Education and Inclusive Growth[1]

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Abstract

This study investigates empirically how educational attainment has contributed to economic growth and income distribution, using cross-country data between 1980 and 2014. The growth accounting exercise shows that an increase in average years of schooling was a significant factor of economic growth, contributing to about 0.4% point of per worker GDP growth on average for the 99 countries. Cross-country panel regressions also confirm that educational expansion, especially at secondary and tertiary levels, played a positive role for economic growth. It was also a major driver for improving distribution of education and income in population: about three additional years of the average schooling was estimated to contribute to reducing the income Gini coefficient by 1.3% points on average. Policies promoting good quality education access to all people are important for inclusive economic development. Moreover, preparing workers for adequate skills in the rapid

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development of digital technologies and automation is a key challenge to support innovation and productivity growth as well as inclusive labor markets.

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Introduction

Education, which entails the acquisition of information, knowledge, skills and values, is an important means to personal development, as well as a basis for national development. The subject - a role of education for economic, political and social development - has been studied by a lot of researchers across many disciplines including economics, education, politics, and sociology. Confucius, in ancient times, said "A jade without chiseling will not become a useful object. A man without learning will not know the way. The rulers should put education first to govern the state and manage people (The Book of Rites)[3]. In human capital theory by Becker (1964) and Mincer (1974), educational attainment is a key component of human capital held by an individual, thereby determining lifetime earnings in labor markets.[4]

The modern economic growth theories explain the aggregate level of human capital, particularly that attains through education, as a critical

[3] 玉不琢，不成器；人不學，不知道。是故古之王者，建國君民，教學為先。《禮記・學記》

[4] Educational capital is considered as a main component of human capital. However, human capital can be more broadly defined as comprising other factors such as health, job experience and skills.

determinant of economic growth over the long run (Lucas, 1988; Mankiw, Romer, and Weil, 1992). Education improves the efficiency of individual workers, by enabling them to perform complex tasks and adapt to the evolving needs of the production system. A pool of well-educated workers builds up the nation's innovative capabilities that help its economy to move up the value chain and to produce more sophisticated, high-value products. In addition, the level of educational attainment has a strong positive impact on social and political outcomes, such as fertility, the education of children, democracy, and the rule of law, which are major determinants for long-term economic performance (Barro and Lee, 2015).

In recent decades, rising income inequality has attracted attention. In many countries, alongside income growth, income inequality has increased (Piketty, 2014). In particular, many East Asian economies once praised as a "miracle of "growth with equity, have also witnessed the deterioration of income distribution in the past 10 years (Jain-Chandra et al., 2016; Lee and Lee, 2018).

Educational attainment embodied in a worker is a major determinant of his or her lifetime earnings, and consequently affects the degree of income inequality in a society. At household level, educational investment in children is regarded as a major device to improve their future earnings. Public spending on education is believed as a highly effective tool for reducing educational inequality and consequently making income distribution more equal.

The purpose of this study is to assess quantitatively the role of education in income growth and distribution across economies in the long run. Although the importance of education is well-acknowledged by the public and policymakers, the effects that education have for income growth and distribution across the population over long periods of time is not always clear in empirical studies. This is largely because identifying the exact contribution of education to

economic growth and income inequality requires controlling for that of other determinants such as technological progress. It is a challenging task to address the identification issue, especially in intertemporal, cross-national contexts. This paper attempts to analyze the exact contribution of education to economic growth and income inequality after controlling for that of other important factors. It contributes to the existing literature by using an updated data set covering a broad range of countries for the period between 1980 and 2015.

The remainder of this paper is organized as follows. Section 2 presents the estimates of educational attainment across countries and discusses the evolution of average educational attainment and its distribution for 138 countries over the sample period. Section 3 assesses the contribution of education to economic growth based on the growth accounting and regression approaches. Section 4 analyzes the role of educational attainment and its distribution on income inequality. Section 5 discusses the role of education in preparing current and future workers for adequate skills in response to rapid technological progress and evolving demands in the labor market . Section 6 concludes.

Evolution of Educational Attainment and Inequality

For the measure of educational attainment, this study uses the average years of schooling for the working-age population, constructed by Barro and Lee (2013, 2015). This dataset is constructed for a large number of countries based on actual census and survey observations on attainment. Missing observations are imputed by using enrollment-ratio and population structure data. The latest dataset provides estimates of educational attainment for the populations, aged 15 and above, of 146 countries at five-year intervals from 1950 to 2010 and projections from 2015 to 2040. The estimates are disaggregated by gender and

five-year age intervals. The data set distinguishes between seven different levels of education: no formal education, incomplete primary, complete primary, lower secondary, upper secondary, incomplete tertiary, and complete tertiary. Hence, the dataset provides the estimates of educational attainment, measured by the average years of schooling, among the adult population at all educational levels as well as at the primary, secondary, and tertiary levels.

The average number of years of schooling for the population aged 15–64, S, is defined as follows:

(1) $S = \sum_a \sum_j dur_j^a \; l_j^a$, a = 15 – 19, ⋯, 60 – 64

where dur_j^a is the duration of education level j, corresponding to seven different levels of education for five-year age population group a, and l_j^a is the fraction of population group a that has attained education level j.

The average years of schooling among the adult population provides an internationally comparable measure of educational capital stock or human capital stock owned by an average worker. It assumes that a group of population with no formal education do not possess any human capital and human capital stock accumulates proportionally to the duration of schooling.

An alternative measure of human capital stock (h) assumes a Mincerian log-linear relationship between the number of years of schooling and human capital, such that

(2) $h = \sum_a \sum_j e^{\theta_j^a \; dur_j^a} \; l_j^a$.

where θ_j^a measures the efficiency of a unit of labor from population group a with education level j, relative to that of labor without any schooling. It indicates the marginal return to an additional year of schooling at level j, which can be derived from education/wage profiles. Hence, human capital per worker, h, is measured by the sum of the shares of workers weighted by relative wage rates across all education levels. If the marginal rate of return to a year of

schooling is constant for all education levels and everyone attains the same level of schooling, Equation (2) can be further simplified to $h = e^{\theta S}$ [5]

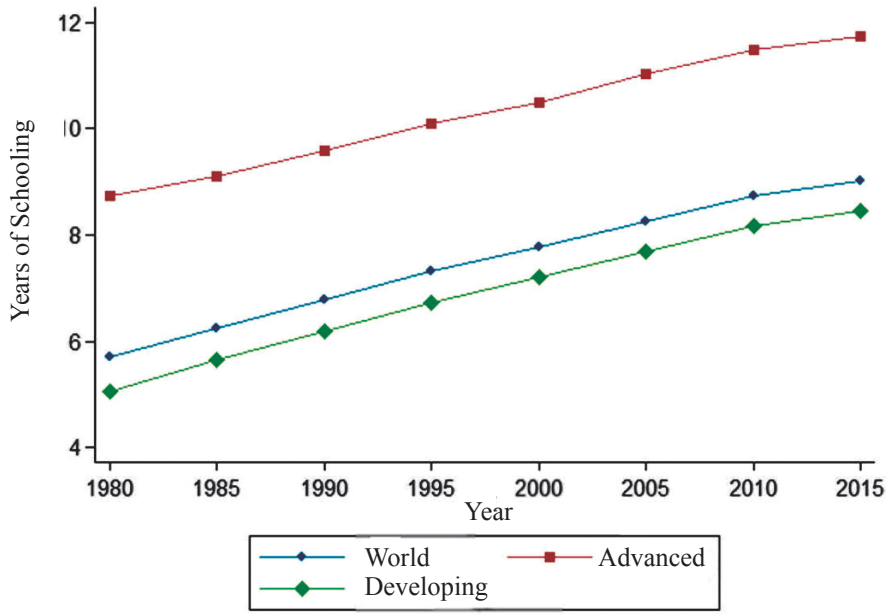

Figure 1. Trends of Educational Attainment from 1980 to 2015 for 138 Economies

Figure 1 presents the trend of educational attainment from 1980 to 2015 for the 138 countries that have complete information. The figures are unweighted averages for all the countries in the sample ("the world) and those in the groups of advanced and developing countries. As can be seen in Figure 1, there has been dramatic expansion of education worldwide and within the group, largely

[5] Lee and Lee (2016) analyze the evolution and distribution of human capital stock worldwide and across nations based on a Mincer-type human capital measure, compared to average years of schooling.

due to increases in school enrollment, especially at the secondary and tertiary levels in the earlier periods (Barro and Lee, 2015). Nevertheless, there remains a substantial gap between advanced and developing countries.

The empirical literature commonly uses two measures of educational inequality: the standard deviation of schooling (De Gregorio and Lee, 2002) and the education Gini coefficient (Castelló and Doménech, 2002; Lee and Lee, 2018). This study adopts the education Gini coefficient for the measure of educational inequality. Figure 2 shows that educational inequality, measured by the education Gini coefficient, has declined continuously in all groups during the sample period. The income distribution in advanced countries is, on average, much more equal than that in developing countries.

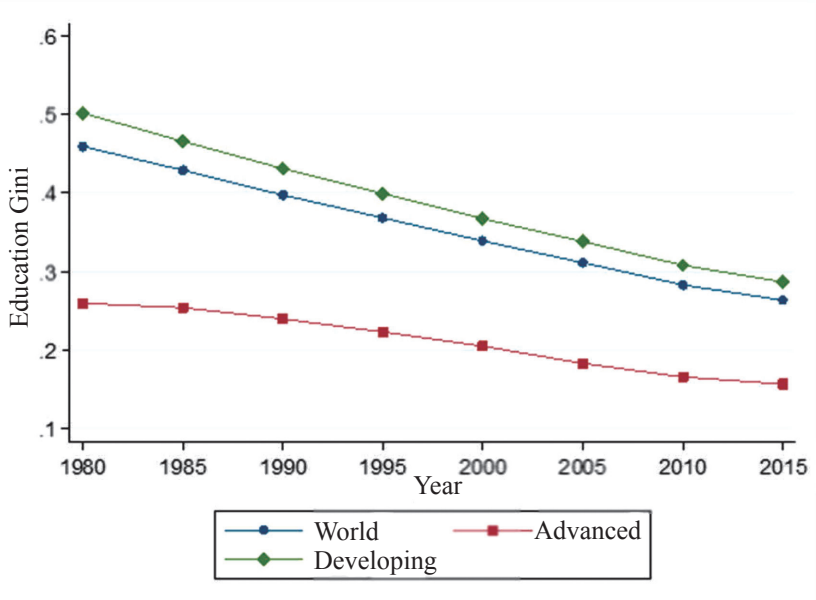

Figure 2. Trends of Educational Inequality from 1980 to 2015 for 138 Economies

The trend of educational inequality contrasts to that of educational attainment which is upward as shown in Figure 1. This reflects that educational expansion tends to improve educational distribution. In a society in which only a small fraction of the population has received formal education, the average educational attainment is low and the educational inequality is high. With an expansion of educational attainment, the level of educational inequality would decrease if the uneducated people received some education. Educational attainment has a strong negative relation with educational inequality for the 138 countries in terms of both level and change as shown in Figures 3 and 4, respectively. This implies that the expansion of education of less-educated population contributed to reducing the level of educational inequality across economies during the sample period.

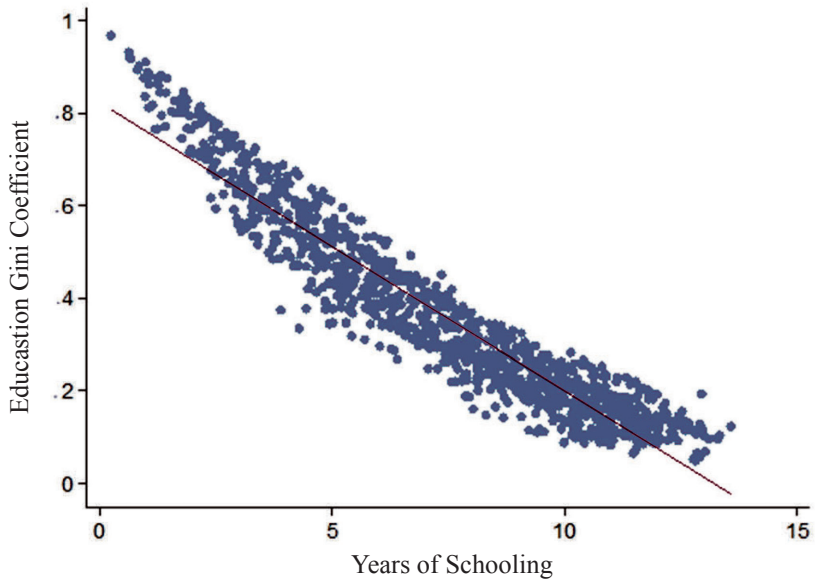

Figure 3. Relationship between Educational Inequality and Educational Attainment, Five-Year Intervals from 1980 to 2015

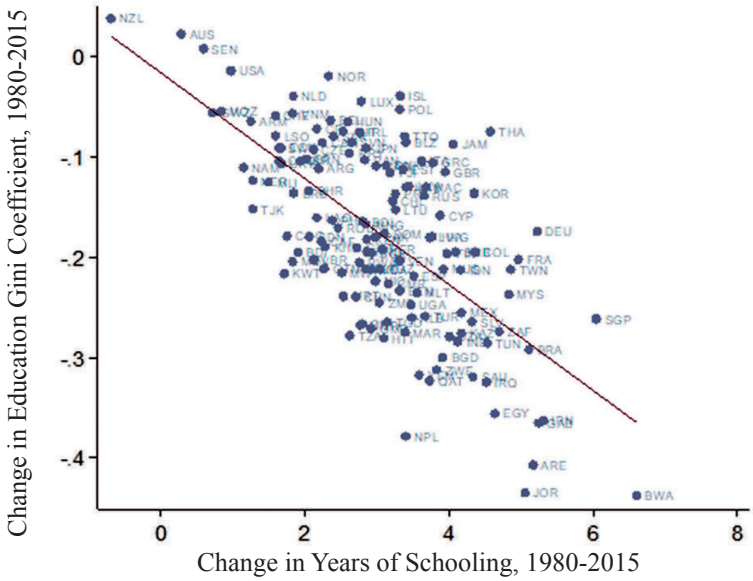

Figure 4. Change in the Educational Attainment and Education Gini Coefficients from 1980 to 2015

However, despite improvement in educational inequality and attainment, economic growth has declined with widening income inequality in many countries in recent decades. This contrasts to our expectation that an increases in the average educational attainment and educational equality tend to improve both income growth and distribution. This trend is puzzling. There must be other important contributing factors of economic growth and income distribution, such as technological development and international trade. Hence, assessing their roles are essential to identifying the exact contribution of education to growth and distribution.

Role of Education in Output Growth

This section appraises the contribution of education to output growth using country-level data based on two standard approaches (Barro and Sala-Martin, 2004). The first one is based on the conventional Solow-type growth accounting. The basic assumption of this approach is that an increase in educated workers raises output through the improvement of labor productivity, controlling for other contributing factors such as physical capital stock and technological advances. The other one is cross-country regression which assesses the contribution of education or human capital to differences in growth rates of per worker output across economies while controlling for other important growth determinants.

The growth accounting methodology proposed by Solow (1958) decomposes the growth rate of the total output of an economy into components associated with changes in factor inputs and total factor productivity (TFP), which reflects technological progress.

Let's assume a standard production function such as

(3) $Y = F(K, H, A) = F(K, h \times L, A)$

where Y is real output, K the stock of physical capital, and H labor input, and the A measures the level of technology or TFP. Here, labor input H is a concept of the overall labor input or human capital stock. The aggregate labor input is defined as $H = h \times L$ where L is total work-hours (or number of workers) and h is a measure of labor quality or average human capital stock per worker which reflects an increase in the average years of schooling for the labor force.

Then, based on the growth accounting approach, the growth of output Y can be easily decomposed into the contribution of four productive components:

(i) growth in physical capital stock; (ii) growth in labor input; (iii) growth in human capital per worker; and (iv) TFP growth.

$$(4)\ \frac{dY}{Y} = v_K \cdot \frac{dK}{K} + v_H \cdot \frac{dH}{H} + \frac{dA}{A}$$

where dX/X represents the percentage rate of change of the variable X, and v_K and v_H are the share of capital and labor income respectively. If the production function exhibits constant returns to scale in K and H, all the income associated with the real output Y is attributed to capital and labor. That is, $v_K + v_H = 1$. In this case, Equation (4) can be also expressed in per worker terms as follows:

$$(5)\ \frac{dY}{Y} = (1 - v_H) \cdot \frac{dK}{K} + v_H \cdot \frac{dH}{H} + \frac{dA}{A}$$

Then, the growth of output per worker ($y \equiv Y/L$) is decomposed into three components: the growth in physical capital per worker ($k \equiv K/L$), the growth in human capital per worker (h) and the total factor productivity growth (A). Hence, we can measure the contribution that human capital made to per worker output growth.

The growth accounting is applied to a broad number of countries over the period 1981-2014 using data on GDP and physical capital stock from the Penn-World Tables (PWT) 9.0 (Feenstra, Inklaar, and Timmer, 2015). Labor shares by countries and over time are also available from the PWT 9.0. The working-age population is sourced from the United Nations (2015).

The overall labor input is an aggregate of all labor inputs classified in seven educational levels, weighted by the relative productivity (or relative wage rates), as in Equation (2). While no detailed data on wage rates for all individual countries is available, international data on the education-wage profiles derived from the Mincerian equation are compiled for a broad number of countries by Psacharopoulous (1994). In this approach, the wage rates of workers are constructed based on the assumption that the marginal rate of return to an

additional school year is constant to be 10%, the world average of return rates in Psacharopoulous (1994), for all countries.

Table 1 reports results of the growth accounting decomposition for the overall sample period of 1981-2014 and three sub-periods— 1980s, 1990s, and 2001–2014—for 99 countries that have complete data. The figures are the weighted averages for the groups of all the countries across the world, advanced and developing countries by using country's share in world GDP.

Table 1 Growth Accounting for GDP per Worker, 1981–2014

Group (no. of countries)	Growth Rate of per-worker GDP	Contribution from		
		Physical Capital per Worker	Human Capital per Worker	TFP Growth Rate
World (99)				
1981–1990	0.019	0.0105 (55.4%)	0.006 (31.5%)	0.0025 (13.2%)
1991–2000	0.0224	0.0116 (51.6%)	0.0063 (28%)	0.0046 (20.3%)
2001–2014	0.0247	0.0144 (58.4%)	0.0035 (14.3%)	0.0068 (27.4%)
1981–2014	0.0233	0.0128 (54.9%)	0.0041 (17.5%)	0.0064 (27.6%)
Advanced (24)				
1981–1990	0.0224	0.0108 (48.3%)	0.0054 (24.3%)	0.0061 (27.4%)
1991–1900	0.0195	0.0093 (47.5%)	0.005 (25.7%)	0.0052 (26.8%)
2001–2014	0.0095	0.0062 (65.8%)	0.0028 (29.5%)	0.0004 (4.6%)
1981–2014	0.0162	0.0084 (51.9%)	0.0029 (17.7%)	0.0049 (30.4%)
Developing (75)				
1981–1990	0.0117	0.0098 (83.6%)	0.0071 (60.3%)	-0.0051 (-43.9%)
1991–2000	0.0276	0.0157 (56.9%)	0.0086 (31%)	0.0033 (12%)
2001–2014	0.041	0.0232 (56.5%)	0.0043 (10.5%)	0.0135 (33%)
1981–2014	0.0307	0.0173 (56.5%)	0.0045 (14.7%)	0.0088 (28.8%)

Notes: Data are sourced from the PWT 9.0 and the Barro–Lee human capital data (www.barro-lee.com). GDP growth is an average annual GDP growth rate over the period, weighted by country share in current price real GDP. The contribution of physical capital per worker, human capital per worker and TFP is the rate of per-worker GDP growth weighted by the country's income share.

As can be seen in Table 1, the average per worker GDP growth rate for the 99 countries over the entire sample period was 2.3% per year. The growth rate was 1.9% in the 1980s, and since then has risen to about 2.2~2.4%.

The average per worker GDP growth rates over 1981–2014 was 1.6% for the sample of 24 advanced countries and 3.1% for the sample of 75 developing countries. In the advanced countries, the average per worker GDP growth rates dropped from about 2.2% in the 1980s to about 2.0% in the 1990s and then further to about 1.0% in the period of 2001–2014. The significant decline of per worker GDP growth rate since the 2000s reflects the impacts of the global financial crisis that hit advanced economies more severely since 2008. In contrast, for developing countries the average per worker GDP growth rates accelerated from 1.2% in the 80s to 2.8% in the 1990s and further to 4.1% in the latest period.

Table 1 presents that the contribution of human capital accumulation (increase in average years of schooling) to economic growth is sizeable worldwide. The annual growth rate of per worker GDP explained by human capital is estimated on average to be about 0.4% point from 1981 to 2014 for the 99 countries in the world, amounting to about 18% of per worker growth over the period. The contribution of human capital to per worker GDP growth rate was greater in the 1980s and the 1990s, about 0.6% point (about 28~32% of annual per worker GDP growth), and then declined to 0.35% point (about 14%) in the 2001–2014 period for the world. It is slightly larger in the group of developing countries, about 0.45% point, compared to about 0.3% in the group of advanced countries in the overall period.

Figure 5 depicts per worker output growth rates and its sources for the three sub-periods and for the entire sample period. The growth accounting exercise implies that human capital is a significant factor for economic growth, but its

contribution to per worker GDP growth is smaller than that of physical capital per worker throughout the period. Compared to that of TFP, it was larger in the 1980s and the 1990s but became smaller in the recent period.

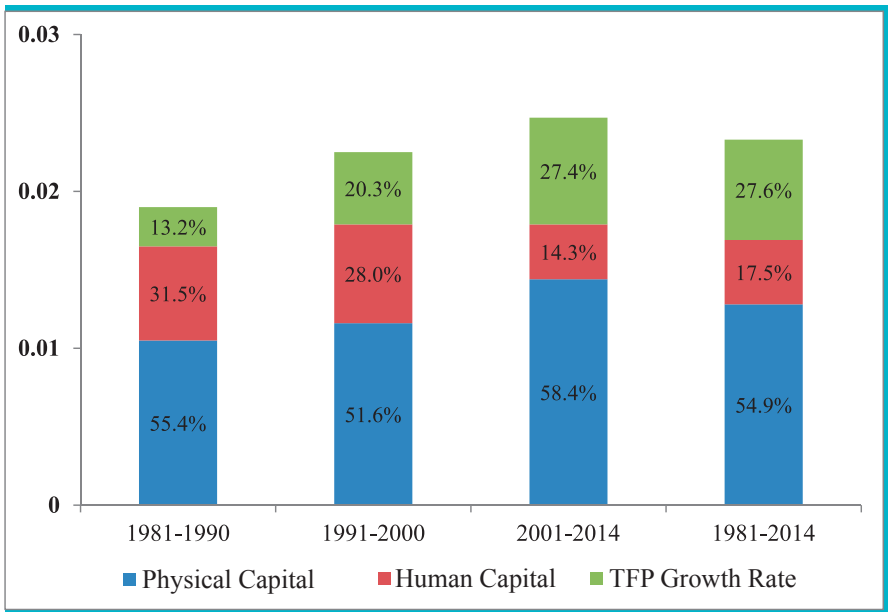

Figure 5. Growth Accounting for Per-Worker GDP Growth of 99 Economies, 1981-2014

These results, however, do not necessarily undervalue the contribution of human capital. The growth accounting method provides only a mechanical decomposition, and it is limited to consider the interactions among the productive components – human capital, physical capital accumulation and TFP – for output growth. An abundant human capital stock can have a positive effect on physical capital accumulation and technological progress (Romer, 1990). Conversely, physical capital accumulation and skill-biased technological

change can raise the relative demand for skilled workers and skill premium, thus promoting human capital accumulation. By ignoring those interactions, the growth accounting result can over- or under-estimate the true contribution of human capital to output growth. In addition, growth accounting does not explain where the growth of inputs and total factor productivity comes from. The result does not necessarily imply a causal effect of human capital in explaining the growth rates of per worker output across economies over time. For example, some exogenous factors can increase both educational attainment and output.

As an effort to identify the independent impact of human capital on output growth, researchers have adopted a regression-based approach. After controlling other important explanatory variables, the framework allows us to investigate the independent role of educational attainment, measured by overall years of schooling, in economic growth (Barro, 1991; Barro and Lee, 1994 and 2015). The regression often adopts cross-country panel data in order to explain differences in growth performance across country,

The basic empirical framework is expressed as

$$(6)\ Dy_{it} = \beta_0 + \beta_1 \log(y_{i,t}) + \beta_2 h_{i,t} + \beta_3 X_{i,t} + \varepsilon_{i,t}.$$

where Dy_{it} is country i's per worker GDP growth rate in period t, $y_{i,t}$ is country i's per worker GDP at the beginning of period t, $h_{i,t}$ is average years of schooling at the beginning of period t, and $x_{i,t}$ indicates a wide variety of external environmental variables that influence long-term GDP growth rates. As suggested by previous empirical researches, investment rate, institutions, fertility, international trade, inflation and other policy factors are major determinants of long-run per worker output (Barro and Xala-i-Martin, 2004; Barro and Lee, 2015).

As can be seen in Equation (6), the estimate of the coefficient β_2 measures the impact of initial educational stock on subsequent per-worker output growth

for the given values of initial per worker output and the external environmental variables of $X_{i,t}$ Most of previous researches find a positive value of β_2 indicating that a higher level of human capital, proxied by educational attainment of the working-age population, tends to increase output growth, controlling for other important factors.

However, previous empirical studies based on cross-country regressions often estimate statistically insignificant coefficient for the overall years of schooling, indicating a weak or insignificant effect of overall educational attainment on output growth (Pritchett, 2001; Barro and Lee, 2015). This result may come from the inaccuracy of the average years of schooling as a measure of human capital stock, for example, because it does not take account of differences in the quality of schooling across countries and over time. It may also come from that not years of overall schooling but those of schooling at some specific levels matter for economic growth. Some empirical studies, such as Barro and Lee (1994, 2015), finds that only secondary and tertiary levels of schooling are important, implying that workers with high educational attainment stimulate physical capital accumulation and facilitate technological progress, thereby contributing to per worker GDP growth.

An interesting result from cross-country regressions is that female educational attainment enters positively while male attainment enters negatively (Barro and Lee, 2015). Thus, an increase in female school attainment—for given values of male educational attainment and other explanatory variables—has a positive effect on economic growth. This could be interpreted as that raising female's educational attainment level up to male's would create better economic and social environments that are more favorable for economic growth.

Education and Income Inequality [6]

Consistent with our belief, the human capital model indicates that educational attainment and its distribution across the population affects the degree of income inequality in a society (Becker and Chiswick, 1966; Mincer, 1974). Under this model, educational inequality is positively associated with income inequality, if other things are controlled for. In addition, the effect of the average years of schooling on income inequality is expected to be either positive or negative, depending on the correlation between educational attainment and the rates of return on education. An increase in average years of schooling tends to magnify the variance of wage among workers, given the rates of return on education or wage rate, and thus lead to a higher level of income inequality. Meanwhile, if an educational expansion increases the proportion of higher-educated workers and thus reduces the wage premium, more equal income distribution is likely to be achieved.

The findings of the previous studies using macro- and micro-level data are broadly consistent with the predictions of the human capital theory. Overall, educational inequality has an unequalizing effect on income distribution, while educational expansion has an ambiguous effect on income distribution when controlling for other important factors (Lee and Lee, 2018). If educational expansion tends to reduce educational inequality, as shown in Figures 3 and 4, it can have an additional equalizing effect on income distribution.

In order to identify the relationship among educational expansion, educational inequality and income inequality, Lee and Lee (2018) adopt the

6 See Lee and Lee (2018) for detailed discussion.

following empirical framework:

$$(7)\ Income\ Gini_{I,t} = \beta_0 + \beta_1\ Education\ Gini_{\ I,t-1} + \beta_2\ Educational\ Attainment_{\ I,\ t-1} + \beta_5\ X_{i,t} + \varepsilon_{\ i,} + \eta_{\ t,} + u_{\ i,t},$$

$$(8)\ Education\ Gini_{\ I,t} = \gamma_0 + \gamma_1\ Educational\ attainment_{\ I,\ t-1} + \gamma_{\ 2}\ Income\ Gini_{\ I,\ t-1} + \gamma_3\ Z_{i,t} + \varepsilon_{i,} + \eta_{t,} + \psi_{\ i,t}$$

where $X_{i,t}$ and $Z_{i,t}$ denote a group of environmental and policy variables that influence country i's income inequality and educational inequality respectively. The environmental variables in Equation (7) include per capita GDP and its square term, based on Kuznets (1955), and policy factors including trade openness, inflation, government consumption, social benefits spending, a democracy indicator, and technological progress (i.e. number of patents). Equation (8) considers the same set of environmental variables in Equation (7) except per capita GDP square and social benefits spending and adds public educational spending.

These regressions apply to a panel set of cross-country data for 95 economies over seven five-year periods from 1980 to 2015.[7] In Equation (7), the dependent variable is the net Gini coefficient of income distribution, sourced from the Standardized World Income Inequality Database (SWIID) that Solt (2016) compiled. In Equation (8), the dependent variable is the Gini coefficient of educational distribution. The estimation technique is a panel data regression with country fixed effects, which controls for possible bias due to unobserved and persistent country characteristics that influence the dependent variables. To reduce reverse causality, we use lagged values of educational variables in

7 See Lee and Lee (2018) for the details of the data and the estimation results with different specifications and estimation techniques.

Equation (7) and of income Gini and educational attainment in Equation (8).

Table 2 Regressions for Income Gini and Education Gini

	(1)	(2)
Dependent variable	Income Gini	Education Gini
Educational Gini $_{t-1}$	0.117***	
	(0.044)	
Educational attainment $_{t-1}$	0.0019	-0.0352***
	(0.0031)	(0.0027)
N of obs., countries	600, 95	600, 95
R^2	0.134	0.818

Source: Lee and Lee (2018)

Notes: The regressions are applied to an unbalanced panel data set for 95 economies over seven five-year periods from 1980 to 2014. The dependent variable is the net income Gini coefficient in regression (1) and the Gini coefficient of educational distribution in regression (2). The regressions include other important explanatory variables including per capita GDP, trade openness, inflation, government spending variables, a democracy indicator, and patent and control for country-fixed effect. Standard errors are in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 2 summarizes the estimation results. Educational inequality has a significantly positive effect on income inequality when controlling for environmental and policy variables with country fixed effects. The estimated coefficient, 0.117, in Column (1) suggests that an increase in the education Gini coefficient of one standard deviation, 0.18. increases the income Gini coefficient by about 2.1% points, which accounts for about 23% of the standard deviation of the income Gini coefficient. In contrast, educational attainment has a

statistically insignificant effect on income inequality when controlling for other variables including educational inequality.

The result in Column (2) shows that educational expansion was a major driver for improving educational distribution. Hence, the average level of educational attainment can have an indirect effect on income inequality by changing educational inequality. The estimated coefficient of educational attainment, -0.035, suggests that an increase in the average schooling of about three years, that is about one standard deviation, decreases the education Gini coefficient by about 0.11, which accounts for about 60% of the standard deviation of the education Gini coefficient. This reduction of educational inequality is expected to decrease income Gini by about 1.3% point. Therefore, increase in educational attainment is the major driver improving the education Gini coefficient, thereby affecting income distribution.

The results of Equations (7) and (8) reported in Lee and Lee (2018) show that fast income increase, trade expansion, and rapid technological progress were the main causes of the rising income inequality in many economies in recent decades and the improved educational attainment and inequality played important roles in mitigating these income-unequalizing forces. Considering the policy variables, higher social benefit expenditures contributed to reducing income inequality, and higher public spending helped narrowing educational equality, thereby implicitly improving income inequality.

Education, Skills and Technology

Empirical findings in the previous sections suggest that strong educational expansion played a major role for sustained and equitable economic growth in the last three decades. However, critics point out the supply of skilled workers

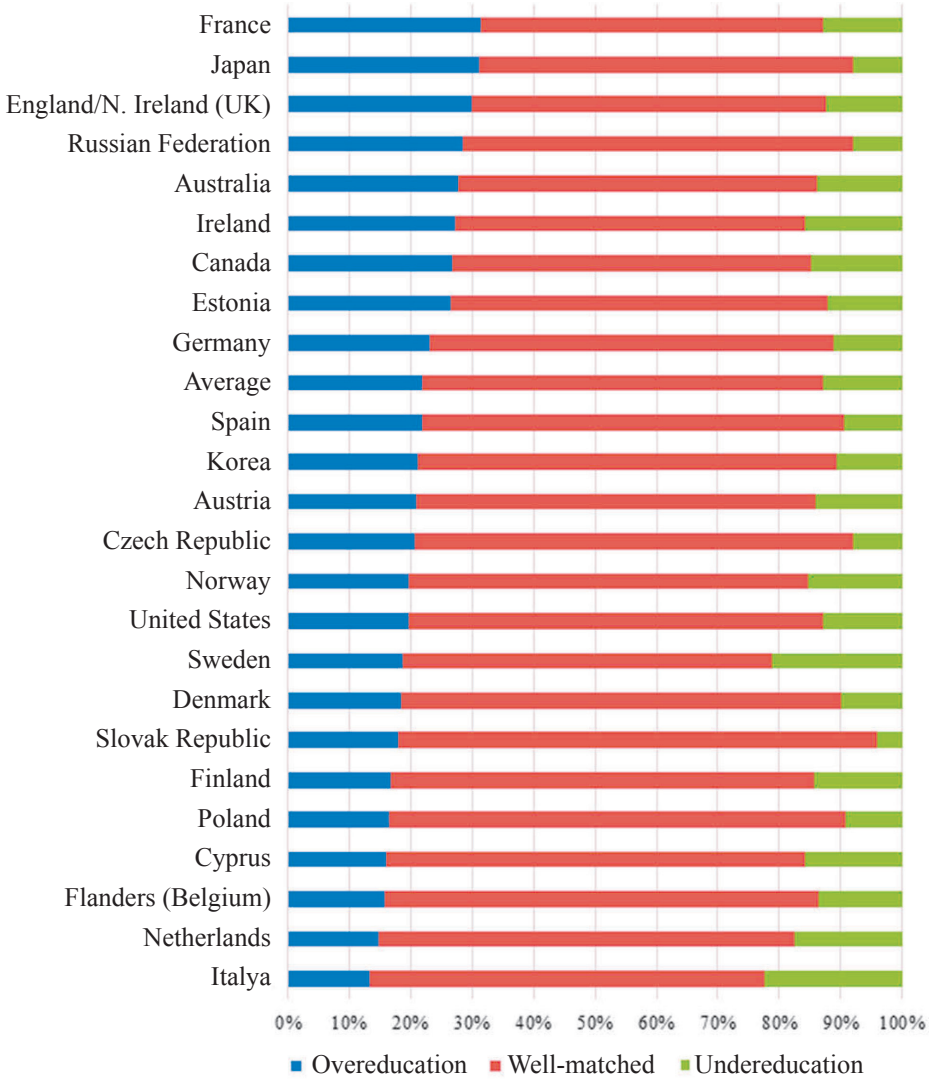

Figure 6. Shares of Over-education, Well-matched Education, and Under-education in PIAAC Data

Source: Author's construction from OECD (2013).

that reflect the strong growth of a better-educated population has not adequately matched with changing demand in the labor market.

The knowledge and skills gained at formal education system often fail to produce graduates with adequate skills and technical competencies relevant to the labor market. According to a survey by the Economist Intelligence Unit (EIU 2015), 64% of the executives surveyed were dissatisfied with the level of attainment of young employees and 52% pointed out a skills gap as an obstacle to the firm's performance. Meanwhile, only 44% of the students aged 18 to 25 believed that their education system provided adequate skills.

OECD's Programme for the International Assessment of Adult Competencies (PIAAC) shows prevailing mismatches between the skills acquired in education and those required in the labor market in many countries (OECD, 2013). PIAAC defines well-matched, over- and under-education of workers based on the respondents' educational attainment and their self-assessment about the education level required for their job. Figure 6 shows the shares of over-education, well-matched education, and under-education for 24 countries. The incidence of mismatch is substantial: on average, 22% of the workers are over-educated while about 13% are under-educated. Note considerable variations across countries. The share of over-educated workers ranges from less than 15% in Italy and the Netherlands to over 30% in France and Japan, while the share of under-education ranges from less than 8% in the Slovak Republic, the Czech Republic and Japan to over 20% in Italy and Sweden. The proportion of over-education tends to be higher among the workers with at least over 16 years of education while that of under-education tends to decrease with attained educational level.

The emergence of a skills mismatch is a serious concern, causing unemployment, underemployment and job dissatisfaction. In Korea, for

instance, unemployment rates of university graduates have been rising in recent years, while many employers often lament their difficulties in filling vacancies. Over-educated workers suffer a wage penalty for their surplus schooling. Lee, Lee and Song (2016) find that the estimated return from an overeducated year is significantly lower than that from a year of well-matched education in the Korean labor market.

The skills of the labor force are important for productivity growth and technological progress. The abundance of skilled workers allows firms and industries to foster production efficiency and innovation capabilities. Hanushek and Woessmann (2012) show a strong positive relationship between cognitive skills and economic growth across nations. Hanushek at al. (2015) report the positive effects of adult cognitive skills on wages after controlling years of schooling and other major determinants. In addition, some recent work provides quantitative evidence for the significant role of noncognitive skills including motivation, self-esteem. perseverance and acceptance of social norms in employment and wages (Heckman, Stixrud, and Urzua, 2006).

Recent advances in information and communication technologies (ICTs) and the acceleration of automation require new type of skills. Robots quickly replace humans for routine and repetitive tasks. Frey and Osbornes (2017) estimate that, 47% of the existing jobs in the United States were at risk of automation. Acemoglu and Restrepo (2017) show that jobs indeed decreased due to the increased use of robots in the US industries. Workers must learn to acquire a broad range of skills— not just technical skill but also non-routine cognitive and interpersonal skills including the 4Cs (critical thinking, creativity, collaboration and communication) that cannot be easily replaced by artificial intelligence (AI) and robots.

Preparing adequate skills for all workers is essential for inclusive

development. The race between skills and technology will determine whether the dividends from new technologies are realized and the benefits widely shared. The recent increase in inequalities of job opportunities and wages that many countries experienced was due to the gap between those who have skills that can make productive use of new technologies, and the others who do not have adequate skills in new technologies (Autor, 2014).

Education has a vital role in preparing workers for adequate skills in response to the current and future demands of the labor market under the environment of rapidly changing technologies. Education system should be able to prepare today's youth for the "skills of tomorrow. With good-quality education starting from early in the life-cycle, all students should be equipped with solid cognitive and non-cognitive abilities as well as ICT skills. By making lifelong learning more accessible, workers must keep their skills up-to-date with new technologies. Governments can provide the strong incentives for employees and firms to continue to re-skill and up-skill voluntarily.

To improve learning outcomes at school and skill training programs, upgrading quality of teachers and school administration system is a key factor (World Bank, 2018). Teachers should be well-trained and qualified. In addition, improving flexibility in curriculum design will make education and training programs more responsive to changing technologies and market demand.

Concluding Remarks

This paper provides evidence that educational attainment plays an important role in both economic growth and income distribution. Growth accounting and regression analyses based on cross-country data show that an increase in average years of schooling contributes significantly to per worker

GDP growth. In addition, it also reduces educational inequality and thus helps to improve income inequality.

Well-designed education and skill policies must be a priority to achieve sustained and inclusive economic growth. During the recent decades, rapid technological progress and trade globalization have caused to widening income inequality, while contributing to economic growth. Out results imply that effective human capital policies, such as inclusive education and training for less-educated and unskilled workers, must be a better policy option to address income inequality by offsetting the negative effects of international trade and technological innovation.

To do so, current education and training system in many countries that falls behind technological progress are subject to reform. In this new era of ICTs and AI, through effective life-long learning, all workers must be equipped with the adequate skills to command and complement with new technologies.

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教育與包容性成長[1]

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摘要

本研究使用1980-2014年間的跨國數據，以實證方法探討教育程度對經濟成長及收入分佈的影響。成長核算顯示，平均受教育年數的增加是經濟成長的重要因素，使99個國家的人均GDP成長率平均約達0.4%點。以回歸法所做的跨國分析也肯定教育擴張對經濟成長的正向作用，尤以中等及高等教育層級的擴張為然。教育擴張也是改善教育分佈及收入分佈的主要驅動力：估計平均受教育年數增加約三年，有助於降低收入基尼係數平均約1.3%點。促使所有人都有機會接受高品質教育的政策對包容性經濟發展至為重要。此外，要支持創新、生產力成長及包容性的勞動市場，讓勞工具備足夠的技能以應數位科技和自動化的快速發展是箇中關鍵挑戰。

關鍵詞：教育、成長、收入分佈、技能

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壹、前言

教育使人習得資訊、知識、技能和價值，個人及國家發展而言至為重要。本文的主題是教育在經濟、政治及社會發展中所扮演的角色，而這是一個經濟、教育、政治和社會等許多領域都做過大量研究的課題。古代的孔子曾說過：「玉不琢，不成器。人不學，不知道。是故古之王者建國君民，教學為先。」（禮記・學記）。而在Becker（1964）和Mincer（1974）的人力資本理論當中，教育程度是個人所擁有的人力資本的關鍵部分，也決定了個人在勞動市場上的終生所得。[3]

現代經濟成長理論將人力資本的總體水平（尤其是透過教育而獲得者）視為長期經濟成長的關鍵決定因素（Lucas, 1988; Mankiw, Romer, and Weil, 1992）。教育使個別勞工有能力從事複雜的工作，並適應生產體系不斷變化的需求，從而提高了勞工的效率。一群受過良好教育的勞工建立國家的創新能力，有助於國家經濟向價值鏈的上方移動，生產更複雜、更有價值的產品。此外，教育程度在社會和政治方面都有很大的正面影響，例如生育率、兒童教育、民主、法治等，都是決定長期經濟表現的主要決定因素（Barro and Lee, 2015）。

最近數十年內收入不平等日趨嚴重的問題已吸引了許多關注。許多國家的收入不平等也隨著收入成長而擴大（Piketty, 2014）。尤其東亞許多經濟體都曾因其「平等成長」的「奇蹟」備受讚美，卻在過去的十年間遭遇收入分配劣化的問題（Jain-Chandra et al., 2016; Lee and Lee, 2018）。

教育程度是決定工人終生所得的主要因素，從而也對社會上收入不平等的程度有所影響。在家庭的層次來看，對子女教育的投資被認為是改善

[3] 教育資本被認為是人力資本的主要部分，但人力資本也可以更廣泛定義為包括健康、工作經驗及技能等其他因素。

未來收入的主要因素。一般認為教育上的公共支出能以高度有效的方式縮減教育不平等，從而使收入分配更為公平。

本研究以量化方式評估教育在各經濟體的長期收入成長及分佈上扮演的角色。雖然公共及政策制定者均肯認教育的重要性，但實證研究顯示，教育對人們長期收入成長及分配的影響並不總是很明顯。這主要是因為教育對經濟成長和收入不平等所造成的影響究竟有多少，需要控制其他決定因素（如科技發展）才能知道。這項辨識工作的挑戰性又因為跨國跨時期的研究而變得更高。本文試圖控制其它重要因素，以分析教育對經濟成長和收入不平等的確切影響。對現存的研究文獻而言，本文的貢獻在於使用從1980到2015年間許多國家的最新數據集。

本文內容的組織方式如下：第二節提出各國教育程度的估算值，並探討樣本時期內138國平均教育程度的演變。第三節以成長核算及回歸分析來評估教育對經濟成長的貢獻。第四節分析教育程度及教育分佈對收入不平等的影響。目前及未來的勞工必須具備足夠的技能，才得以因應技術的快速發展及勞動市場不斷變化的需求，而第五節便探討教育在其中所扮演的角色。第六節則為本文作結。

貳、教育程度與教育不平等的演變

本文使用Barro（2013）及Lee（2015）所建立的勞動年齡人口平均教育年數來衡量教育程度。該數據集以許多國家的人口實查和教育程度調查為基礎。調查闕漏之處則以入學率和人口結構數據來補足。最新的數據集是對全球146個國家15歲及以上人口的教育程度所做的估算，時間為1950到2010年，每五年為一個區段，此外還有2015到2040年的預測。測算數值因性別和五歲級距的年齡區段而有異。數據集將教育程度分為七個水平：無正規教育、不完整的小學教育、完整的小學教育、初中、高中、不完整的高等教育、完整的高等教育。因此該數據是以平均受教育年數來估算教

育程度，涵蓋了所有教育水平的成人人口，以及初等、中等、高等教育水平的成人人口。

15-64歲人口受教育的平均年數S定義如下：

(1) $S = \sum_a \sum_j dur_j^a \, l_j^a$, a = 15 – 19, ⋯, 60 – 64

dur_j^a 表示教育水平j的持續時間，與五歲年齡區段內共七個不同教育水平的人口群體a相對應，l_j^a 則是已達教育水準j的人口群體a的分數。

成人人口的平均教育年數是個衡量標準，可就一個普通勞工所具有的教育資本存量或人力資本存量在國際間進行比較。它假設沒有受過任何正規教育的人口群體沒有任何人力資本，而人力資本存量與受教育年數成比例的積累。

另一個人力資本存量的替代算法（h）假設受教育年數和人力資本之間存在著Mincer式的對數線性關係，如：

(2) $h = \sum_a \sum_j e^{\theta_j^a \, dur_j^a \, l_j^a}$

θ_j^a衡量人口群體a當中教育程度j的單位勞動效能，相對於不曾受過教育者。這顯示在教育程度j級上多受一年教育的邊際回報，可以從教育／薪資概況中得知。因此，每個勞工的人力資本h，是以所有教育水平上相對薪資加權後勞工份額的總數來計算。若多受一年教育的邊際回報在所有教育水平上都維持不變，且每個人都達致同樣的教育水準，則方程式（2）可以進一步簡化為$h = e^{\theta S}$。[4]

圖1顯示1980-2015年全球138個有完整資料的國家其教育程度的演變趨勢。這些數字是樣本中的所有國家（即全球）、發達國家和發展中國家的未加權平均數值。如圖所示，教育在全球和各群體當中都有戲劇性的擴展，主因在於入學數的提高，又以較早時期的中等及高等教育為然（Barro and Lee, 2015），但發達國家和發展中國家之間的鴻溝依然存在。

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4 Lee和Lee（2016）以Mincer型的人力資本衡量標準（相對於平均受教育年數）為基礎，分析了各國及全球人力資本存量的演變和分佈。

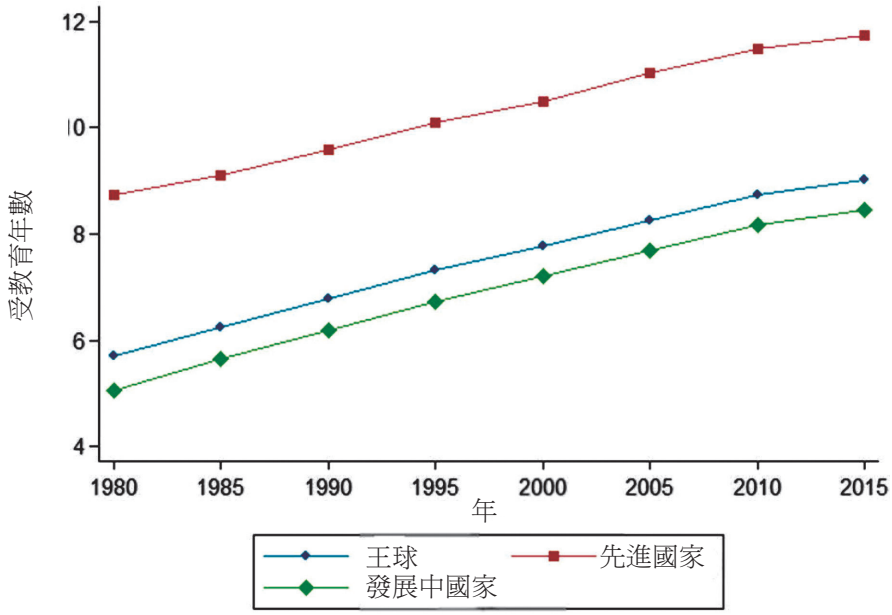

圖 1　1980-2015 年共 138 個經濟體教育程度的演變趨勢

實證研究通常使用兩種標準來衡量教育不平等：學校教育的標準差（De Gregorio and Lee, 2002）及教育基尼係數（Castelló and Doménech, 2002; Lee and Lee, 2018）。本研究以基尼係數來衡量教育不平等。圖2顯示，以教育基尼係數測量所得的教育不平等，在同一樣本時期內，在所有群體當中都持續的衰退。發達國家中的薪資分佈整體而言較發展中國家平等。

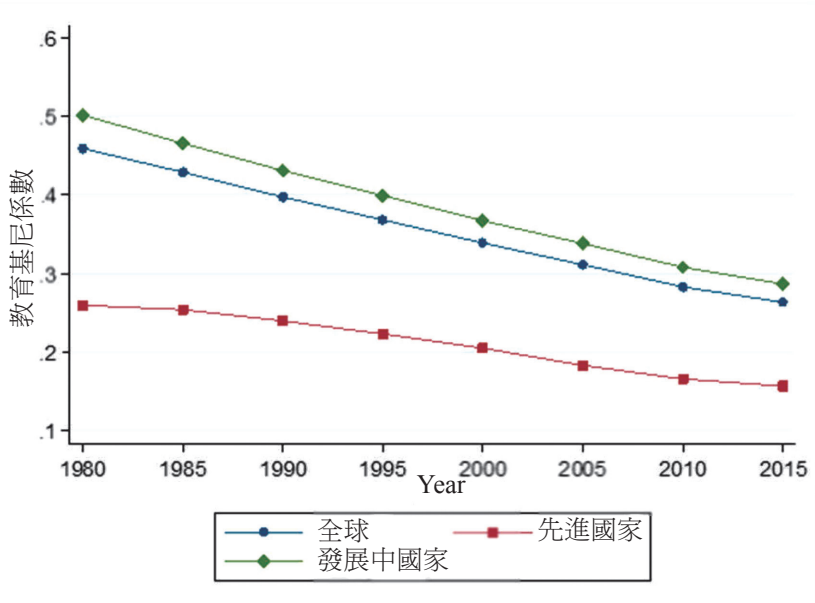

圖 2　1980-2015 年 138 個經濟體的教育不平等的演變趨勢

教育不平等的演變趨勢與向上的教育程度的演變趨勢形成對比，如圖2所示。這顯示教育擴張往往能夠改善教育分佈。一個只有少數人口接受過正規教育的社會，其平均教育程度低而教育不平等高。隨著教育程度的擴張，若未受教育的人得以些受一些教育，教育不平等便會降低。教育程度和教育不平等之間存在著強烈的負相關，這在138國皆然，圖3和圖4分別顯示程度和變化。這意味著教育程度低的人口間的教育擴張，有助於降低同一樣本期間內各經濟體教育不平等的程度。

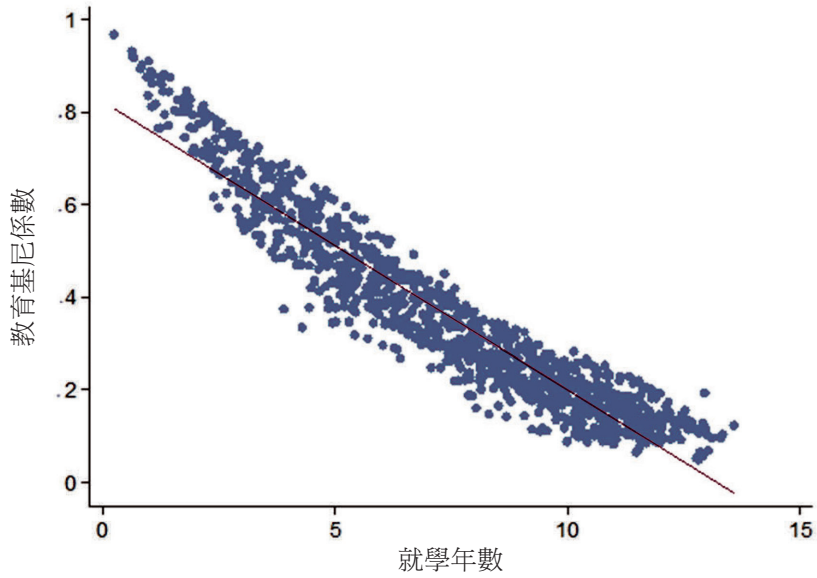

圖 3　教育不平等與教育程度的關係，1980-2015（級距：五年）

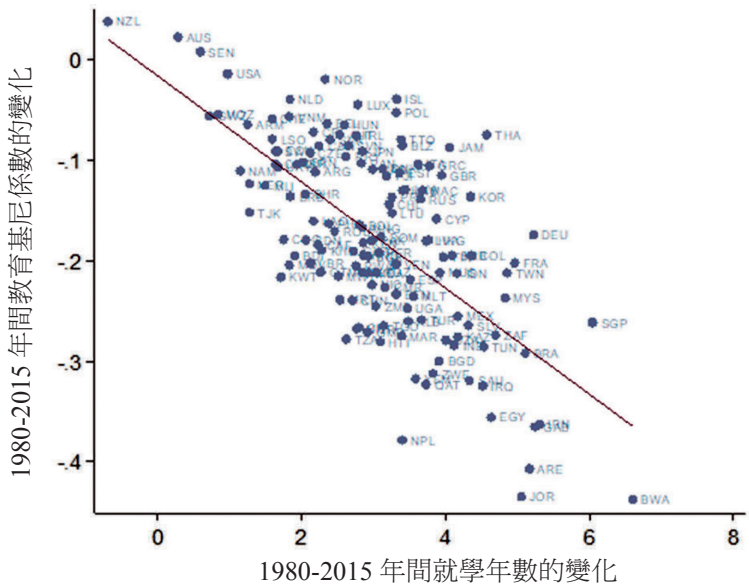

圖 4　1980-2015 年教育程度與教育基尼係數的變化

儘管教育不平等和教育程度都有改善，近數十年來隨著收入不平等的擴大，許多國家的經濟成長都衰退了。我們預期平均教育程度和教育平等的提升，應該對收入成長和分佈都有益處，實際情況卻與此相反，令人十分疑惑。必然還另有其它重要的因素影響著經濟成長和收入分佈，例如科技發展和國際貿易等。

參、教育在產出成長中的作用

本節評價教育對產出成長的影響，所使用的國家級數據以兩種標準方法（Barro and Sala-Martin, 2004）為基礎。其一是以一般的Solow型成長核算（Solow-type growth accounting）為基礎。此方法的基本假設認為，受過教育的勞工增加，會藉由提升勞動生產力而提高產出，受控制的其他因素包括物質資本存量及技術進步。另一種方法是跨國回歸（cross-country regression），評價的是其他影響成長的決定性因素受控制的情況下，教育或人力資本對各經濟體人均產出成長率差異的影響。

Solow提出的成長核算方法（1958）將經濟體總產出的成長率分解為與要素投入（factor inputs）和全要素生產力（total factor productivity, TFP）有關的組成部分，而這能夠反映出技術上的進步。

假設標準生產方程如下：

(3) $Y = F(K, H, A) = F(K, h \times L, A)$

其中Y是實際產出，K是物質資本存量，H是勞動投入，而A測量技術或TFP水平。此處的勞動投入H是個整體勞動投入或人力資本存量的概念。勞動力總投入定義為 $H = h \times L$，其中L是總工時（或勞工人數），h是勞動品質或平均人均人力資本存量的衡量指標，反映出勞動力平均受教育年數的增加。

以成長核算方法為基礎，產出Y的成長可以輕鬆的分解為四個生產要素的貢獻：（i）物質資本存量的成長；（ii）勞動投入的成長；（iii）人

均人力資本的成長；（iv）TFP的成長。

$$(4)\ \frac{dY}{Y} = v_K \cdot \frac{dK}{K} + v_H \cdot \frac{dH}{H} + \frac{dA}{A}$$

其中dX/X代表變項X的變化百分比率，而v_K和v_H分別是其資本和勞動收入的份額。若生產函數在K和H展現出不變的規模報酬，那麼與實際產出Y相關的所有收入都歸因於資本和勞動力。也就是說，$v_K + v_H = 1$。而在本例中，方程式（4）可以人均方式表現如下：

$$(5)\ \frac{dY}{Y} = (1 - v_H) \cdot \frac{dK}{K} + v_H \cdot \frac{dH}{H} + \frac{dA}{A}$$

而後人均產出的成長（$y \equiv Y/L$）可分解為三個要素：人均物質資本成長（$k \equiv K/L$）、人均人力資本成長（h）及全要素生產率成長（A）。我們因此可以測量人力資本對人均產出成長的影響。

成長核算方法被運用到1981-2014間的許多國家，使用的是PWT 9.0（Penn-World Tables）的GDP和物質資本存量數據（Feenstra, Inklaar, and Timmer, 2015）。PWT 9.0也能得出不同時期各國的勞動力分額。勞動年齡的人口數則來自聯合國的統計（2015）。

總勞動投入是教育水平七個分類的所有勞動投入的總和，並經過相對生產力（或相對薪資率）的加權，如方程式（2）所示。雖然我們並沒有各國薪資率的詳細數據，卻有Psacharopoulous（1994）以Mincer方程式就許多國家整理出的教育薪資概況的國際數據。這個方法以一個假設為基礎而建構勞工的薪資率，亦即每多受一年教育的邊際回饋穩定維持在10%，而所有國家的全球平均回顧則取自Psacharopoulous（1994）。

表1顯示就有完整數據的99個國家的整體樣本時期（1981-2014）及三個子時期（1980年度、1990年代、2011-2014）所做的成長核算分解結果。這些數字是所有國家、發達國家和發展中國家就其在全球GDP所佔份額進行加權後的平均數。

表1　1981-2014人均GDP的成長核

類群（國家數）	人均 GDP 成長率	影響來自		
		人均物質資本	人均人力資本	TFP 成長率
全球（99）				
1981–1990	0.019	0.0105 (55.4%)	0.006 (31.5%)	0.0025 (13.2%)
1991–2000	0.0224	0.0116 (51.6%)	0.0063 (28%)	0.0046 (20.3%)
2001–2014	0.0247	0.0144 (58.4%)	0.0035 (14.3%)	0.0068 (27.4%)
1981–2014	0.0233	0.0128 (54.9%)	0.0041 (17.5%)	0.0064 (27.6%)
發達國家（24）				
1981–1990	0.0224	0.0108 (48.3%)	0.0054 (24.3%)	0.0061 (27.4%)
1991–1900	0.0195	0.0093 (47.5%)	0.005 (25.7%)	0.0052 (26.8%)
2001–2014	0.0095	0.0062 (65.8%)	0.0028 (29.5%)	0.0004 (4.6%)
1981–2014	0.0162	0.0084 (51.9%)	0.0029 (17.7%)	0.0049 (30.4%)
發展中國家（75）				
1981–1990	0.0117	0.0098 (83.6%)	0.0071 (60.3%)	-0.0051 (-43.9%)
1991–2000	0.0276	0.0157 (56.9%)	0.0086 (31%)	0.0033 (12%)
2001–2014	0.041	0.0232 (56.5%)	0.0043 (10.5%)	0.0135 (33%)
1981–2014	0.0307	0.0173 (56.5%)	0.0045 (14.7%)	0.0088 (28.8%)

註：數據取自PWT 9.0及Barro-Lee人力資本數據（www.barro-lee.com）。GDP成長是時期內的GDP年度成長率，以當前價格實際GDP中的國家份額加權。人均物質資本、人均人力資本及TFP的貢獻是以國家收入份額加權的人均GDP成長率。

表1顯示99國在整個樣本時期內的平均人均GDP成長率為每年2.3%。1980年代的成長率為1.9%，此後上升至2.2-2.4%。

1981-2014期間，24個發達國家的平均人均GDP成長率在為1.6%，在75個發展中國家則為3.1%。發達國家的平均人均GDP成長率自1980年代的約2.2%降到1990年代的約2.0%，又在2001-2014期間進一步降到約1.0%。2000年以來人均GDP成長率的顯著衰退反映了2008年以來全球金融危機在發達國家所造成的衝擊。相對的，發展中國家的平均人均GDP成長率從

1980年代的1.2%加速成長到1990年代的2.8%，又在最近的時期進一步成長到4.1%。

表1顯示人力資本積累（平均受教育年數增加）對經濟成長的影響在全球範圍內相當顯著。在1981-2014的全時期全球99國當中，以人力資本表示的人均GDP年成長率平均估算值為0.4%點，達這段期間內人均成長的18%。人力資本對人均GDP成長率的影響在1980及1990年代較大，約為0.6%點（人均GDP年成長率的28-32%），而在2001-2014期間內出現全球性的衰減，降低到0.35%點（約14%）。這在發展中國家影響較大，約為0.45%點，在全時期內的發達國家則為約0.3%點。

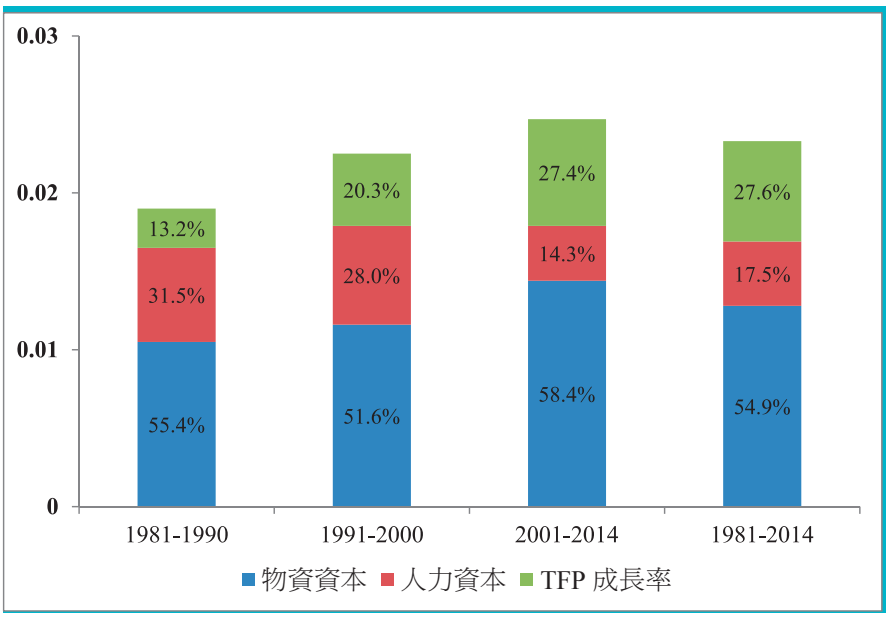

圖 5　1981-2014 年 99 個經濟體人均 GDP 成長的成長核算

圖5顯示人均產出成長率及在整段樣本時期內和三個子時期內的成長來源。成長核算顯示人力資本是經濟成長的重要因素，但對人均GDP成長

的影響小於人均物質資本在全時期內的影響。與TFP相比，其影響在1980及1990年代較大，在最近的時期則較小。

但這些結果不必然就低估了人力資本的影響。成長核算方法只是一個機械性的分解，因此僅限於就產出成長考慮生產要素（人力資本、物質資本積累及TFP）之間的互動。充足的人力資本存量對物質資本的積累和技術的進步都有正面的影響（Romer, 1990）。反過來說，物質資本的積累和技能偏向的技術變革能夠提高對熟練勞工的相對需求及技能溢價，因而能夠促進人力資本積累。若是忽略這些互動，成長核算的結果便可能高估或低估人力資本對產出成長的實際影響。此外，成長核算並不能解釋投入和全要素生產率的成長來源為何。從結果來看，人力資本對各經濟體不同時期人均產出成長率未見得有因果關係式的影響。例如一些外生因素也能夠同時提高教育程度和產出。

很多研究者採取以回歸分析為基礎的方法，試圖分辨人力資本在產出成長上的獨立影響。控制其它重要的解釋變項之後，該框架有助於我們透過測量整體教育年數，來探查教育程度在經濟長中所扮演的獨立角色（Barro, 1991; Barro and Lee, 1994, 2015）。回歸法通常採用跨國數據，以解釋各國成長表現上的差異。

基本的實證框架表示為

$$(6)\ Dy_{it} = \beta_0 + \beta_1 \log(y_{i,t}) + \beta_2 h_{i,t} + \beta_3 X_{i,t} + \varepsilon_{i,t}.$$

其中Dy_{it}是i國家在t時期內的人均GDP成長率，$y_{i,t}$是i國家在t時期開始時的人均GDP，$h_{i,t}$是t時期開始時的平均受教育年數，$x_{i,t}$則指出影響長期GDP成長率的許多外部環境變量。正如之前的實證研究所指出的，投資率、制度、生育率、國際貿易、通貨膨脹及其他政策因素都對長期人均產出有著重要的影響（Barro and Xala-i-Martin, 2004; Barro and Lee, 2015）。

如方程式（6）所示，係數β_2的估算值衡量的是初始教育存量對之後人均產出成長的影響，初始人均產出和外部環境變量$X_{i,t}$則為給定的數值。先前的許多研究都得出正向的β_2值，顯示在其他因素受控制的情況下，與

勞動年齡人口的教育程度相當的高水準人力資本往往能提高產出成長。

然而先前以跨國回歸法為基礎的實證研究多半就整體受教育年數得到不具統計相關係的係數，這表示整體教育程度在產出成長上影響薄弱或無關緊要（Pritchett, 2001; Barro and Lee, 2015）。這可能是因為以平均受教育年數作為人力資本存量的衡量標準並不精確，例如各國及個時期的學校教育素質就沒有被納入考慮。這也可能是因為對經濟成長具有重要性的並非整體受教育年數，而是在特定教育水平上受教育的年數。如Barro（1994）和Lee（2015）等人的實證研究發現，只有中等教育和高等教育的年數具有重要性，意味著高教育程度的勞工可刺激物質資本的積累並促進技術發展，從而對人均GDP成長造成影響。

跨國回歸法獲得的結果當中有一個相當有趣，那就是女性教育程度有正向發展，男性教育程度則成負向發展（Barro and Lee, 2015）。因此女性教育程度的提升—相對於一定值的男性教育程度及其他解釋性變量—對經濟成長有正面影響。這也可以解釋為女性教育程度提高至與男性同等水準，能夠創造出一個較有利於經濟發展的經濟與社會環境。

肆、教育及收入不平等[5]

教育程度及其在人口間的分佈會影響社會上的收入不平等程度（Becker and Chiswick, 1966; Mincer, 1974），這一點與我們所想一致。在這個模型之下，如果控制其他變項，則教育不平等與收入不平等存在著正相關。此外，平均受教育年數對收入不平等的影響或正或負，要視教育程度與教育投資報酬率之間的相關性而定。在一定的教育投資報酬率或薪資率基礎上，受教育年數增通常會放大勞工之間的薪資差異，從而導致較高程度的收入不平等。同一時間，若教育擴張使受過較高教育勞工的比例增

5 詳細的討論請見：Lee and Lee (2018).

加，並因此而降低了薪資溢價，薪資便有可能分配得較為平等。

早先的研究使用宏觀或微觀層面的數據，其結果大體上與人力資本理論的預測相一致。整體而言，教育不平等會在收入分配上產生不平等效應，但其它重要因素受控制的情況下，教育擴張在收入分配上的作用卻很模糊（Lee and Lee, 2018）。若教育擴張如圖三及圖四所示的可以降低教育不平等，那麼對於收入分配也可能具有額外的平等效應。

Lee與Lee（2018）採取以下的實證框架來分辨教育擴張、教育不平等及收入不平等之間的關係：

(7) 收入基尼係數 $_{I,t} = \beta_0 + \beta_1$ 教育基尼係數 $_{I,t-1} + \beta_2$ 教育程度 $_{I,t-1}$
$+ \beta_5 X_{i,t} + \varepsilon_{i,} + \eta_{t,} + u_{i,t}$

(8) 教育基尼係數 $_{I,t} = \gamma_0 + \gamma_1$ 教育程度 $_{I,t-1} + \gamma_2$ 收入基尼係數 $_{I,t-1}$
$+ \gamma_3 Z_{i,t} + \varepsilon_{i,} + \eta_{t,} + \psi_{i,t}$

其中$X_{i,t}$和$Z_{i,t}$分別表示一組影響i國收入不平等及教育不平的環境及政策變量。方程式（7）的環境變量包括以Kuznets為基礎（1955）的人均GDP及其平方，以及包括貿易開放、通貨膨脹、政府消費、社會福利支出、民主指標、技術進展（即專利數目）在內的政策因素。除了人均GDP平方和社會福利支出，方程式（8）考慮的環境變量跟方程式（7）一樣，此外再加上公共教育支出一項。

這些回歸法適用於1980至2015年間七個五年期間共95個經濟體的一組跨國數據。[6] 在方程式（7）當中，因變量是收入分配的淨基尼係數，資料來源為Solt彙編的標準化世界收入不平等資料庫（Standardized World Income Inequality Database, SWIID, 2016）。方程式（8）的因變量是教育分佈的基尼係數。這個測算技術是一組國家特定效果的數據回歸，會影響因變量但觀察不到的持久國家特性可能造成的偏差則受到控制。為了降低

6 不同規格及不同測算技術所得的詳細數據及估算結果，見：Lee and Lee (2018).

反向因果關係，我們使用了方程式（7）當中的教育變量和方程式（8）當中的收入基尼係數及教育程度的滯後值。

表2　收入基尼係數及教育基尼係數的回歸分析

	（1）	（2）
因變量	收入基尼係數	教育基尼係數
教育基尼係數 $_{t-1}$	0.117***	
	(0.044)	
教育程度 $_{t-1}$	0.0019	-0.0352***
	(0.0031)	(0.0027)
觀測值的母體數 N，國家	600, 95	600, 95
決定係數 R^2	0.134	0.818

資料來源：Lee and Lee (2018)

註：此為就1980-2014超過75年間95個經濟體不平衡數據集所做的回歸分析。因變量為淨收入基尼係數的回歸（1）及教育分佈基尼係數的回歸（2），並納入其他重要的解釋變量如人均GDP、貿易開放、通貨膨脹、政府支出變量、一項民主指標、專利及國家特定效果的控制。括號中為標準誤差。***、**、*分別表示1%、5%及10%的統計相關性。

表2是測算結果的摘要。在控制具有國家特定性的環境及政策變量情況下，教育不平等對收入不平等具有顯著的積極影響。第一欄的係數估算值（0.117）表示教育基尼係數增加一個標準差（0.18）會使收入基尼係數增加約2.1%點，佔收入基尼係數標準差23%左右。相反的，在包括教育不平等內在的其他變量受控制的情況下，教育程度對收入不平等的影響並不具有統計相關性。

第二欄的結果顯示教育擴張是改善教育分配的主要驅動力。平均教育程度水準因而可能透過改變教育不平等而對收入不平等產生間接的影響。教育程度的基尼係數估算值為-0.035，這顯示平均受教育年數增加約三年（約當一個標準差）可使教育基尼係數減少約0.11，約佔教育基尼係數標

準差的60%。教育不平等的降低預計可使收入基尼係數減少約1.3%點。因此教育程度的提升是教育基尼係數獲得改善的主要推動力，從而也對收入分配產生影響。

Lee和Lee的研究（2018）中方程式（7）和（8）的結果顯示，近數十年來快速的收入成長、貿易擴張及快速的技術進步加劇了收入不平等，而要減緩這些會加深收入不平等的力量，教育程度和不平等的改善極為重要。將政策變量納入考慮後，較高的社會福利支出有助於降低收入不平等，而較高的公共支出則有助於縮小教育不平等，從而間接的改善了收入不平等。

伍、教育、技能與技術

前幾節所述的實證研究顯示，強大的教育擴張是過去三十年間經濟得以公平方式持續成長的主要原因。然而批評家指出，熟練技能勞工的供應反映出教育程度較佳的人口大幅增長，但其供應並未能吻合於勞動市場上不斷變化的需求。

正規教育體系畢業的學生往往技能不足，也不具備與勞動市場相關的技術能力。經濟學人智庫（Economist Intelligence Unit, EIU 2015）的一項調查顯示，接受調查的高階經理人有64%對年輕員工的程度不滿意，有52%指出技能差距妨礙企業表現。而18-25歲的學生當中則只有44%自認為在教育體系內習得了足夠的技能。

OECD國際成人能力評量計劃（Programme for the International Assessment of Adult Competencies, PIAAC）顯示，自學校教育習得的技能與勞動市場所需的技能兩者不相吻合，是許多國家都常見的現象（OECD, 2013）。PIAAC以受訪者的教育程度及其對工作所需教育水平的自我評估為基礎，就勞工教育程度與工作所需相合、勞工教育程度過高及勞工教育程度過低做出定義。圖6顯示24國勞工教育程度過高、教育程度適當和

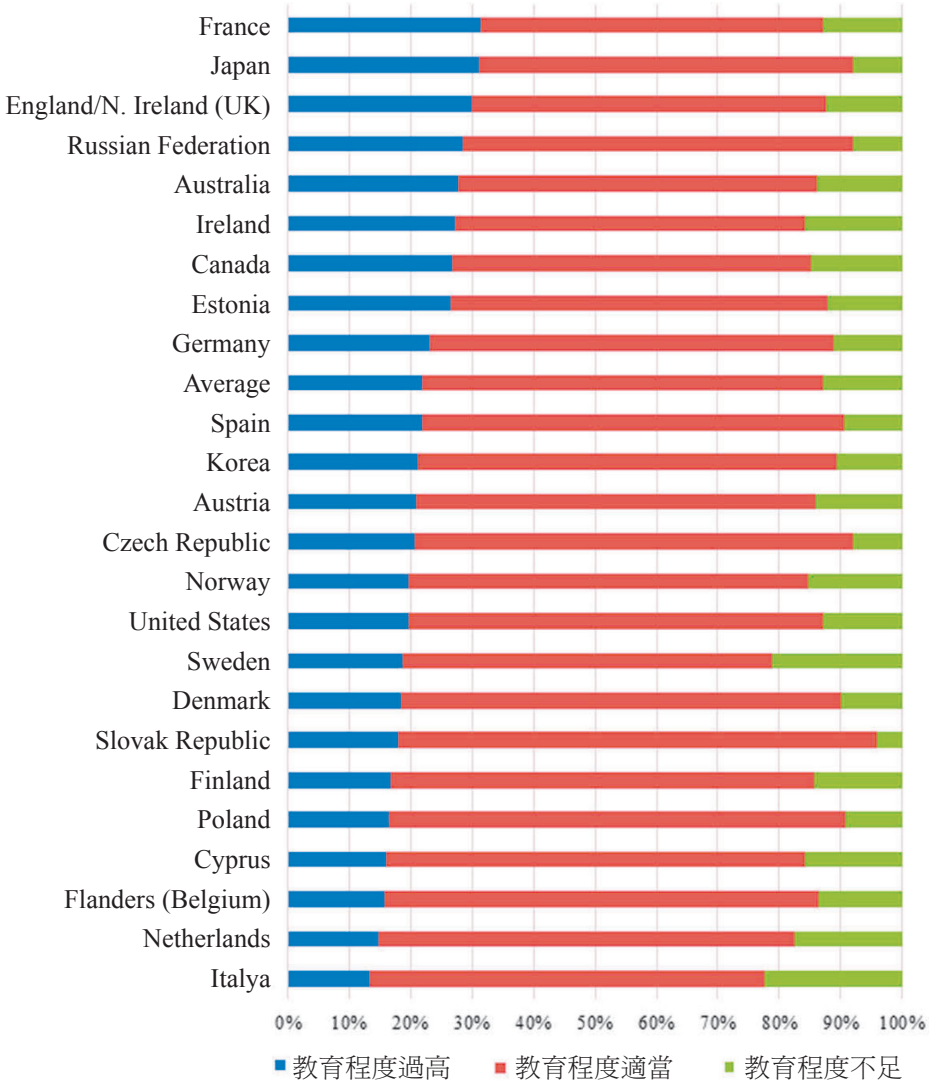

圖 6　PIAAC 數據中教育程度過高、教育程度適當、教育程度不足的份額

資料來源：作者建自OECD（2013）

勞工教育程度過低的比例，而教育程度與工作所需不相合的比率甚高，有22%的勞工教育程度過高而13%教育程度不足。應予注意的是各國間顯著的差別。教育程度過高的比例變化從義大利和荷蘭的低於15%到法國和日本的高於30%，教育程度不足的比例則從斯洛伐克、捷克和日本的低於8%，到義大利和瑞典的高於20%。教育程度過高的比例在至少受過十六年教育的勞工之間較高，教育程度不足的比例則會隨著所受教育程度愈高而降低。

出現技能不吻合的現象是個嚴重的問題，會導致失業、就業不足和工作不滿。以韓國為例，大學畢業生的失業率在近幾年不斷攀升，許多雇主都感到填補職缺的困難。教育程度過高的員工因其過剩的學校教育而受到薪資懲罰。 Lee、Lee與Song（2016）的研究指出，在韓國勞動市場上，一年過度教育的投資報酬率估計遠低於教育程度適當情況下每一年教育的投資報酬率。

勞動力的技能對生產力的成長和技術進步至關重要。充足的技能熟練勞工讓企業與產業界得以提高生產效能及創新能力。Hanushek與Woessmann的研究（2012）顯示，在許多國家中，認知技能和經濟成長之間有顯著的正面關聯。Hanushek等人的研究（2015）顯示，控制學校教育年數及其他主要決定因素後，成人認知技能在各國都會對薪資產生正面影響。此外還有一些近期的研究提供了量化證據，顯示動機、自尊、毅力堅持、接納受僱與薪資的社會規範等非認知技能的重要影響（Heckman, Stixrud, and Urzua, 2006）。

資訊和通訊技術（ICTs）的最新進展以及加速的自動化都需要新型態的技能。機器人迅速取代人類而從事例行重複的工作。Frey及Osbornes（2017）估計，美國現存的工作中有47%都面臨著自動化的風險。Acemoglu與Restrepo（2017）指出，美國確實因為產業界機器人的使用增加而導致工作數量減少。勞工必須具備廣泛的技能，不只是技術能力，也包括非常態認知技能和人際交往能力，這當中也包括稱為4Cs的批判性

思考、創造力、協作與溝通（critical thinking, creativity, collaboration and communication），都是無法輕易為人工智能和機器人取代的能力。

包容性發展當中有一關鍵在於讓所有勞工都具備適當的技能。新技術的分紅能否實現、利益能否廣泛分享，都取決於技能和技術間的這場競賽。近來許多國家都遇到工作機會與薪資不平等增加的問題，其原因在於擁有技能可以善用新科技的人和其他不具備適當技能的人之間的差距（Autor, 2014）。

要讓勞工具備足夠的技能，以回應快速變遷情況下的勞動市場未來的需求，教育是其關鍵。教育體系應當要能夠讓今日的年輕人具備「明日的技能」。有了自生命週期早年便展開的高素質教育，所有學生都應該具備紮實的認知及非認知能力以及ICT技能。隨著愈來愈容易獲得的終身學習機會，勞工應當使其技能與新技術保持同步。政府可以對員工和企業提出強大的誘因，促使他們繼續主動更新並提升技能。

要改善學校及技能訓練計畫中的學習成果，提升教師及學校行政體系的素質是關鍵因素（World Bank, 2018）。教師應當受過良好的訓練且訓練合格。此外，提升課程設計的彈性也將使教育和訓練計畫更能因應變遷中的技術和市場需求。

陸、結語

本文提供證據而指出，教育程度在經濟成長和收入分配上都扮演著重要的角色。以跨國數據為基礎的成長核算及回歸分析顯示，平均受教育年數提高對人均GDP的成長有顯著的影響，此外也減少教育不平等，從而有助於改善收入不平等。

要達成永續及包容性的經濟成長，妥適的教育和技能政策是當務之急。在最近的數十年間，快速的技術成長及貿易全球化使經濟獲得成長，卻也擴大了收入不平等。研究結果顯示，有效的人力資本政策（如包容性

教育、對教育程度較低及技能不熟練勞工提供訓練）可抵銷國際貿易及科技創新的負面效應，因而在處理收入不平等方面必然是較佳的政策選擇。

目前許多國家的教育和訓練體系都落後於技術發展，因而為達上述目標必須進行改革。在ICTs和AI的新時代，透過有效的終身學習，所有勞工都必須具備夠的技能，以掌握新技術並與之相輔相成。