International Journal of Educational Development 42 (2015) 106–114

Contents lists available at ScienceDirect

International Journal of Educational Development

journal homepage: www.elsevier.com/locate/ijedudev

A study of the rate of return to higher engineering education in China

Jing-bo Fan [a], Cheng-gang Zhang [b,*]

[a] School of Public Administration, University of International Business and Economics, Beijing PR China
[b] School of Social Sciences, Tsinghua University, Beijing, PR China

ARTICLE INFO

Article history:
Received 13 April 2013
Received in revised form 20 April 2015
Accepted 27 April 2015

Key words:
Engineering education
Return to education
Discipline

ABSTRACT

Engineering education comprises 1/3 of the higher education system in China. Currently, participation in engineering education among the educated classes is decreasing. According to the theory of human capital, the rate of return to education influences individual educational choices and student resources available at colleges and universities. Based on responses to the Chinese General Social Survey (CGSS 2003, 2008), descriptive statistics were used to explore the rate of return to higher engineering education in China, and models were developed to estimate the rates of return to education across different disciplines. Results revealed that the rate of return to higher engineering education in China in 2003 was 10.6%, whereas it was 14.7% in 2008. A ranking of the rates of return across higher education disciplines in China revealed that engineering was in an intermediate position, ranking 7th in 2003 and 6th in 2008. Gender differences were evident in the rates of return to engineering education in China, with high rates for males and low rates for females. Females' return rates increased considerably from 2003 (9.7%) to 2008 (14.3), ranking 10th in 2003 and 3rd in 2008. Our results provide a better understanding of the effects of promoting China's engineering education on human capital and the rationality of income distribution with regard to the labor market. These results have significant policy implications for educators and policy-makers.

1. Introduction

In human capital theory, education is no longer regarded as a consumer good; instead, education is a necessary investment that enhances individual competence and productivity. The term "human capital" was first used by Mincer, who analyzed the relationship between human capital investment and personal income differences using theoretical models (Mincer, 1958). During the 1960s, the concept of human capital began to dominate the economics of education, promoting the development of many research fields, such as the rate of return to education, wage determination, and income distribution (Nafukho et al., 2004; Sweetland, 1996; Paulsen, 2001). As the transition toward a market system progresses in China, the wage system has become increasingly responsive to the key components of human capital. The rate of return to education influences individual educational choices and student resources available at colleges and universities. It is apparent that people will spend more money on education if it enhances their personal earnings (Zhong, 2011).

Engineering education[1] refers to teaching the principles related to the professional practice of engineering. Engineering education comprises 1/3 of the higher education system in China, and it has an important role in providing engineering talent to support China's modernization. It consists of the initial education required to become an engineer and any advanced education and specializations that may follow. Additional examinations and supervised training are typically required in order to obtain a professional engineering license. In the current study, engineering education is defined as participating in formal higher education in the discipline of engineering, namely enrollment in formal engineering education programs at colleges and universities. Most of China's enterprises are still at the bottom of the global industry chain. Yet from the perspective of the industry chain, China has the advantage of production and assembly links. However, most of the core components and special materials have to be imported from abroad, and China's distribution and service capabilities are weak.

* Corresponding author. Tel.: +86 10 62788191.
E-mail addresses: fanjb@uibe.edu.cn (J.-b. Fan), zcgice@tsinghua.edu.cn (C.-g. Zhang).

[1] Discipline is the categorization of certain related majors. According to the notice "on the issuance of China < discipline catalog of degree-granting and personnel training (2011)>" issued by the Chinese Ministry of Education, there are 13 disciplines in Chinese higher education: philosophy (01), economics (02), law (03), education (04), literature (05), history (06), science (07), engineering (08), agriculture (09), medicine (10), military science (11), management (12) and art (13).

http://dx.doi.org/10.1016/j.ijedudev.2015.04.010
0738-0593/

Although China had 100 companies enter the most recent Fortune Global 500 list, the appearance of productive, high-tech enterprises were particularly lacking on the list of mainland enterprises. Technological reform and transformation of the mode of economic growth require the cooperation of engineering talents who have experience in higher education and possess strong R&D capabilities. China has strong product capacity in the production chain, yet it is weak in the fields of research, development, technology, and sales.

Education gives a higher production capacity to individual. Many studies have tried to estimate the return to education, that is to say, the effect of an additional year of education on earnings. Return to education refers to the income obtained by an individual or a society that is due to an increase in education. Return to education is the primary type of human capital income. Rate of return to education is an important index for measuring the monetary return to education. A private rate of return to education measures personal monetary income, whereas a social rate of return to education measures social monetary income. The current study focuses on the personal monetary return, which is the increase in personal income caused by progressing through educational levels. The estimated rates of return to education are all private rates of return to education and for the Mincer rate of return. This study focuses on exploring the return to education of degree program in higher engineering education in China.

Understanding individual earnings gets at the very core of social sciences, because it answers questions regarding the very foundations behind human well-being. China provides a valuable context in which to examine issues relating to the rate of return to education. A paradox exists within Chinese engineering education. On one hand, the Chinese employment market has exhibited a strong demand for engineering talent. On the other hand, both the quantity and quality of student resources within engineering education have decreased over the past 10 years. China needs to reflect on its unsustainable growth model and its companies' lack of international competitiveness.

2. Literature review

Studies on the rate of return to education started based on human capital theory, which was proposed in the 1960s, and research has progressed over the past 50 years. Theodore W. Schults proposed human capital theory in the early 1960s and Gary S. Becher, Milton Friedman, and Jacob Mincer made significant contributions to developing this theory. Human capital theory is the critical theoretical framework for examining returns to education. Schultz stressed the importance of population quality improvement for increasing economic development and promoting the welfare of the poor. Understanding individual earnings is at the core of social science as it pertains to the foundations of human well-being. Indeed, insight regarding the determination of earnings supports policy-makers' abilities to develop tactics to promote wealth, ease poverty, and eventually place countries on the path to increased growth and prosperity (Polachek, 2008).

Human capital theory suggests that, as with other types of capital, human capital can improve with investments in education, training, medical care, and other manners; however, education is considered the most important investment. According to this theory, education should not be regarded as a consumer good; rather, it is an investment that enhances human capital and improves personal abilities and social productivity. These improvements are reflected in the labor market through increases in economic growth and personal incomes. Human capital theory suggests that the income from human capital is more equitable than the income from non-human capital in the distribution system. Education may increase personal incomes, which reduces inequality in income distributions. Educational improvement may also narrow the income gap that is caused by differing educational levels.

With the increase in research, other theories, such as the screening theory, specific human capital theory, and labor market segmentation theory, have also been proposed. The current study examines the return to China's higher engineering education programs primarily from the perspective of human capital theory.

The improvements in personal productivity that are due to education are reflected in the labor market via return to education. One long-standing finding is that education has a positive impact on economic outcomes, as education increases knowledge and skills, thereby improving individuals' productivity. Human capital theory explains why wage differentials are increasing. There are wage differentials by education level (Murphy and Welch, 1992). Berger explored the relationship between college students' predicted future earnings and their choice of major (Berger, 1988). Comparisons of rate of returns to education across countries are commonly found in literature. Psacharopoulos examined the economic returns on higher education in 25 countries (Psacharopoulos, 1981, 1989). Gorodnichenko and Peter measured the returns to schooling in Russia and Ukraine from 1985 to 2002 Gorodnichenko and Peter, 2005) and explored the individual characteristics of gender, race/ethnicity, and parental education. Studies have demonstrated that the rate of return to education differ significantly among various groups in society. Barrow and Rouse examined whether the rate of return to education varied by race and ethnicity (Barrow and Rouse, 2005). Bobbitt-Zeher examined the roles of education and gender with regard to the income gap evident for 12,144 individuals (Bobbitt-Zeher, 2007).

In general, higher education results in considerable economic benefits for educatees, and this phenomenon has been confirmed by numerous empirical studies (Song et al., 2008; Perna, 2005; Boarini and Strauss, 2007). Thomas examined three sources of influence on the initial earnings of college graduates and found that graduates from health-related and engineering majors commanded the highest salaries (Thomas, 2000). Internationally, the rate of return to engineering education is generally the highest or relatively high among all majors in higher education. Black, Sanders, and Taylor examined the data from the 1993 American National Survey of College Graduates (NSCG) to analyze the income gaps for graduates of different majors (Black et al., 2003). The results revealed that economics graduates received higher incomes than graduates of any other majors with the exception of engineering graduates, whose incomes were considerably higher than those of economics graduates. Bourne and Dass conducted an empirical analysis of the personal internal rates of return for individuals who received higher education in science and engineering in the developing countries of the Caribbean. The results indicated that the personal rates of return for engineering majors were highest compared to all other majors. The top-ranked majors with regard to internal rates of return were electrical and computer engineering, civil engineering, mathematics and computer science, chemical and process engineering and mechanical engineering (Bourne and Dass, 2003). Additional studies have examined the rates of return to education (Bell, 2010; Wahrenburg and Weldi, 2007).

A number of studies have focused on higher education issues; however, few studies have examined the rate of return to engineering education, and even fewer studies have focused on the rate of return to Chinese engineering education. The present paper aims to study the rate of return to Chinese higher engineering education and to compare this rate with the rates of other disciplines. This study will provide insight regarding the influence of promoting China's engineering education on human capital, the degree to which human capital value is realized in the