	0.9301569	0.9257695	0.004387481	FALSE
Jiangxi	52865	0.958848	0.8367806	0.122067383	TRUE
Shandon	70129	0.9811793	0.8648231	0.116356276	TRUE
Henan	55825	0.9801424	0.8275947	0.152547717	TRUE
Hubei	76712	0.9857426	1.0114322	0.025689609	FALSE
Hunan	57746	0.962643	0.8738919	0.088751142	TRUE
Guangdong	94448	0.8470753	0.8559217	0.008846319	FALSE
Guangxi Zhuang Autonomous	42964	0.9347783	0.9622196	0.027441343	FALSE
Hainan	56740	0.9403379	1.3578199	0.417481996	TRUE

Table 1: (continued).

Chongqing	75828	0.9982712	0.971831	0.026440192	FALSE
Sichuan	55472	1.0337979	1.0427148	0.008916862	FALSE
Guizhou	46433	0.930886	0.8671329	0.063753105	TRUE
Yunnan	47944	0.9602505	1.1237224	0.163471927	TRUE
Tibet Autonomous	48902	0.9970867	1.0490196	0.051932936	FALSE
Shannxi	66649	0.9708535	0.8614052	0.109448286	TRUE
Gansu	32995	0.9785297	0.8881524	0.090377221	TRUE
Qinghai	48570	0.9353783	0.8066465	0.128731797	TRUE
Ningxia Hui Autonomous	54217	0.9438849	0.9150685	0.028816399	FALSE
Xinjiang Uyghur Autonomous	54280	0.9829551	1.0750586	0.092103521	TRUE

In this table,

“Gender ratio” represents the proportion of the female population versus the male population, which is calculated by:

$$Gender\_ratio = \frac{FE}{ME} \quad (2)$$

“Higher educated” represents the proportion of the female population that receives a higher level of education versus that of male. It is calculated by:

$$Higher\_educated = \frac{HFE}{ME} \quad (3)$$

“Discrimination level” represents GDL(gender discrimination level):

$$GDL = \left| \frac{FE}{ME} - \frac{HFE}{HME} \right| \quad (1)$$

“If discriminate” determines whether gender discrimination exists in the area. Area with “Discrimination level” higher than 0.053794 is marked as TURE in this section, and FALSE otherwise.

After this, this research extracted all areas that are considered to have at least mild discrimination.

Table 2: Provinces with at least mild discrimination.

province	GDP	Gender ratio	Higher educated	discrimination level	If discriminate
Hebei	46182	0.959118	0.9016544	0.057463625	TRUE
Inner Mongolia Autonomous	67852	0.9373957	0.9917012	0.054305503	TRUE
Liaoning	57067	0.9929245	0.9391304	0.053794094	TRUE
Jiangsu	122398	0.9672811	0.8738706	0.093410445	TRUE
Anhui	58072	0.9791151	0.8069835	0.172131576	TRUE
Jiangxi	52865	0.958848	0.8367806	0.122067383	TRUE
Shandon	70129	0.9811793	0.8648231	0.116356276	TRUE
Henan	55825	0.9801424	0.8275947	0.152547717	TRUE
Hunan	57746	0.962643	0.8738919	0.088751142	TRUE

Table 2: (continued).

Hainan	56740	0.9403379	1.3578199	0.417481996	TRUE
Guizhou	46433	0.930886	0.8671329	0.063753105	TRUE
Yunnan	47944	0.9602505	1.1237224	0.163471927	TRUE
Shannxi	66649	0.9708535	0.8614052	0.109448286	TRUE
Gansu	32995	0.9785297	0.8881524	0.090377221	TRUE
Qinghai	48570	0.9353783	0.8066465	0.128731797	TRUE
Xinjiang Uyghur Autonomous	54280	0.9829551	1.0750586	0.092103521	TRUE

After removing outliers from the results, the remaining provinces are further classified into areas with high and low levels of gender discrimination using the median gender discrimination level(GDL), which is around 0.056. The GDP information of the two groups with high and low levels of gender discrimination is summarized respectively in figure 1& figure 2:

```
> summary(pl_gender_discl)
  province      gdp      gender_ratio  he_gender_ratio  gender_disc_level
Length:15   Min.   : 36001   Min.   :0.8118   Min.   :0.8341   Min.   :0.004387
Class :character 1st Qu.: 47226   1st Qu.:0.9296   1st Qu.:0.9303   1st Qu.:0.009340
Mode  :character Median : 75828   Median :0.9730   Median :0.9601   Median :0.022231
          Mean  : 79970   Mean   :0.9503   Mean   :0.9532   Mean   :0.021274
          3rd Qu.:100707  3rd Qu.:0.9852   3rd Qu.:0.9790   3rd Qu.:0.026941
          Max.   :164563   Max.   :1.0338   Max.   :1.0490   Max.   :0.051933
```

Figure 1:Summary data of the “mild gender discrimination” group

```
> summary(pl_gender_disch)
  province      gdp      gender_ratio  he_gender_ratio  gender_disc_level
Length:16   Min.   : 32995   Min.   :0.9309   Min.   :0.8066   Min.   :0.05379
Class :character 1st Qu.: 48414   1st Qu.:0.9542   1st Qu.:0.8552   1st Qu.:0.08250
Mode  :character Median : 56282   Median :0.9650   Median :0.8739   Median :0.10143
          Mean  : 58859   Mean   :0.9636   Mean   :0.9310   Mean   :0.12351
          3rd Qu.: 60216   3rd Qu.:0.9794   3rd Qu.:0.9523   3rd Qu.:0.13469
          Max.   :122398   Max.   :0.9929   Max.   :1.3578   Max.   :0.41748
```

Figure 2: Summary data of the “severe gender discrimination” group

As can be seen from the comparison chart, the maximum, median, minimum and average values of GDP in areas with a relatively high degree of gender discrimination are uniformly lower than those in areas with a relatively low degree of gender discrimination.

By drawing the scatter chart(FIG.3) and calculating the correlation between the degree of gender discrimination in each province and GDP data, which is -0.2579. The research concluded that cities with less female education in general have less economic development.

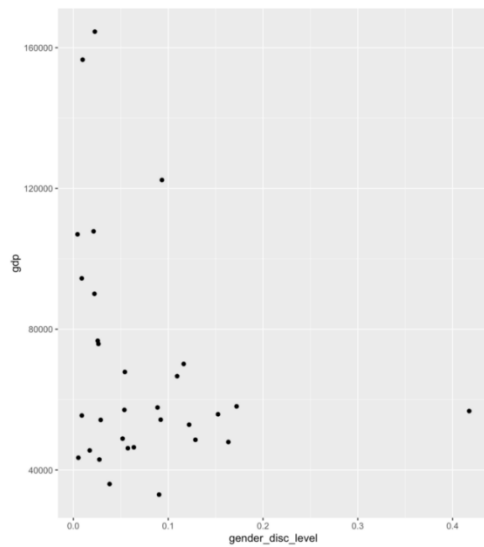


Figure 3: Scatter plot of gender discrimination level versus GDP

### 3.3. Change in Degree of Gender Discrimination & GDP Growth Rate

At the same time, in order to further test the correlation between gender discrimination and economic development, the educational level of female in 2018 and 2019 was compared to test whether there was any change in the degree of gender discrimination between the two years.

A comparative analysis was conducted combining with the change rate of GDP.

First, the rate of change of GDP in 2018-2019 :

$$GDP\_change\_rate = \frac{GDP19 - GDP18}{GDP18} \quad (4)$$

Rate of change of male and female education ratio:

$$Gender\_ratio\_change\_rate = \frac{GER19 - GER18}{GER18} \quad (5)$$

The changing rate of the proportion of men and women with higher education:

$$Higher\_education\_gender\_change\_rate = \frac{HGER19 - HGER18}{HGER18} \quad (6)$$

And the change rate of the degree of gender discrimination :

$$Discr\_level\_change\_rate = \frac{GDL19 - GDL18}{GDL18} \quad (7)$$

Are calculated separately.

GDP19: GDP of the current province in 19 years

GDP18: the current provincial GDP of 18 years

GER19: The ratio of females with 19 years of education to males in the current province

GER18: The ratio of females with 18 years of education to males in the current province

HGER19: Ratio of females to males with higher education in 19 years in the current province

HGER18: Ratio of females to males with higher education in 18 years in the current province

GDL19: The degree of gender discrimination in the current province over 19 years

GDL18: Degree of gender discrimination in current provinces over 18 years (calculated using the same method as Formula 1)

The data are summarized in TAB.3:

Table 3: Changes in the extent of gender discrimination in China by province from 2018 to 2019.

province	GDP change rate	Gender ratio change rate	Higher education gender change rate	Discr level change rate	If discr increase
Beijing	0.07490774	-0.02765218	-0.077682958	-0.25455367	FALSE
Tianjin	0.05015334	-0.060592646	-0.078110934	-0.45158539	FALSE
Hebei	0.07130927	-0.02485344	-0.107001917	1.1990934	TRUE
Shanxi	0.05903278	0.023582531	-0.020286035	-0.31549481	FALSE
Inner Mongolia Autonomous	0.06397792	-0.022617061	0.054255538	1.94777831	TRUE
Liaoning	0.05933725	-0.00340189	0.012420106	-0.21702171	FALSE
Jilin	0.04718663	0.000916437	0.011900154	-0.03506518	FALSE
Heilongjiang	0.05956971	0.001604955	-0.000962131	0.06882388	TRUE
Shanghai	0.05272818	-0.011641244	0.009398733	-0.01201018	FALSE
Jiangsu	0.05579229	0.000496781	-0.043279346	0.74930142	TRUE
Zhejiang	0.05894139	0.003010229	-0.010349629	-0.37369548	FALSE
Anhui	0.07385628	0.038379877	0.119989326	-0.22601962	FALSE
Fujian	0.08548639	0.008335006	0.046154315	-0.883131	FALSE
Jiangxi	0.07859139	0.014772118	-0.032973158	0.53394794	TRUE
Shandon	0.05501565	-0.011218893	-0.056895552	0.5449094	TRUE
Henan	0.07120927	0.004126437	-0.1714262	5.71904301	TRUE
Hubei	0.07879453	0.046416567	0.455134755	-0.89596794	FALSE
Hunan	0.09348785	-0.022872857	-0.109264047	20.71486065	TRUE
Guangdong	0.06383123	-0.006637718	0.028235929	-0.56460643	FALSE
Guangxi Zhuang	0.07377787	0.013927998	0.042533273	25.76026549	TRUE
Hainan	0.07460086	-0.015422724	0.079612157	0.37953729	TRUE
Chongqing	0.08479135	0.001733572	0.072482879	-0.7074974	FALSE
Sichuan	0.07595624	0.020094066	0.023187329	0.57792293	TRUE
Guizhou	0.0857203	0.018065651	-0.009631196	0.64304842	TRUE
Yunnan	0.10556657	0.033902791	0.165925012	3.6652284	TRUE
Tibet Autonomous	0.07533644	-0.013475687	0.146351324	-0.45683832	FALSE
Shannxi	0.07161347	-0.024539202	-0.093437739	1.42743168	TRUE
Gansu	0.07137059	0.01430367	0.04809678	-0.22975071	FALSE
Qinghai	0.06191788	0.013425061	0.032281918	-0.09066136	FALSE
Ningxia Hui Autonomous	0.05793397	-0.072709427	-0.124374114	0.0613949	TRUE
Xinjiang Uyghur	0.04485082	-0.019454085	0.033095384	1.41349076	TRUE

“If discr increase” determines whether the level of gender discrimination has rose in the area. Area with “Discr level change rate” higher than 0 is marked as TURE in this section, and FALSE otherwise.

Additionally, the correlation between the change rate of gender discrimination degree and the change rate of GDP index in each province is found to be 0.2968, which is the opposite to the paper’s prediction.

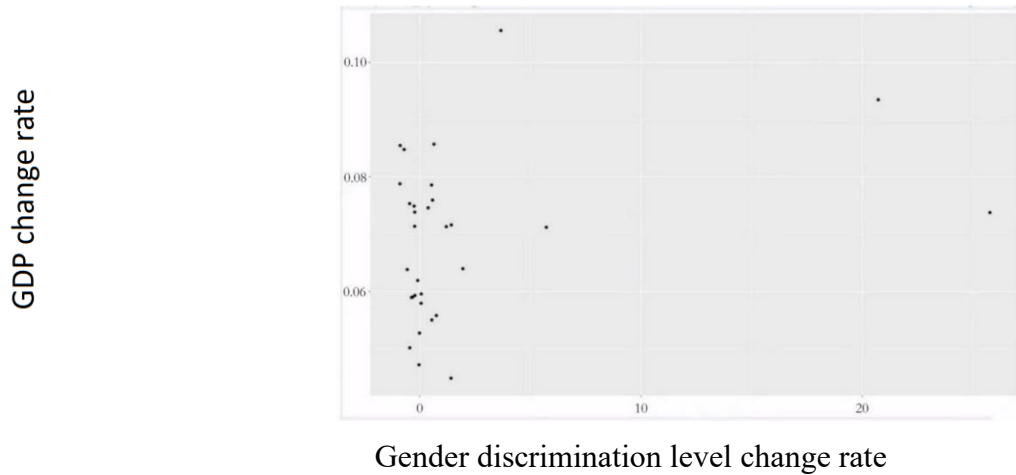


Figure 4: the relationship between the change in gender discrimination level and GDP.

After drawing a scatter plot (FIG.4), it can be found that the values of very few provinces affected the overall trend, so this paper-removed outliers in the data and re-conducted the plot (FIG. 5).

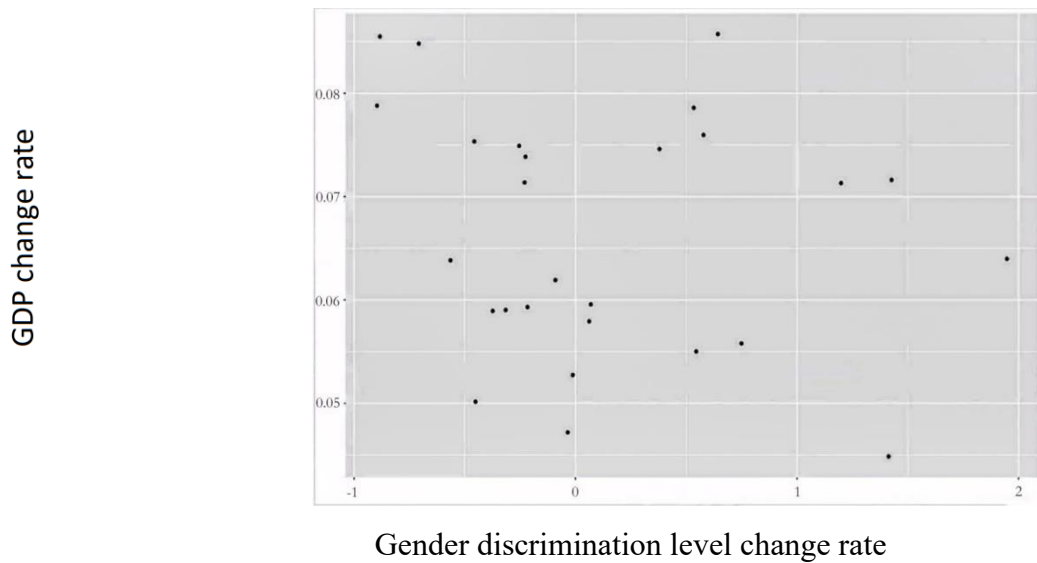


Figure 5: the relationship between the change in gender discrimination level and GDP without outlier.

The correlation coefficient of the adjusted plot was  $-0.1886$ . In addition, the regression line is drawn by linear regression and also shows that the rate of change of gender discrimination degree in each province is negatively correlated with the rate of change of GDP index in each province (FIG. 6).



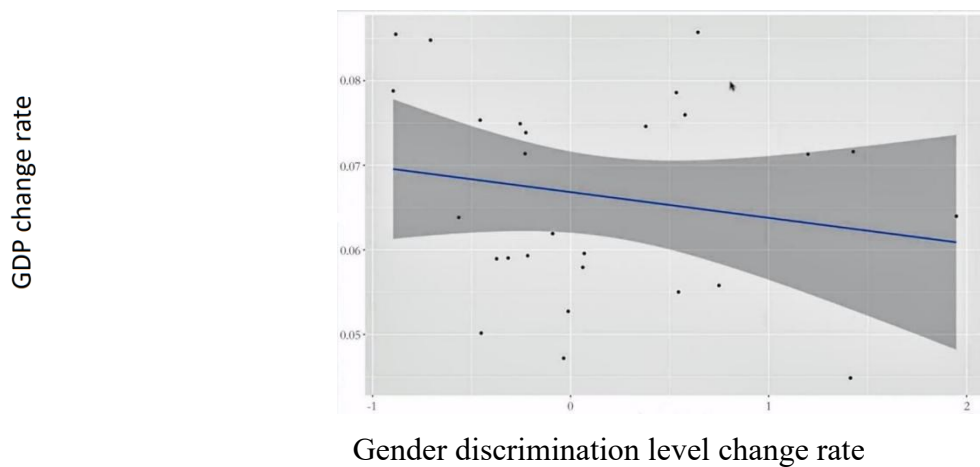


Figure 6: regression line of Gender discrimination level change rate and GDP change rate.

Thus, it is found that the increasing rate of gender discrimination is generally accompanied by slow or even negative economic growth.

To further test this study's conjecture, a hypothetical experiment was also proposed.

The original hypothesis(H<sub>0</sub>) is that the severity of gender discrimination is not correlated with GDP, while the alternative hypothesis(H<sub>a</sub>) is that the severity of gender discrimination is negatively correlated with GDP.

By analyzing the degree of gender discrimination in Chinese provinces and their GDP index, it is concluded that the P value of the hypothesis is 0.04333, which means under the premise that the original hypothesis. Namely, the probability that gender discrimination and GDP data in 2019 really occurs("the severity of gender discrimination is not correlated with GDP") is only 0.04333, which is a very low probability event and smaller than the significance level 0.05. Therefore, it is reasonable to reject the null hypothesis that "the severity of gender discrimination is not correlated with GDP" and claim that the severity of gender discrimination is negatively correlated with GDP.

#### 4. Gender Discrimination in Other Countries

The same problem happens in Pakistan. While the Constitution of Pakistan emphasizes equal treatment for all in society, the reality has backfired. Women lag behind men in almost every area of life. They have less access to education, health care and employment opportunities. They enjoy very limited ownership rights. This limits their active role in economic and development activities. In the study of Pervaiz and his partners, the ADF Unit root Test and the Unrestricted co-integration Rank test (Trace) were used to conduct a short run on the relationship between labor force growth, investment and trade opening gender inequality variables and economic growth Labor force growth, investment and trade openness are estimated to have a significant positive impact on economic growth, while gender inequality has a significant negative impact. This proves that gender inequality hinders Pakistan's economic growth in terms of female labor market participation, average human capital stock and fertility rate. Therefore, this study also suggests that addressing gender inequality should consider not only its intrinsic value, but also its instrumental value growth for the economy. [8]

South Korea is also a case in point. Under a series of policies, gender inequality in education in South Korea is decreasing. However, gender inequality is still affecting the employment rate of women in the workplace. Jingyoung Kim and his partners use the framework of equal labor force participation rate of men and women under the background of no gender bias exists in the family

and labor market, and finds that under the new stable state, the growth rate of per capita output increases to a higher value. The results show that by eliminating gender inequality, the annual growth rate of per capita income could increase by about half a percentage point. According to the article's estimates of full gender equality, complete elimination of gender discrimination in the Labour market would increase female Labour market participation from 54.4 to 59.3%, while average per capita income growth would increase from 3.6% to 4.3%. Interestingly, however, the elimination of gender inequality in household production or education alone will reduce the growth rate of per capita income. This is mainly due to the shrinking supply of male workers. With full equality between men and women in family production or education, men will increase the amount of time allocated to family production, child rearing and education, and their time in the Labour market will decrease.[9]

## 5. Conclusion

In conclusion, through the analysis, the research first found that the GDP of regions with relatively high rates of gender discrimination was relatively low, and that the rate of change in GDP was negatively correlated with the degree of gender discrimination, that is, the rate of change of the proportion of men and women receiving higher education, which was also verified by the hypothesis experiment. Gender inequality has hampered economic growth by affecting average education levels, fertility rates, the average size of the labor force, and import and export policies, and many believe that inequality in the workplace may have also been affected by it. This paper does not exclude the possibility that provinces with lower GDP may lead to increased gender discrimination, which will need to be analyzed in a subsequent study.

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