An Empirical Study of the Yields of Discipline and Gender Differences in Postgraduate Education of China

Xu Xi Wen, Liu Ting and Ko Jang Wang

Abstract – **In 2015, the State Council issued the "Overall Plan to Promote the Construction of World-Class Universities and First-Class Disciplines" and adopted the "double-class" policy as a long-term national strategy for the development of higher education. The "double first-class" policy takes the promotion of postgraduate education as an important work direction. At the same time, subject layout and subject adjustment are the important contents of the comprehensive reform of graduate education. To adapt to the current general trend of postgraduate education in China, there are new changes in the choice of subjects and employment fields for individual students corresponding to the national macro-policy and subject development strategy. Based on CFPS data on a large sample of household tracking, OLS regression using Mincer's income equation and PSM were used to control the sample's self-selection from subject and gender perspectives. Empirical results show that (1) after controlling the subject and gender, each additional year of postgraduate education can significantly increase the income of learners by 17.2%. (2) The return on investment is inverted "U" as the number of years of work increases, that is, as the number of years of work increases, income increases, and when the number of years of work reaches a peak, income begins to decline. (3) The yield on female graduate education is significantly lower than that of male graduate education. Based on the research results, it is proposed that educational reform should be carried out by following this trend, perfecting the postgraduate management mechanism, and improving the precision of postgraduate education. At the same time, for the problem of inequality in the income of male and female education, universities should strengthen employment guidance and promote the rational allocation of resources.**

Keywords – **Chinese postgraduate education, educational yield, Minter income equation, discipline, gender.**

I. INTRODUCTION

According to data from the National Bureau of Statistics, the number of postgraduate graduates in 1999 was 47,100, and by 2021, this number had risen to 772,800. Over the course of more than two decades, the scale of postgraduate education has expanded more than tenfold. As the national macro-level strategy to enhance postgraduate education and academic development is reinforced, individuals' choices regarding postgraduate education are exhibiting significant shifts. Data from the China Postgraduate Admissions Information Network show that in 2017, the number of applicants for postgraduate exams was 2.01 million, which rose to 4.62 million in 2021, marking an increase of nearly 130% over four years. This growth reflects the allure of postgraduate education in terms of prospective employment opportunities and the anticipation of higher earnings.

In 2015, the State Council of China officially promulgated the "Overall Plan for Promoting the Construction of World-Class Universities and Disciplines," designating the "Double First-Class" initiative as a long-term strategic plan for advancing higher education. Official data reveal that the proportion of postgraduate students in "Double First-Class" universities has surpassed 50% of their total student populations, and these institutions account for more than half of the nation's postgraduate degree conferrals. These statistics highlight the significant role that superior postgraduate education plays in the identity and achievements of top-tier universities, integral to fulfilling the "Double First-Class" objectives. (Du, 2018) Accordingly, the initiative underscores a profound commitment to advancing the academic development of postgraduate education. Concurrently, comprehensive reforms in postgraduate education are being energetically undertaken across Chinese universities, particularly in the restructuring of academic disciplines and specialties—a critical step considered essential for elevating the quality of education and aligning with future developmental demands. However, within the rapidly evolving employment market and the rise of new industries, the demand for graduates in various disciplines is also changing. Despite a growing number of individuals seeking postgraduate education, two trends have emerged: on one hand, students are increasingly shying away from engineering disciplines, and even those who do choose such fields are less inclined to pursue careers as engineers (Liu, 2016); on the other hand, there is a growing tendency among doctoral graduates to forgo careers in academia. (He & Zhu, 2019)

As the scale of graduate education continues to expand, and as it occupies an increasingly important position within China's higher education system, coupled with the deepening of educational system reform, the connection between graduate education and the labour market has increasingly become a focus of academic research.(Bao et al., 2017; Gao & Shen, 2016; Shen et al., 2019) At the same time, the issue of individual benefits for graduate students is also attracting more attention in academia. However, existing empirical research on the rate of return of graduate education, especially studies from a disciplinary perspective, remains insufficient. (Liu & Yang, 2018) This deficiency does not align with the distribution of disciplines in Chinese graduate education nor its rapid development trends, and it fails to fully reflect

Xu Xi Wen : master student, Sungkyunkwan University (Email address: xuxiwen@g.skku.edu)
Liu Ting, Institution of Educational Research, Sungkyunkwan University (Email address: liuting0113@skku.edu).
Ko Jang Wan, Department of Education, Sungkyunkwan University (Email address: jakosu@skku.edu).

the latest trends in China's graduate job market. Therefore, this study advocates for a comprehensive analysis of the educational costs and investment returns of different university majors, emphasizing the need to consider the impact of professional choices on long-term career development and ongoing adjustments to the socio-economic structure, with the hope of contributing to higher education investment and policymaking.

II. LITERATURE REVIEW

While testing the causal relationship between education and wage income and developing new econometric methods, many Western economists have fully utilized the opportunities presented by the development of microeconomic big data since the 1960s to estimate the education rate of return for different groups, regions, and even countries. Empirical evidence indicates that the rate of return on educational investment is an important measure of educational productivity and an effective incentive for private human capital investment (Heckman, J.J. et al., 2006 & Steveson, A., 2016). Since the massive expansion of higher education in China in 1999, there has been a surge of research on the rate of return on higher education in China. However, most studies have focused only on the undergraduate level or have investigated undergraduates and graduate students (Zhu et al., 1995; Ma & Zhang, 2001; Xiao, 2003). Although there is less empirical research on the return on education at the graduate level compared to other educational stages and types, since the end of the last century, with the growth in the scale of graduate education, research on the return on graduate education has gradually started to attract scholars' attention. (Liu & Yang, 2018)

Existing research on the rate of return of graduate-level education indicates that the return rate for graduate students in China is not low. statistical calculations on the costs and income of master's degree students have yielded an internal rate of return of 15.49%, which is higher than the average return rate of material capital during the same period, making it a worthwhile investment. Xiong (2008) calculations of the return rates for various educational levels in China from 2003 to 2008 found that the return rate for graduate education was about 9.0%, slightly lower than the return rates for junior college and undergraduate education in the same years. Fan (2011) Moreover, the educational return rates for both female and male graduate students in China have been on the rise, with male graduate students consistently having higher rates of return than female graduate students.

The return on education is not only related to the duration of education or the level of educational attainment but may also be associated with the discipline or specialty studied. Some researchers have pointed out that educational duration or level primarily measures the time dimension of human capital accumulation, reflecting vertical differences in human capital, but this does not reveal horizontal differences (Saha & SensarmaR., 2011). The horizontal differences in human capital can be identified through the specific disciplines or majors that individual's study.

Currently, domestic scholars mostly focus on the rate of return on education for different undergraduate majors. Fan (2011) calculated the returns of different majors and disciplines at the higher education level and found that in 2003, the highest returns were in service professions, foreign languages, sports arts, and finance. By 2008, the highest returns were in service professions, bioengineering, science, and law, while disciplines or majors like liberal arts, agriculture, fisheries, politics, and medicine consistently had lower returns. Wang (2015) analyzed the educational returns for public administration master's students in Kunming City, and the empirical results showed that controlling for social background, family conditions, and personal ability, the rate of return for public administration master's students was 13.14%. The studies only calculate the overall rate of return on education for graduate students or a specific discipline or major, and the conclusions are not truly based on a disciplinary comparison of the rate of return on graduate education.

III. RESEARCH METHOD

Mincer's human capital income function

Currently, in the field of the economics of education, common indicators used to calculate the rate of return on education include the internal rate of return and the Mincer rate of return. Among these, the calculation of the Mincer rate of return assumes that the main cost of education is the opportunity cost, thereby eliminating the need to obtain data on direct costs. Because the calculation of the Mincer rate of return has low data requirements, it has become the most widely adopted method. This study will also use the Mincer earnings equation to estimate the Mincer rate of return on graduate education. The model of Mincer's human capital income function is as follows.

$$\ln \text{earn\_adj}_i = \alpha_1 + \beta \text{edu}_i + \alpha_2 \text{exp}_i + \alpha_3 \text{exp}_i^2 + \alpha_4 \text{major}_i + \varepsilon_i$$

In the model, "$earn\_adj$" represents the adjusted labor income of an individual on an annual basis; "Edu" stands for years of education; "exp" for work experience; "exp^2" for the square of work experience; "α_1" is the constant term; "major" denotes the field of study; "α_2" and "α_3" are the coefficients for work experience and its square, respectively; "ε_i" is the random error term with an expected value of zero (E(u)=0); "β" is the core explanatory variable — the rate of return on educational investment, indicating the mean change in the log of labour income per unit change in years of education, holding other variables constant. Specifically, the Mincer rate of return for a particular stage of education is usually compared to the next lower educational stage as a reference group. Both the educational stage being estimated and the next lower stage are regressed together, and the coefficient "β" obtained is the Mincer rate of return for that stage of education. Sometimes, the next lower educational stage is used as a reference, and the specific educational stage is included as a dummy variable in the

Mincer earnings equation. The regression coefficient for the specific educational stage dummy variable, divided by the years of education for that stage, yields a value that approximates the Mincer rate of return. (Carnoy, 1995)

The study will first apply Ordinary Least Squares (OLS) to regress the Mincer earnings equation. Although the OLS method may have issues such as omitted variable bias and self-selection bias, which could lead to some degree of distortion in the calculated rate of return on education, its greatest advantage lies in the convenience of performing comparative analyses across different levels. (Rosenbaum, P. R., & Rubin, D. B., 1985) Therefore, this article still opts to use the OLS method to analyse and interpret the Mincer earnings equation. However, to correct potential biases in the estimated results of the standard Mincer income function to some extent, the study will also adopt the Propensity Score Matching (PSM) method as a supplementary analytical approach.

Propensity Score Matching (PSM)

Propensity Score Matching (PSM), introduced by Rosenbaum and Rubin in 1985, is a quasi-experimental design technique aimed at stimulating the conditions of a randomized controlled trial by constructing a matched control group. This method utilizes observational data to mitigate or eliminate estimation biases caused by self-selection bias. The core idea of PSM is to select a group of individuals from those who have not received a specific intervention, who are not significantly different in major characteristics from those who have received the intervention, thus creating a simulated control group. By comparing these two groups of samples, which have been balanced on key characteristics, the net effect of the intervention can be estimated. For example, in this study, the reason for choosing PSM is to control for self-selection biases that may be due to individual inherent excellence or effort level, which could lead to higher income levels even for individuals who have not received graduate education, thereby necessitating the distinction between the real effects of graduate education and the impact of individual traits.

In this study, when using the Propensity Score Matching method, the grouping variable chosen is whether the sample is a graduate student or not, with covariates including years of work experience and discipline.

IV. DATA COLLECTION

The data used for the actual analysis in this study comes from the 2020 China Family Panel Studies (CFPS). The reason for using this data is that it has a relatively large number of samples suitable for the study's purpose, especially for analysing the rate of return on educational investment at the school level. The sample for this study covers various educational levels, including associate degree, bachelor's degree, and graduate studies, with major disciplines ranging from management, economics, medicine, agriculture, arts, to engineering, thus ensuring good data representativeness and reliability in reflecting the rate of return on education for different disciplines. The data used in this study includes information on individuals' highest educational attainment, age, work experience, income, gender, the discipline of highest education, workplace, household registration, political affiliation, etc., which are sufficient to analyse the two main research questions of the study. The sample should include graduate students, with information on discipline, years of work, and income. After excluding samples with missing values in core variables, a total of 1225 valid samples remained, which is the total sample size for this study. Within the data used for this study, there are 1110 samples with a bachelor's degree as the highest educational attainment and 115 samples with graduate education, including 106 master's degree holders and 9 doctoral degree holders.

TABLE I VARIABLE DEFINITIONS AND CODING

Variable name	Definition/Coding
Logarithm of annual income	Logarithm of annual income
Years of education	Years of education corresponding to the highest degree: Bachelor's = 16, Master's = 19, Doctorate = 22.
bachelor	1= The highest degree is bachelor's degree; 0= The highest degree is not bachelor's degree
doctoral	1= The highest degree is doctor's degree; 0= The highest degree is not doctoral 's degree
master	1= The highest degree is master's degree; 0= The highest degree is not master's degree
Working years	2020 - The year of formally starting work.
Working life squared	Square of years of work experience.
Science	1 = Science; 0 = non-science.
Engineering	1 =Engineering; 0 = non-engineering
Agriculture	1 =Agriculture； 0 = non-agriculture
Medicine	1 = Medicine； 0 = non-medicine
Economics	1 = Economics; 0 = non-economics
Humanities and Social Sciences	1 = Humanities and Social Sciences; 0 = Non-Humanities and Social Sciences
Gender	1= male; 0= female

The definition and coding of core variables are shown in Table 1. Among them, annual income includes the total income from wages, royalties, labour fees, year-end bonuses, and part-time work in the previous year. Education variables are expressed in two ways: years of education and educational stage. Since the data for scientific and technological workers do not provide detailed records of the sample's years of education, only the "highest education level" is available. Therefore, in this study, the years of education for bachelor's, master's, and doctoral degrees are set as 16 years, 19 years, and 22 years, respectively. The educational stage is represented by two dummy variables, with bachelor's degree as the reference group, resulting in dummy variables for master's and doctoral degrees.

TABLE II SIMPLE DESCRIPTIVE STATISTICS OF VARIABLES

Variable name	Sample size	Mean (standard deviation)
Logarithm of annual income	1,225	76940.97（64942.94)
Years of education	1,225	16.248（0.878)
bachelor	1110	0.783（0.412)
doctoral	9	0.006（0.075)
master	106	0.075（0.263)

Working years	1,225	0.183（0.644）
Working life squared	1,225	0.449（1.996）
Science	7	0.005（0.07）
Engineering	79	0.056（0.231）
Agriculture	3	0.002（0.046）
Medicine	23	0.016（0.124）
Economics	10	0.007（0.084）
Humanities and Social Sciences	105	0.074（0.262）
Gender	1,225	1.511（0.5）

V. RESULTS

OLS RESULTS

Regression results of the standard and extended Mincer earnings equations

Table 3 presents the regression results of the standard human capital cost-income equation and the extended human capital cost-income equation. In the standard human capital cost-income equation, the rate of return on human capital costs for graduate education (including master's and doctoral degrees) is 0.185, which means that each additional year of graduate education significantly increases the income of the learner by 18.5%. After controlling for discipline and gender, each additional year of graduate education significantly increases the learner's income by 17.2%. Although the absolute difference in the rate of return on education calculated by the standard human capital cost-income equation and the extended Mincer income equation is only 1.3%, it can also suggest that discipline and gender may cause variations in the rate of return on education. The regression results of the extended human capital cost-income equation in Table 3 also show that compared to humanities and social sciences, graduate education in science, agriculture, and medicine significantly contributes more to income, with engineering and agriculture having the largest effect on income enhancement. In terms of gender, controlling for other factors, male income is significantly higher.

TABLE III REGRESSION RESULTS OF THE STANDARD AND EXTENDED MINCER EARNINGS EQUATIONS

	Regression results of the standard	extended Mincer earnings equations
	Logarithm of annual income	Logarithm of annual income
Years of education	0.185***	0.172***
	-0.028	-0.027
Working years	-0.662***	
	-0.11	-0.107
Working life squared	0.126***	0.139***
	-0.035	-0.035
Science		-0.642*
		-0.34
Engineering		-0.589***
		-0.104
Agriculture		-1.113**
		-0.519
Medicine		-0.359*
		-0.193
Economics		-0.031
		-0.285
Gender		-0.329***
		-0.048
Constant term	7.959***	8.724***
	-0.454	-0.451
N	1418	1418
R^2	0.078	0.131
F	40.015	23.489

*** p<0.01, ** p<0.05, * p<0.1

Humanities and social sciences serve as the reference group for disciplines. As for the coefficients of work experience and the square of work experience, both the standard and extended forms show the same classic "inverted U" relationship as existing models, meaning that income increases with work experience up to a certain point, after which it begins to decline as work experience continues to increase.

This study reports that such phenomena are due to the different types of human capital accumulated by department. In China, the knowledge and skills learned in engineering and agriculture are both highly specialized, and at the graduate level, there is a greater emphasis on research and development than at the undergraduate level, making the expertise of engineering and agriculture more pronounced. The human capital accumulated through studying these two disciplines is considered specialized, whereas the knowledge learned in humanities and social sciences involves more "soft skills," and the accumulated human capital is more general. (Barney， J. B., 1991) Specialized human capital is generally considered valuable, scarce, non-substitutable, and non-imitable, and can be used as a source of continuous competition for companies. Therefore, employers pay for specialized human capital, making the return on specialized human capital higher than that on general human capital. (Becker, G.S., 1964)

Moreover, according to China's "Made in China 2025" policy and the "China Agricultural Industry Development Report" published by the Chinese Academy of Agricultural Sciences in 2018, globalization and continuous development provide new opportunities and directions for agriculture, and industries related to agriculture need a lot of scientific and technological talent for development. Therefore, the return on investment for science and agriculture is expected to increase over a certain period.

Lastly, the OLS regression analysis results show a low R^2 value, indicating that the factors influencing wages are very complex. In this study, it is noted that the more rapidly society develops and changes, the smaller the R^2 of the human capital rate of return function becomes, which is due to the increasing complexity of factors affecting wages. Thus, from this perspective, a small R^2 value can be seen as a normal occurrence.

Gender differences in the rate of return after controlling for discipline

When not controlling for discipline, the rate of return on education for female graduate students is 16.9%, while for male graduate students it is 19.3%, with males having a 2.4% higher rate of return than females. After adding discipline into the equation, the rate of return for female graduate education is 15.0%, and for male graduate education, it is 16.2%, with males still having a higher rate of return than females. However, whether the absolute difference in coefficients is significant needs to be verified by adding an interaction term between gender and years of education. Constructing a dummy variable for gender with females as the reference and controlling for the main effects, the coefficient of the interaction term is significantly positive (0.625), indicating that compared to females, males experience a greater increase in wages with each additional year of education.

TABLE IV COMPARISON OF GENDER-SPECIFIC RATES OF RETURN

	Before controlling for discipline		After controlling for discipline	
	female	male	female	male
Years of education	0.169***	0.193***	0.150***	0.162***
	-0.039	-0.039	-0.038	-0.038
Working years	-	-	-	-
	0.845***	0.537***	0.861***	0.558***
	-0.158	-0.149	-0.156	-0.145
Working life squared	0.143***	0.109**	0.154***	0.114**
	-0.052	-0.048	-0.051	-0.046
Constant term	8.090***	7.977***	8.470***	8.583***
	-0.629	-0.637	-0.625	-0.625
N	694	724	694	724

*** p<0.01, ** p<0.05, * p<0.1

What accounts for the higher rate of return on education for men at the graduate level compared to women? Previous research found that women's rate of return on education is higher than men's, which was explained by the lower opportunity cost of education for women. (Zuo, 2018) So how can we explain the notably lower rate of return for female graduate students? According to research, gender discrimination is found to be more severe among groups with higher human capital. This implies that gender discrimination could be most serious among graduate student populations, who are at the highest levels of educational attainment. (Ge et al., 2018) This indirectly suggests that gender discrimination in employment choices and career advancement prevents female graduate students from fully realizing their human capital, hence they do not receive the economic rewards they deserve, resulting in a lower rate of return.

PSM RESULTS

Rates of return on graduate education under PSM

First, the study estimated the probability of workers going on to graduate school by using a logit model with variables such as work experience, the square of work experience, department, gender, marital status, and overseas study or work experience as independent variables, and 'whether a graduate student' as the dependent variable. The overall model was significant at the 0.01 level, indicating that the selection of such covariates in this paper is effective for estimating the propensity scores of graduate students.

Next, because the sample size of graduate students in this paper's data is small, Kernel density estimators were used to estimate the distribution of the propensity scores. The standard deviations of all covariates except for marital status showed varying degrees of decrease after data matching. In terms of the balance of covariates, excluding unit type, there were different degrees of group differences between the experimental group and the control group before data matching, which indicates that there are certain differences in sample characteristics regarding graduate school enrolment. However, after data matching, the deviation of all covariates between the experimental group and the control group decreased to within 10%, and the differences in most of the covariates are no longer significant. The null hypothesis that there are no significant differences between the experimental and control groups could not be rejected, and at the same time, the counterfactual research design of the main study, which uses the control group as the experimental group, was satisfied while testing the conditional independence hypothesis.

Overall, regardless of the intervention strategy, the wages of the experimental group that received graduate education were significantly higher than those of the control group that did not receive graduate education, and the estimates of the Average Treatment on the Treated (ATT) were all positive, indicating that graduate education significantly increased the sample wages.

TABLE V: RATES OF RETURN ON GRADUATE EDUCATION UNDER PSM

		Rate of return	Standard error	z	p	95% Confidence Interval	
After controlling for discipline	ATT	0.516	0.132	3.91	0	0.257	0.774
	ATU	0.58	0.136	4.26	0	0.313	0.847
	ATE	0.574	0.136	4.23	0	0.308	0.84
Before controlling for discipline	ATT	0.583	0.074	7.86	0	0.437	0.728
	ATU	0.609	0.077	7.93	0	0.458	0.759
	ATE	0.607	0.077	7.92	0	0.456	0.757

In intervention strategies without controlling for the department, the estimate of ATT was significant at the 0.01 level, with a value of 0.583, meaning that individuals who received graduate education had a 58.3% higher educational return than those who did not receive graduate education. In the controlled-department intervention strategy, graduate education could provide individuals with a rate of return of 51.6%, which is significant at the 0.01 level. Additionally, this demonstrates that both OLS and PSM results show that graduate education, as the highest level of educational attainment, is a high-return

investment. After controlling for the department, the income from graduate education decreased somewhat, indicating that there is indeed some degree of self-selection bias in the distribution of departments.

Gender-specific rates of return on graduate education under PSM

Without controlling for the discipline, the rate of return on graduate education is 63.9% for men and 56.6% for women, with men having a higher rate of return than women. This is consistent with the results obtained using the OLS method and conclusions from previous literature studies. Even after controlling for discipline, the rate of return for men was still higher at 59.9% compared to 52.2% for women.

TABLE VI: GENDER-SPECIFIC RATES OF RETURN ON GRADUATE EDUCATION UNDER PSM

	Sample	Experimental group	control group	Difference
Male (controlling for discipline)	before PSM	11.639	11.04	0.599
	ATT	11.641	11.087	0.554
	ATU	11.045	11.661	0.616
	ATE			0.61
Male (without controlling for discipline)	before PSM	11.639	11	0.639
	ATT	11.641	11.005	0.636
	ATU	11.003	11.645	0.642
	ATE			0.642
Female (controlling for discipline)	before PSM	11.281	10.76	0.522
	ATT	11.281	10.852	0.429
	ATU	10.787	11.31	0.523
	ATE			0.514
Female (without controlling for discipline)	before PSM	11.281	10.716	0.566
	ATT	11.281	10.775	0.506
	ATU	10.735	11.266	0.531
	ATE			0.529

Comparing the values of ATT and ATU, it can be observed that regardless of whether the discipline is controlled or not, there is ATT > ATU for both men and women. This means that after completing undergraduate education, those who do not actually go on to graduate education would receive a lower return on education if they did undertake such education, compared to those individuals who choose to receive graduate education. This indicates that when deciding whether to pursue graduate education, both male and female labour forces are quite rational, with those who are more capable opting for this level of education and receiving higher educational returns.

VI. CONCLUSION
VII.

The factors affecting individual labour income distribution are complex, involving not only educational factors but also numerous factors beyond education. And education itself, varying in levels and structures, can lead to different distributional outcomes. Moreover, educational factors interact with those beyond education. Therefore, it cannot be simplistically stated that education expansion reduces or exacerbates income inequality; the impact of education on labour income distribution varies across different levels, categories, and for different groups. The main research findings and conclusions of this article are as follows:

First, graduate education can bring substantial returns to learners. After controlling for discipline and gender, each additional year of graduate education can significantly increase the income of learners by 18.5%. Even after correcting for self-selection bias, graduate education still significantly increases learners' income by about 51.6%. This is consistent with many current findings on the rate of return on education, that is, the OLS results are stable. (Ashenfeilter. O, & Krueger. A., 1994)

Therefore, China should continue to develop graduate education. Graduate education is not only beneficial to individuals but also closely related to the establishment of a nationwide lifelong learning education system and the overall economic and technological strength of the country. Against the backdrop of China-U.S. trade disputes, it is necessary to further increase the rate of return on graduate education, attract more potential individuals to receive graduate education, and contribute to China's independent and self-reliant technological fields, striving for China to become a technologically powerful country as soon as possible. More individuals at the primary stage will advance to middle and high levels. Receiving graduate education will also help promote the advancement from the popularization at the primary stage to middle and high levels in China's higher education. (Bie, 2021)

Second, at the graduate level, investments in agricultural and engineering education yield higher returns than other fields, and this result is statistically significant. This is likely because the rate of return on educational investment is closely related to market demand, which is often influenced by policy. Policies like "Made in China 2025" and the "China Agricultural Industry Development Report" may have already promoted the value of education in the fields of engineering and agriculture. This has also increased the rate of return on graduate education in engineering and agriculture.

In a broader sense, this suggests that changes in the rate of return on educational investment not only reflect economic and technological trends but also reflect the influence of policy on the labour market. It also indicates that when choosing educational and career paths, one should consider macroeconomic policies and industry trends. This is of significant guidance for students, educational institutions, government policymakers, and private enterprises, especially in terms of resource allocation and talent development.

Third, both OLS and PSM results show that, regardless of discipline control, graduate education brings higher returns for women, but the rate of return on female graduate education is significantly lower than that of male graduate education. This is consistent with existing findings on the gender differences in the rate of return on graduate-level education. This indicates that, compared to other educational levels, female graduates face greater employment discrimination. Encouragingly, PSM results

show that the choice for women to pursue graduate studies is more rational, with higher-ability women choosing to continue their studies.

REFERENCES

Barney, J. (1991) Firm Resources and sustained competitive advantage, *Journal of Management*, 17(1), pp. 99–120.

Carnoy, M. (1996) Race, gender, and the role of Education in earnings inequality: An introduction', *Economics of Education Review*, 15(3), 207–212.

Daniere, A. (1965) Gary S. Becker. human capital: A theoretical and empirical analysis, with special reference to education. New York: National Bureau of Economic Research, *The ANNALS of the American Academy of Political and Social Science*, 360(1), 208–209.

Heckman, J.J., Lochner, L.J. and Todd, P.E. (2006) Chapter 7 earnings functions, rates of return and treatment effects: The Mincer equation and beyond, *Handbook of the Economics of Education*, 307–458.

Krueger, A. and Ashenfelter, O. (1992) *Estimates of the economic return to schooling from a new sample of twins* [Preprint].

Psacharopoulos, G. and Patrinos, H.A. (2004) Returns to investment in education: A further update, *Education Economics*, 12(2), 111–134.

Rosenbaum, P.R. and Rubin, D.B. (1985) Constructing a control group using multivariate matched sampling methods that incorporate the propensity score, *The American Statistician*, 39(1), 33.

Saha, B. and Sensarma, R. (2011) Academic specialisation and returns to education: Evidence from India, *Journal of Education and Work*, 24(5), 501–520.

Stevenson, A. (2016) The returns to quality in graduate education, *Education Economics*, 24(5), 445–464.

Yang, C.-H., Lin, C.-H.A. and Lin, C.-R. (2010) Dynamics of rate of returns for postgraduate education in Taiwan: The impact of higher education expansion, *Asia Pacific Education Review*, 12(3), 359–371.

Ma Yang, Zhang Yulu. (2001). Research on the rate of return of higher education. Comparative Education Research (09), 37-40.

Wang Huadong. (2015). Research on the personal economic rate of return of public administration master's education investment (Master's degree thesis). Yunnan University.

Zuo Yiqi. (2018). Research on the rate of return of higher education in my country (Master's degree thesis, Capital University of Economics and Business)

Liu Yun. (2016). "Escape from engineering" leads to a shortage of top technical talents [N]. Guangming Daily.

Liu Xiao, Yang Po. (2018). Analysis of the current situation, reflection and new directions of research on the rate of return of graduate education - discussion based on existing research literature. Education Academic Monthly (04), 20-27.

Du Zhanyuan (2018), Deepen the reform of graduate education and promote the connotation development to a new level - Speech by the Vice Minister of the Ministry of Education at the 2018 Provincial Degree Committee, Discipline Evaluation Group and Teaching Guidance Committee Working Conference

Xiao Nanzi. (2003). Analysis of the Private Rate of Return of Higher Education in my country and a Preliminary Study on the Cost Sharing Policy of Higher Education (Master's Degree Thesis). Chongqing University.

Bie Dunrong. (2021). Theoretical Basis and Implementation Path of Reconstructing the Continuing Education System. Research on Lifelong Education (04), 9-16+61.

He Fei, Zhu Zhiyong. (2019). Academic or Market-oriented Career-Changes, Reasons and Enlightenment of Doctoral Students' Career Choice. Research on Graduate Education (03), 3-8.

Shen Wenqin, Zuo Yue, Chen Hongjie. (2019). Which doctoral graduates are employed in enterprises? - Based on the survey and analysis of 13 universities in 2016. Degree and Graduate Education (03), 29-35.

Zhang Yi, Li Fengliang. (2015). Where do engineering graduates go?. Research on Higher Engineering Education (02), 100-104.

Fan Jingbo. (2011). Research on the trend of changes in education income in China from 2003 to 2008. Statistics and Information Forum (08), 47-52.

Fan Jingbo. (2014). Research on the income gap of engineering education from the perspective of human capital. Educational Science (01), 1-6.

Gao Yao, Shen Wenqin. (2016). Employment status of Chinese doctoral graduates - based on the analysis of 75 universities directly under the Ministry of Education in 2014. Degree and Postgraduate Education (02), 49-56.

Gao Yao, Liu Xiao, Yi Yanxia. (2016). Employment status of Chinese master's graduates - based on the quantitative analysis of 75 universities directly under the Ministry of Education in 2014. Research on Postgraduate Education (03), 12-19.

Zhu Jianfang, Wang Boqing, Ernst Shijun Duofu. (1995). Research on the personal rate of return of human capital investment in China. Economic Research (12), 55-63.

Ge Yuhao, Deng Jiameng, Zhang Shuai. (2018). Is there gender discrimination in college students' employment? - Based on the method of virtual matching resumes. Economics (Quarterly) (04), 1289-1304.

Bao Wei, Du Qiang, Ma Jialing. (2017). Whether to take academic career as a career: the academic career orientation of doctoral students and its influencing factors. Higher Education Research (04), 61-70.

Xiong Wen. (2008). Research on personal investment decision-making of postgraduate education (Master's thesis). Hunan Normal University.