**Gender inequality in education and economic growth,**

**the case of China**

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1. **Introduction**

*If we educate a boy, we educate one person. If we educate a girl, we educate a family and a whole nation. (African proverb, quoted by James Wolfensohn, President of World Bank, 1995)*

Education has been regarded as a crucial development goal of what? (Sen, 1999) and is essential to economic growth of a country. According to development economics, the fact that economic gains from educating females are greater than that from educating males in developing countries has long been recognized. As Wolfensohn (1995) points out, educating girls has a ‘catalytic effect’ on every dimension in economic growth. However, in reality, there are significant gender disparities in education in the developing world especially in Africa and Asia.

There are two reasons that female and male education may have different impacts on economic growth. First, female education could directly improve productivity as with male education when better-educated women with higher human capital to join the labor force. Female labor force participation rates in what? could be raised with higher levels of educational attainment although various among countries are in general lower than males. (Rewrite: Educational attainment also seem to raise The proportion of female which is often lower than those of male in a nation’s labor force ) In addition, according to some case studies, female education produces social gains which indirectly affect the output level and economic growth by reducing fertility and infant mortality, increasing life expectancy, promoting offspring education, improving family health and adjusting income arrangement (eg., Caldwell, 1982; Smock, 1981; Standlng, 1981; Schultz,1988).

Quantities of cross-country studies have examined the role of female education in economic growth, but consensus remains elusive. Some claim that female education may negatively impact economic growth like Barro and Lee (1994) report the ‘puzzling’ finding with Dollar and Gatti (1999), Forbes (2000), Yamarik and Ghosh (2003),while Knowles, Lorgelly, and Owen (2002) find that gender gaps in education have actually a statistically significant negative effect on the level of gross domestic product (GDP). The contradiction in such cross-country studies may due to different econometric methodologies they employed. However, it could be caused by the geographical and institutional divergence in the data set. Thus, it seems important and necessary to apply within-country examination which may provide more informative and accurate results.

China could be an ideal case for the study of gender inequality in education and economic growth for two reasons. On the one hand, China provides enough sample variations in gender inequality both in time trend and across provinces for a panelregression. Traditionally, Confucian attitudes and norms emphasize the subordination of women to men with discrimination on women education reflected by the famous epigram “Innocence is the virtue for women”. Things have changed since 1949 as the Communists government instituted a series of measures affecting/changing the role of women. With the compulsory education policy, the illiteracy rate has decreased dramatically, from 80% in 1949 to 99.5% in 2008[[1]](#footnote-1). On the other hand, as the one of the largest developing countries in the world, the experience and lessons of China are worth learning for other developing countries.

This paper hence seeks to identify the relationship between gender inequality in education and economic growth in China. Compared with previous cross-country empirical examinations, I utilize Chinese data to conduct a cross-province panel data analysis. by running a within-country analysis, the geographical and institutional variations could be controlled to some extent, and this study主语？！could provide more informative and accurate results.

The rest of the paper is organized as follows. Section II reviews insights from the theoretical and empirical growth literature as they have stated the possible effects of gender inequality on economic growth of a country. In Section III, the empirical analysis of this study is presented, including the regression model, data source and the results Section IV summarizes the whole paper.

1. **Literature Review**

The past 50 years have witnessed a growing amount of literature in the field of economic growth. 这里可以加一个Indeed开头。不加当然也可以。From Solow model (1956) to endogenous growth theory (eg., Roemer 1986; Lucas 1988), economists try to employ concepts such as technology progress, endowments, social infrastructure and education level to explain economic growth and the gap between developed and developing countries. 衔接。可加for example Nelso and Phelp (1966) emphasize that the growth impetus is mainly decided by the human capital stock which could promote technology progress. 可用while合并句子Lucas focuses on the impact of education on human capital accumulation.

**1. Theoretical Research**

There are a few models that explore the relationship between gender inequality in education and economic growth.

Galor and Weil (1996) link fertility and growth, pointing out that there may exist a positive feedback loop; namely, a rapid decline in fertility accompanied by accelerated output growth. They believe increases in capital per worker raise women’s relative wages first and then reduce fertility by raising the cost of children, and finally the lowered fertility leads to the rising level of capital per work.

Lagerlof (1999) applied an overlapping generation framework to demonstrate that initial gender inequality in education can lead to a self-perpetuating equilibrium of continued gender inequality in education with the consequences of high fertility and low economic growth. In this model, gender inequality in education may generate a poverty trap which would justify public action to escape this low-level equilibrium with self-perpetuating gender gaps.

**2. Empirical Research**

**2.1From labor economics viewpoint**

Some Micro studies show that the marginal private rate of return on educating girls is higherin many developing countries (Alderman, Behrman, Khan, Ross, & Sabot, 1995; Alderman, Behrman, Ross, & Sabot, 1996; Hill & King, 1995; World Bank, 2001). There is also considerable evidence for the imperfect substitutability of male and female labor in many settings. Simulation studies have shown that a more equal allocation of male and female labor among industries would indeed boost economic growth (World Bank, 2001; Tzannatos, 1999)

**Barro’s “puzzling Finding”**

In Barro’s early （后面有这位学者的研究，所以我写了early stage）research, he finds some evidence that could support conditional convergence, which means that the growth rate of one country not only depends on the initial income level but also the initial human capital level.

Based on their early researches, Barro and Lee (1994) and Barro and Sala-i-Martin (1995) include education and health capital stock into human capital while dividing education into female and male effects. They report the ‘puzzling’ finding that the coefficient on female primary and secondary years of schooling is negative. They suggest that a large gap in male and female schooling may signify backwardness and may therefore be associated with lower economic growth. Later, some researchers point out that this finding may be related to multicollinearity.（后面一句解释了共线性问题，但我也觉得这句话好像有点短） as In most countries, male and female schooling are closely correlated,逗号在这里很重要！语法！ which makes it difficult to identify the effects individuallyexamine the effects seperately.

* 1. **Panel data examinations**

In response to the multicollinearity problem in estimating cross-section growth equations, Caselli et al. (1996) use panel data including five five-year periods to re-estimate Barro and Lee’s equations 好像还可以。我纠正我的意见。(想表达重新检验两位作者的回归式，不知道该怎么改) with a generalized method of moment (GMM) estimator. They report that the coefficient on female schooling is significantly positive while the coefficient on male schooling is negative. They argue that female education hence captures both (positive) ‘fertility effects’ and (negative) ‘human capital effects’, and the former outweighs the later while male education only represents a human capital effect, hence enjoys the negative coefficient.

Dollar and Gatti (1999) also examined the relationship between gender inequality in education and growth. They try to explain five-year growth intervals and attempt to control for the possible endogeneity between education and growth using instrumental variable estimation. In contrast to Barro, they find that female secondary education achievement (measured as the share of the adult population that have achieved some secondary education) is positively associated with growth, while male secondary achievement is negatively associated with growth. In the full sample, both effects are insignificant, but it turns out that in countries with low female education, furthering female education does not promote economic growth, while in countries with higher female education levels, promoting female education has a sizeable and significant positive impact on economic growth. interesting!

The above literature review shows that quantities of empirical literature have shed light on the relationship between gender inequality in education and economic growth by accomplishing cross-country analysis but! no consensus has been achieved. This research focuses on the case of China by doing a cross-province panel data examination. It digs deeper into the issue of gender inequality under a more specific circumstance (the case of China), hence may derive a more solid and convincing result. What’s more, as China is becoming one of the largest developing countries in the world, it would be worthwhile reflecting the developing path and learn from China.

**III. Method**

This research utilizes a within-country panel data set to run OLS regressions in order to control cultural, institutional variances among countries. The regression model is explained as follows.

**Baseline Regression**

According to the cross-country regression (Klansen, 2002), the following basic regression equation is set:

1. $y\_{it}=C\_{i}+α\_{1}Inv\_{it}+α\_{2}PGR\_{it}+α\_{3}LFG\_{it}+α\_{4}KED\_{it}+α\_{5}FMR\_{it}+α\_{6}Inst\_{it}+α\_{7}Y\_{i96}+ε\_{it}$

where i represents province, t for year. The dependent variable y is the economic growth rate. Ci is the province specific constant. Invit represents the investment level of province i in year t. PGR is the population growth rate. LFG is the labor population growth rate. KED is the total education level. FMR represents the level of gender inequality in education. Inst is for the institutional quality and Y represents the initial economic condition.

1. $Inv\_{it}=C\_{i}+β\_{1}PGR\_{it}+β\_{2}LFG\_{it}+β\_{3}KED\_{it}+β\_{4}FMR\_{it}+β\_{5}Inst\_{it}+β\_{6}Y\_{i96}+δ\_{it}$
2. $PGR\_{it}=C\_{i}+γ\_{1}KED\_{it}+γ\_{2}FMR\_{it}+γ\_{3}Inst\_{it}+γ\_{4}Y\_{i96}+μ\_{it}$
3. $LFG\_{it}=C\_{i}+θ\_{1}KED\_{it}+θ\_{2}FMR\_{it}+θ\_{3}Inst\_{it}+θ\_{4}Y\_{i96}+σ\_{it}$
4. $y\_{it}=C\_{i}+λ\_{1}KED\_{it}+λ\_{2}FMR\_{it}+λ\_{3}Inst\_{it}+λ\_{4}Y\_{i96}+η\_{it}$

Equation (1) measures the direct impact that gender inequality in education 缺动词on economic growth; but gender inequality may also affect economic growth through channels such as investment rates, overall population growth, and growth in the working age population. Following Klasen (2002), I take a step further to estimate a set of regressions (2)-(4) to capture the indirect effects of gender inequality on economic growth. I examine the influence of gender bias in education on population growth, labor force growth, and investment to determine the indirect impacts of gender inequality on economic growth.

The total effect is determined via the technique called ‘path analysis’ where the total effect is defined as: $Total effect= Direct Effect + Indirect Effects$. For example, the total effect of female-male ratio of illiterate would be:

$$α\_{5}+\left(β\_{4}\*α\_{1}\right)+(γ\_{2}\*α\_{2})+(γ\_{2}\*β\_{1}\*α\_{1})+(θ\_{2}\*α\_{3})+(θ\_{2}\*β\_{2}\*α\_{3})$$

The first term is the direct effect, the second term the indirect effect via investments, the third term the indirect effect via（我在其他文献里看到了这样的用法，包括之前的term） population growth, the fourth term the indirect effect via population growth and investment, the fifth term via labor force growth, and the sixth term via labor force growth and investment.

Equation (5) is a ‘reduced form’ regression that omits the intervening factors of population and labor force growth as well as investment. This could directly measure the total effect of gender bias in education.

**IV. Data**

This study uses the province-level data in China from 1996 to 2012. Chongqing is not included since it does not have complete records for each year. The panel data set includes the time series of 30 units in 17 years. Table 1 provides information on data sources and how the main variables of interest are constructed.

**Table 1 1 Data Sources and variables description**

|  |  |  |
| --- | --- | --- |
| Variable | Definations | Data Source |
| $$y\_{it}$$ | Per capita annual compound growth rate | China Statistical Yearbook |
| $$Inv\_{it}$$ | $$Average investment rates=\frac{provincial fixed-asset investment}{national fixed asset investment}$$ | China Statistical Yearbook |
| $$PGR\_{it}$$ | $$Growth rate of provincial populations=\frac{Popolation\_{t}-Popolation\_{t-1}}{Popolation\_{t-1}}$$ | China Population StatisticsYearbook |
| $$LFG\_{it}$$ | $$Growth rate of working-age population=\frac{LFP\_{t}-LFP\_{t-1}}{LFP\_{t-1}}, LFP is the working-age to total provincial populatioin ratio $$ | China Population StatisticsYearbook |
| $$KED\_{it}$$ | $$Provincial education improvement rate=\frac{TER\_{t}-TER\_{t-1}}{TER\_{t-1}}, TER is the illiterate aged 15\&above to total$$$$ population rate$$ | National Sample Survey on Population Changes |
| $$FMR\_{it}$$ | $$Female-Male ratio of illiterate=\frac{1-FIR}{1-MIR}, FIR=\frac{Female illiterate aged 15\&above}{Female population} , MIR=\frac{Male illiterate aged 15\&above}{Male population}$$ | National Sample Survey on Population Changes |
| $$Inst\_{it}$$ | $$Institutional quality=The degree of Regional Marketization$$ | Fan et al (2003) |
| $$Y\_{i96}$$ | Real GDP per capita in 1996 | China Statistical Yearbook |

**V. Results**

This section presents the results of the basic regression equations (1) through (5) as described above. As Table 2 shows, nearly all regressions have a strong explanatory power and perform well on specification tests.

Regression (1) confirms a number of known findings regarding the importance of investment growth and institutional qualities (*Inv, Inst*), the importance of growth in education level (*KED*), the negative impact of population growth (*PGR*) and the positive impact of labor force growth (*LFG)*. The coefficient on female-male illiteracy ratio *(FMR)* turns out to be positive, which comforts with the previous cross-country studies that gender equality in education is highly related to economic growth.

Regression (2) shows the determinants （想表达投资决定因素）可以吧of investments and finds that higher investment rates are related to higher labor force growth, higher human capital, and better institutional quality. Additionally, lower female illiteracy rate also appears to lead to higher investment growth rate, confirming the indirect linkage between gender inequality in education, investment, and economic growth.

Regression (3) and (4) demonstrate that gender inequality in education has the expected impact on population growth and labor force growth, which indicates that gender inequality in education is indirectly related to economic growth.

Regression 5 is a “reduced form” regression which estimates the impact of gender inequality in education on economic growth. Compared with (1), the magnitude of coefficients of labor growth rate, female illiteracy rate and institutional quality in (5) are all larger. The comparison hence confirms the hypothesis that gender inequality in education affects economic growth both directly and indirectly.

In conclusion, the results of this panel data study indicates that the economic growth rate has a significant, positive relationship with gender equality in education. What’s more, the gender inequality in education impedes economic growth not only in a direct way but also in an indirect way through investment, population and labor force growth.

**Table 2 Gender Inequality and Economic Growth[[2]](#footnote-2)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **(1)** | **(2)** | **(3)** | **(4)** | **(5)** |
| **Dependent Variable** | **Growth** | **Inv** | **PGR** | **LFG** | **Growth** |
| Constant | -0.165\*\*\* | 0.752\*\*\* | 0.015\* | 4.16\*\*\* |  |
|  | (-3.513) | (9.896) | (0.885) | (4.6) |  |
| Inv | 0.273\*\*\* |  |  |  |  |
|  | -7.666 |  |  |  |  |
| PGR | -0.081 | -0.112 |  |  |  |
|  | (-0.559) | (-0.390) |  |  |  |
| LFG | 0.423\*\*\* | 0.550\*\*\* |  |  | 0.548\*\*\* |
|  | (-4.488) | (3.028) |  |  | (5.657) |
| FMR | 0.129\*\*\* | 0.138\* | -0.011 | 0.002\* | 0.166\*\*\* |
|  | (2.529) | (1.375) | (-0.536) | (0.052) | (2.874) |
| KED | 0.043 | -0.157 | 0.041 | 0.035 | 0.003 |
|  | (0.566) | (-1.041) | (1.201) | (0.082) | (0.040) |
| Inst | 0.016\* | 0.080\*\*\* | 0.016\*\*\* | 0.025\* | 0.036\*\*\* |
|  | (1.373) | (3.517) | (3.504) | (0.046) | (2.842) |
| Y | 0.009\*\*\* | -0.068\*\*\* | -0.020\*\* | 0.018\*\* | -0.009\*\*\* |
|  | (2.115) | (-9.732) | (-2.396) | (0.225) | (-2.274) |

*\*denotes significance at the 90% level, \*\*at the 95% level, and \*\*\* at the 99% level.*

**IV．Discussion**

This paper has examined to what extent gender inequality, particularly gender inequality in education reduces growth and development. The results indicate that discrimination toward women in education not only harms the women concerned but also has a strong negative impact on economic growth.

The usual caveats of cross-country regressions applied in this study, however, including omitted variable bias and endogeneity. （跨国回归往往会出现遗漏变量和内生性问题，这两个是经济学里面的术语，但endogeneity拼写检查会报错）In order to avoid these problems, efforts have been made to control variables and establish simultaneous equations system. Instrument variables, as a better tool to control for endogeneity though, haven’t been explored in this study and this is clearly an important area for further research.

Furthermore, although the results presented in the paper suggest a strong linkage between gender inequality in education and economic growth, it is possible that these findings are due to measurement errors, misspecification of the model or other problems. Further investigations as well as complementary analyses using micro data are required to conclusively determine the causal relations between the gender inequality and economic growth.

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2. The regression results are taken from, Lingling Sun. *An empirical study of a linkage between gender equality in education and economic growth*, Zhejiang University (2008). [↑](#footnote-ref-2)