

**Intelligence, personality, and creativity:
Unleashing the power of intelligence and
personality traits to build a creative and
innovative economy**

Achieving HOPE: Happiness of People through Education

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Background paper for discussion at the November 2014 Seoul symposium on “Achieving HOPE: Happiness of People through Education. Innovation in Korean Education for a Creative Economy,” drafted by Elizabeth King (former Director, Education, HDN) and Halsey Rogers (Lead Economist, Education GP). This World Bank Group paper is a contribution to a larger study by a team of six Korean government research organizations (henceforth referred to as the “Korea study team”); that study, which began in January 2014, is aimed at promoting educational innovation for creative human resources. The authors are grateful for contributions from Esperanza Lasagabaster (Practice Manager, GTCDR), Amer Hasan (Education Economist, GEDDR), and Vy Nguyen (consultant, Education GP), as well as comments from peer reviewers Luis Benveniste (Practice Manager, Education GP), Emmanuel Jimenez (Director, IEG), Klaus Rohland (former Country Director, China, Korea, and Mongolia), and Shahid Yusuf (Chief Economist, The Growth Dialogue), from Jim Yong Kim (President, WBG), Harry Patrinos (Practice Manager, Education GP), and Alex Valerios (Senior Economist, Education GP), and from Bert Hofman (Chair, Country Director, China, Korea, and Mongolia), Claudia Costin (Senior Director, Education GP), and other participants at the review meeting.

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Executive Summary

This paper offers a framework for promoting a creative and innovative economy through education and complementary policies. Often, the focus of education systems is on building on students' intelligences and promoting their cognitive skills—especially as measured through learning assessments in areas such as maths, language, and science. This is an essential goal, and indeed it is at the heart of the World Bank Group's education strategy, *Learning for All*. Fostering a creative and innovative economy through education requires much more than this. This paper provides a careful reassessment of the inputs and outcomes of education systems as well as the economy-wide goals countries should espouse if they are to succeed in this endeavor:

- *Beyond intelligence as an education input:* As education systems build skills, they need to take into account and capitalize on students' personality traits, and not just their intelligences and socioeconomic backgrounds. Personality traits can be as important as cognitive ability in determining how far a student progresses through school and what he or she learns from it.
- *Beyond cognitive skills as an education outcome:* The skills built through education include not only cognitive skills but also noncognitive skills, such as perseverance and openness to failure. These skills are important for students' future performance in labor markets, their productivity, as well as for their ability to use talents creatively. Policy should therefore consider how well key elements of the education system—such as early childhood development programs, teacher policy, curriculum, and the incentives generated for students—promote noncognitive skills as well as cognitive skills.
- *Beyond the education system to promote a creative economy:* To spur a creative economy, it is not enough to focus on the education system. The level of innovativeness and creativity in the economy is determined not just by skills, but also by the economic policies and cultural factors affecting labor markets and entrepreneurship—specifically, the extent to which they allow the economy to make use of workers' skills and creativity. This requires focusing attention on other areas, such as the overall business environment, openness, workplace culture, and gender equity.

The paper closes by exploring briefly some implications for and from Korea's efforts to promote a creative education system and build a creative economy. It highlights that:

- Korean students are achieving very high and sustained levels of the cognitive *skills* that are a foundation for creativity, as well as at least some creative skills; incentives in the education system may also help build important noncognitive skills like “grit.”
- There is much room for improvement in promoting a more *creative and enjoyable educational experience*; the system places unusually heavy financial, psychological, and social stresses on students and their families, which can have costs in terms of noncognitive skills.

- For any such reforms to have sustainable effects, it may be necessary to continue realigning the *incentives* faced by students and their families—especially those driven by *university admissions* and by the attractiveness of the *vocational and technical education* track—and to support those changes with shifts in the educational *culture*.
- Reforms to the education system can be supported by *economic policies* that promote the effective use of skills for a creative economy and reinforce the creativity-promoting effects of education system reforms.

1. Introduction

Cognitive ability, as measured by IQ, and background factors such as socioeconomic status and demographics have historically been seen as the principal determinants of a student's academic success. However, a growing body of research from psychology, education, behavioral economics and neuroscience is showing that personality traits also predict academic and work performance. This change in paradigm suggests that education systems face a more complex challenge than traditionally recognized: *to work not only with the different types of intelligence possessed by students but also with their different personality traits in order to produce academic success measured by cognitive and noncognitive skills.*

The challenge raises several questions: How does an education system work with students' different types of innate cognitive abilities and different personality traits to improve cognitive and noncognitive skills? How can it engender the behaviors that lead to more learning and creative thought? How can it unleash students' potential to promote not only academic performance but also greater creativity and innovation? Does an exclusive focus on academic performance, as measured by cognitive skills, stifle creativity? If so, how can governments ensure an enabling environment in public and private institutions to promote both? What other policy measures, outside the education system, are necessary to allow cognitive and noncognitive skills to promote creativity and ultimately lead to an innovative economy?

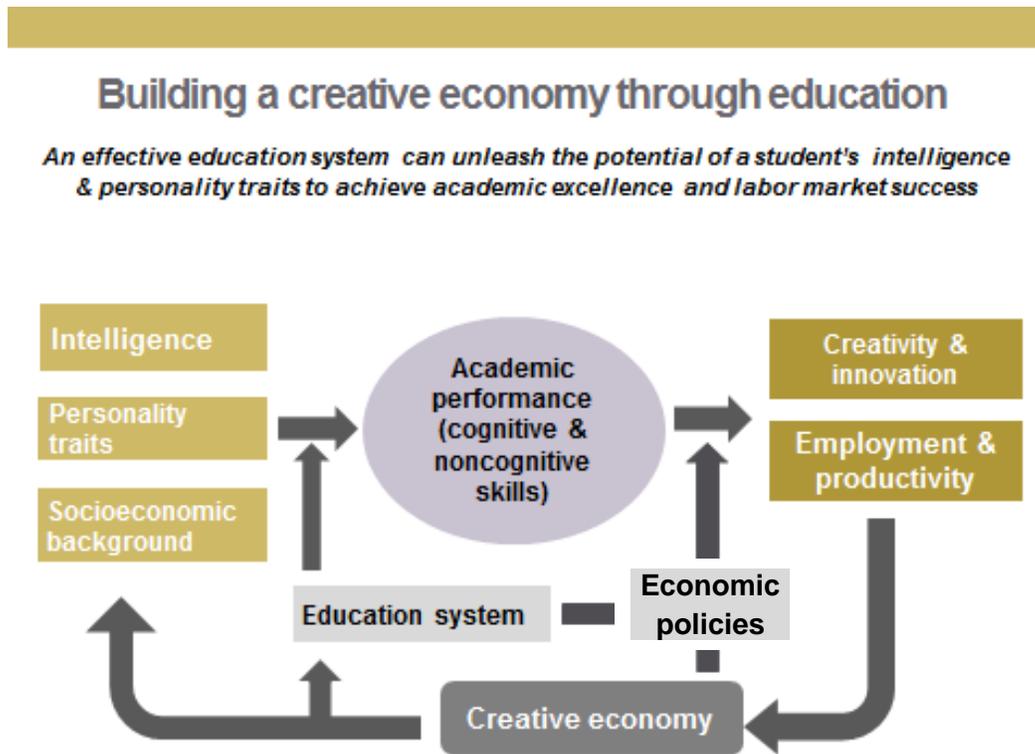
This paper reviews the research findings from the different literatures (psychology, education, behavioral economics, and neuroscience) that relate to these questions. Several good reviews summarize the findings on aspects of these questions, but rarely address all of the questions above. In particular, those reviews do not shed light on how education can improve both cognitive and noncognitive skills and how such skills promote creativity and labor market outcomes. The scientific literatures on human intelligence and personality are large, but our focus is on the subset of research findings that relate intelligence and personality to academic performance. Likewise, the literature on creativity, innovation, and productivity is extensive, but our focus will be on the research findings that relate academic performance to creativity and, ultimately, to productivity in the workplace.

We combine the various insights from these disciplines into a simple diagram depicting the relationships suggested by the questions above and examined by researchers from different disciplines. This paper is organized around the key relationships depicted in Figure 1.

Intelligence, personality traits and socioeconomic background are factors that determine academic performance. Education systems harness these factors to develop academic success—a construct that encompasses various skills, both cognitive and noncognitive. But creativity and innovation are promoted not only by the education system but also by economic policies that ensure such skills are valued by employers and lead to improved productivity and labor market success. We add that culture too plays a role and influences the potential impact of education and

economic policies. Together all these elements combine to lay the foundations of a creative economy.

Figure 1: Conceptual framework: From intelligence & personality traits to a creative economy



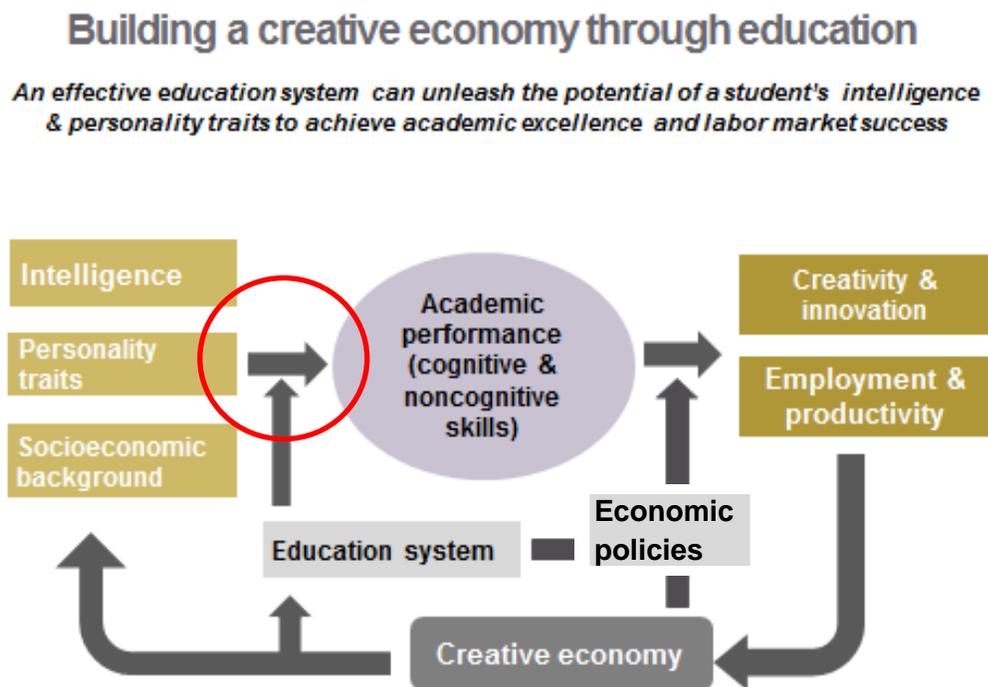
Each of the next four sections of this paper highlights a different part of Figure 1. The paper explores the links between intelligence, personality traits, socioeconomic background and academic performance (Section 2) and unpacks academic performance into its constituent elements, cognitive and noncognitive skills including the skills related to creativity (Section 3). It focuses on the various ways in which the education system can directly forge the links between academic performance, creativity, and productivity (Section 4) and how economic policies reinforce these links (Section 5).

While the focus of the paper is on providing a framework for thinking through interventions for a creative economy, in the final section (Section 6) of the paper we offer some thoughts on the case of Korea. Korea has experienced a tremendous increase in its average years of schooling since the 1950s, has consistently excelled on international standardized assessments, and has experienced stellar economic growth that is marked by significant shifts in its industrial composition. Does a high-performing education system and economy like Korea have lessons for other countries on the benefits and costs of its approach? Can Korea do better in promoting creativity and productivity—and how can it do so?

2. Intelligence, personality, background and academic performance

Figure 1 posits that a student's innate intelligence, personality traits, and socioeconomic background determine his or her academic performance. It also posits that the efficiency and effectiveness of the institutions that make up the education system combine with individual characteristics and family background to produce academic outcomes. Academic outcomes comprise both (1) cognitive skills, typically measured by academic achievement (GPA or test scores), and (2) "noncognitive" skills¹, as measured by personality assessments. In the conceptual structure below, these skills are meant to capture the combined effects of nature (in intelligence and personality traits) and nurture through schooling. Studies of the effectiveness of schools and education systems have focused almost solely on completed schooling levels and tests of cognitive skills. The relative neglect of noncognitive skills, until recent years, has been due mainly to a lack of consistent and widely accepted measures of these skills.

Figure 2: Spotlight on formation of cognitive and noncognitive skills



¹ Because these skills also depend on cognition, other terms such as "social and emotional competencies" are often used to capture this concept instead of "noncognitive skills."

a. Intelligence

Academic achievement has long been thought to be determined primarily by intelligence or cognitive ability, but more recent research findings from psychology and education show that personality traits, such as conscientiousness and openness, also predict overall academic success even when controlling for cognitive ability, in elementary school, secondary school, and college.² Heckman (1999, p.1) has argued that “the preoccupation with cognition and academic ‘smarts’ as measured by test scores to the exclusion of social adaptability and motivation causes a serious bias in the evaluation of many human capital interventions...”

The psychology literature on intelligence points to different types of intelligences. In all, while there have been debates between the supporters of and dissenters to these various theories, the theories have in common a definition of human intelligence—that it is about how well a person deals with environmental changes throughout life, processes that involve knowledge acquisition, problem-solving, decision-making and creation—and that there is more than one ability associated with intelligence. For example, Sternberg’s triarchic theory posits that intelligence has componential, experiential, and practical components (Sternberg, 1985); Gardner’s multiple intelligences include eight abilities rather than one general ability (Gardner, 1985); and Cattell’s (Cattell 1943, 1963) theory distinguishes between a person’s ability to think logically and solve problems in new situations (fluid intelligence) and a person’s ability to acquire and use skills, knowledge and experience (crystallized intelligence).³

Innate cognitive ability, as measured typically (and more narrowly) by IQ, is still the strongest predictor of academic performance, from primary school to tertiary level, and of educational level more generally. In a meta-analysis of over 3,000 studies, Walberg (1984) found a correlation of 0.7 between cognitive ability and academic performance at school level. Similar correlations have also been reported in more recent studies (e.g., Gagné & St Pèrè, 2002). But the correlation between cognitive ability and academic performance tends to decline for students in the higher educational levels, indicating that other factors become more important as students progress to secondary and tertiary. In one study, for example, it fell from 0.7 in elementary school to as low as 0.4 at the tertiary level (Jensen, 1998).

b. Personality traits

An individual also possesses distinct *personality traits* that affect his or her efficiency of developing and using intelligence. Personality traits are defined as the relatively enduring

² See Chamorro-Premuzic & Furnham (2003); Duckworth and Seligman (2005); Heckman, Stixrud, and Urzua (2006); and Nofle and Robins (2008).

³ Because the multiple intelligence domains in these theories overlap with personality traits (discussed below), for the remainder of the paper we will use “intelligence” to refer to a more traditional, narrowly cognitive dimension.

patterns of thoughts, feelings, and behaviors that differentiate individuals from one another (Roberts, 2009). Research into the relationships between personality traits and academic performance was intense throughout the 1950s, but it was not until the birth of Eysenck's parsimonious model of personality that various studies in the area began to examine with some consistency the same personality traits (Barrett, Petrides, Eysenck, & Eysenck, 1998; Eysenck, 1997). Eysenck's model reduces the multitude of narrow personality constructs to three broad dimensions: introversion-extraversion, neuroticism or emotional stability, and psychoticism.

Subsequently, a broader taxonomy with a five-factor model was developed. The Big Five model's overarching domains are Openness to Experience, Conscientiousness, Extraversion, Agreeableness, Neuroticism (or Stability of Emotion, to take the positive flip side of neuroticism), which have been summarized as O-C-E-A-N. The Big Five model, accepted by most personality psychologists as an adequate structure behind all personality traits, is widely used in the empirical literature on traits that predict success in labor markets and life.

For example, the personality trait of conscientiousness—which is related to “grit”, defined as the tendency to pursue long-term goals with sustained zeal and hard work—has been shown consistently to predict achievement in academic, vocational and avocational domains (Duckworth, Peterson, Matthews, & Kelly, 2007; Duckworth & Quinn, 2009; Duckworth, Quinn, & Seligman, 2009).

While there is some correlation among these personality traits (see Duckworth et al., 2007, study 2; Roberts et al., 2011), such traits are much less correlated with each other and with cognitive skills than different cognitive skills are with each other. For example, estimates from the U.S. National Education Longitudinal Survey by Deke and Haimson (2006), cited by Brunello and Schlotter (2011), show that “the correlation among measures of cognitive skills (reading, history and science) is above 0.75”, whereas “key personality traits—such as work habits, pro-social behaviour, leadership and locus of control—are instead rather poorly correlated both with cognitive skills and among themselves”, with much lower correlations on the order of 0.2. As a result, unlike cognitive skills, noncognitive skills cannot be summarized effectively by a single indicator.

A large research literature estimates the effect of intelligence or cognitive ability and personality on academic performance. These studies, which are based on relatively large sample sizes, add confidence for the results about the relationships between personality traits and academic success. Higher levels of both cognitive and noncognitive ability (personality traits) are associated with better education outcomes. For example, Heckman, Stixrud and Urzua (2006) find that in the U.S. increasing noncognitive ability over the same decile range as cognitive ability has a greater effect on lowering attrition from high school and increasing transition to college than increasing cognitive ability over the same decile range. Both cognitive and noncognitive ability also predict who graduates from a four-year college, but the effect of noncognitive ability is stronger for females.

Perseverance, dependability, and consistency are the most important predictors of grades in school (Bowles & Gintis, 1976). Data from the U.S. on the personality traits of 8th graders show that these traits affect enrollment in or completion of post-secondary education. For instance, 39.1 percent of students who spent one hour a week on homework completed some form of post-secondary education program, compared to 65.2 percent of those who spent seven or more hours a week on homework (Deke and Heimson, 2006, cited in Brunello & Schlotter, 2010). Unfortunately, most of these estimates come from the U.S. and a very limited number of European countries.

c. Socioeconomic background

There are, of course, also large education and microeconomic literatures that examine the impact of predictors related to the socioeconomic background of students. These find that a student's individual and family backgrounds (e.g., family income, parents' education) are key determinants of educational performance (years of schooling completed and test scores), while institutional and resource variables have a more limited effect (see reviews by Glewwe, 2002; Orazem & King, 2007). An example of a relatively recent study, Hojo and Oshio (2012), using the 2007 TIMSS data, found that student's individual and family backgrounds are key determinants of student performance in South Korea and Sweden, and, to a lesser extent, in Taiwan and Japan. When these variables are excluded, the explained variance declines by more than 80 percent in Korea and Sweden, 64 percent in Taiwan and 51 percent in Japan; in contrast, this effect is modest in Hong Kong (6 percent) and Singapore (15 percent).

Another indicator of the importance of socioeconomic factors is that programs that address demand-side obstacles to enrollment (such as scholarships and conditional cash transfers) have been found to increase school enrollment as well as continuation rates. Virtually every program that has had a credible evaluation has found a positive effect of cash transfers to families on school enrollment, although these effects are sometimes found among some age groups and not others (Fiszbein, Schady, & Ferreira, 2009).

Even when controlling statistically for the level of household income or wealth, many studies have found that parents' education is significantly associated with a child's academic success. In particular, mother's schooling might increase a child's cognitive achievement because a mother with more schooling tends to spend more time reading to her children as well as make books and other school inputs more available in the home. Reviewing about 300 estimates from about 20 countries, Behrman (2002) find estimates suggesting that "one more year of mother's schooling increases the grades attained by 0.14 grades, the probability of progression to the next school level by 0.07, the completed grades by 0.19 grades, household educational expenditures by 1.0 percent, cognitive achievement by 0.5 percent, and earnings by 0.0 percent". Within most samples the standard deviation in mother's schooling attainment is 3-4 grades, so a one standard deviation change at the median would imply effects 3-4 times these magnitudes. Interestingly, Carneiro, Meghir & Pary (2010) find that a mother's education increases the child's attainment

in both math and reading at ages 7-8 but not at ages 12–14, and that mother’s education reduces the incidence of behavioral problems and decreases grade repetition. These results imply a positive causal effect from parental education on children’s outcomes.

Identifying parents with poor literacy and numeracy skills can help predict which children are most at risk of having poor skills themselves. De Coulon, Meschi, and Vignoles (2011) find strong evidence that U.K. parents with better numeracy and literacy in adulthood have children who perform better in early cognitive and noncognitive tests: Adult literacy and numeracy scores are more highly correlated with children’s behavior outcomes than early noncognitive skills. For example, raising the adult literacy/numeracy score by one standard deviation improves the child’s predicted score on a measure of emotional behavioral health by 0.1 standard deviations, even after controlling for exogenous child characteristics (e.g., age, gender) and family structure (e.g., number of siblings, single parenthood). Thus, adult basic skills are strong predictors of child cognitive *and* noncognitive outcomes.

But even when controlling for socioeconomic background and demographic characteristics, which are the more traditional predictors of academic success, a student’s noncognitive skills such as commitment, self-efficacy, and achievement motivation show a positive relationship with school continuation rates (and therefore completed level) and academic excellence. According to a meta-analysis of hundreds of U.S. studies on college outcomes (Robbins, Allen, Casillas, Peterson, & Le, 2006), such noncognitive factors account for an additional 8 percent of accounted variance in continuing to college, and 4 percent of variance accounted for a student’s GPA. Academic self-efficacy and achievement motivation were the strongest contributors, along with high school GPA and standardized test performance.

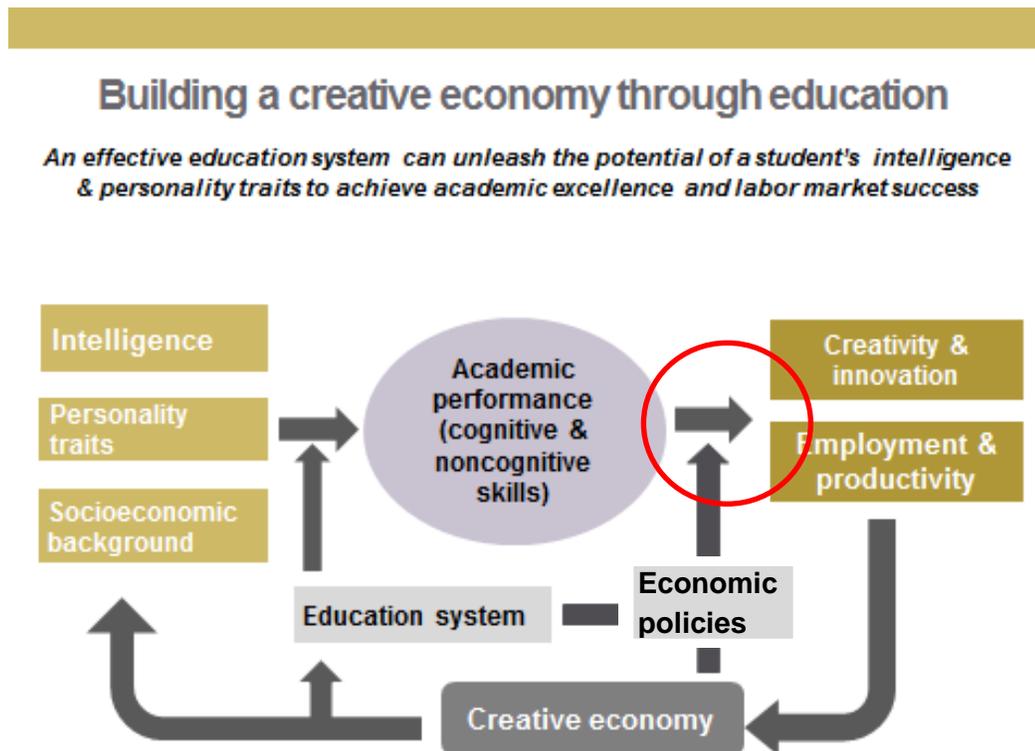
We return in Section 4 to the topic of how education systems promote noncognitive skills, in addition to the cognitive skills that usually receive more attention, and how schools and the education system as a whole could be more effective in achieving this.

3. Cognitive and noncognitive skills, creativity, and labor market success

As highlighted in Figure 3, a range of cognitive and noncognitive skills learned or developed in school, from the primary grades to the tertiary level, predicts work-related behaviors and labor market outcomes such as creativity, innovation, employability and productivity. In turn, labor market success contributes to economic growth at the macro level. Cognitive and noncognitive skills also contribute to social goals besides economic prosperity, such as building a cohesive society and culture, but these are not included in the figure, because we are focusing here on economic goals.

In this section, we review the literature on how cognitive and noncognitive skills enhance performance in the workplace. Most empirical studies on the topic of skills and labor market outcomes measure worker skills in terms of years of schooling completed and other training acquired. Few studies estimate the relationship between academic outcomes (as measured by individual performance on specific tests) and labor market outcomes, and much fewer still examine the relationship between noncognitive skills and labor market outcomes. The major obstacle to this research has been the availability of measures of skills of workers in large, representative data sets.

Figure 3: Spotlight on the link from skills to creativity and labor-market success



a. Cognitive Skills

Cognitive skills matter for an individual's employability, productivity and earnings. A large body of research has estimated the effect of academic performance, as measured by years of education completed, on occupation, employment and earnings. This literature gained momentum with the pioneering work of Mincer (1963). For developing countries, hundreds of studies have estimated rates of returns to schooling. The recent survey of these estimates by Montenegro and Patrinos (2014) shows that, globally, another year of schooling on average raises earnings by more than 10 percent and that the average return is similar across all country income groups.

But the increased availability of comparable skill measures across countries, largely due to student performance on global tests, such as Progress in International Reading Literacy Study

(PIRLS), Program for International Student Assessment (PISA) and the Trends in International Mathematics and Science Study (TIMSS), has been supporting a growing number of cross-country studies that estimate the relationship between average test scores and measures of economic growth. At the macro level, the research suggests that student test scores are a better predictor of country economic growth than average years of schooling. Using data from international student assessments such as PISA and TIMSS, Hanushek and Woessmann (2008) estimate that an increase of one standard deviation in average student reading and math scores (roughly equivalent to improving a country's performance ranking from the median to the top 15 percent) is associated with a large increase of two percentage points in annual GDP per capita growth.⁴

b. Noncognitive Skills

Still, student test performance, even at age 15, is likely to be an imperfect measure of work skills for several reasons. One reason is that skills and knowledge acquired in school can depreciate after students leave school (as evidenced by the research findings about students' learning losses over summer vacation⁵), so the transition to jobs that do not use the specific cognitive skills acquired in school or to spells of unemployment could indeed be accompanied by learning losses. A second reason is that from the perspective of employers, work-readiness means the possession not only of skills and knowledge but also personality traits and attitudes needed for the world of work. Job stability and dependability are noncognitive skills valued by employers. Motivated and dependable workers who feel that they have control over their life tend to challenge themselves and so are able to have a job that requires more education than they have acquired. Hence, noncognitive skills also matter for individuals' employment prospects and income, above and beyond cognitive ability.

On the first point, the OECD has been addressing the lack of cognitive skills data on workers with its Survey of Adult Skills in 33 countries, which collects information on the literacy, numeracy and problem-solving skills of adults ages 16-65 in randomly sampled households.⁶ Hanushek et al. (2013) analyzed the data in 22 countries and found that the estimated returns (as measured by hourly wages) to the three broad skills are similar, on average (17.1, 17.8 and 14.3 percent, respectively). Even when all three skill domains are taken together, each remains

⁴ See Breton (2011) for an alternative view emphasizing quantity of education, however.

⁵ Summer loss for all students is estimated to be equal to about 1 month (Cooper 1996), but it is larger for math (2.6 months of grade-level equivalency loss), especially for low-income students.

⁶ The Survey of Adult Skills is an international survey conducted in 33 countries as part of the Programme for the International Assessment of Adult Competencies (PIAAC). The Survey interviews adults aged 16 to 65 in their homes, about 5,000 individuals per country; respondents answer questions via computer, although the survey can also be implemented via pencil-and-paper. The respondents are also asked to provide a broad range of information, including how skills are used at work and in other contexts, such as the home and the community.

statistically significant, but the point estimates on literacy and numeracy of 7.6 and 7.8 percent, respectively, are twice as large as the point estimate on problem-solving skills of 3.7 percent.

In addition, it may be costly to ignore personality traits, and standard estimates may undervalue their effects. For example, because factors like motivation and conscientiousness affect measures of academic success like test scores and grades, some of the apparent labor-market returns to cognitive test scores may actually reflect differences in these noncognitive skills (Brunello & Schlotter, 2011). A review by Bowles, Gintis, and Osborne (2001) concludes that while introducing a measure of cognitive performance into an earnings equation using schooling years reduces the coefficient of years of education by an average of 18 percent, much of the return to schooling reflects other factors that cognitive tests do not capture. This suggests that schooling is contributing to earnings through mechanisms other than measured cognitive functioning.

Numerous studies shed some light on the ways through which noncognitive skills affect labor market performance. Brunello and Schlotter (2011) provide several examples. One route is through the skills that employers demand. For example, in the U.S., “employers of new college graduates report that communications skills, motivation/initiative, teamwork skills, and leadership skills are all more highly valued than academic achievement or grade point average”, which measure cognitive skills more directly (Kuhn & Weinberger, 2005, citing a survey by the National Association of Colleges and Employers). Another route to differential job-market performance is through job-seeking, which involves spending time, effort, and resources to prepare a resume, read job advertisements, and contact employers. In the U.S., personality traits, as measured by a composite of the core traits of self-esteem, generalized self-efficacy, emotional stability, and locus of control, predict how individuals go about the job search process (Wanberg, Glomb, Song, & Sorenson, 2005). A third route is through better employment persistence: in Sweden, noncognitive skills have much stronger effects on labor earnings for low-income workers than do cognitive skills, in part because low noncognitive skills predict longer spells of unemployment for those who become unemployed, whereas low cognitive skills do not (Lindqvist & Vestman, 2011).

Finally, personality traits also appear to predict long-term occupational attainment and income. Murnane et al. (2000) use two longitudinal data sets with earnings information of U.S. workers from the mid-1980s and early 1990s and find evidence to support both the view that cognitive skills affect subsequent earnings and the proposition that the effect of those skills is modest, indicating that other factors—including personality traits—may explain much of the variation.

But what aspects of noncognitive skills are at work in labor market success? Judge and Bono (2001) demonstrate in their meta-analysis that core self-evaluation traits (self-esteem, generalized self-efficacy, locus of control, and emotional stability) are among the best predictors of job performance and job satisfaction. Positive personality traits reduce counterproductive work behaviors such as absenteeism which are costly for employers (Ones, Viswesvaran & Schmidt, 2003; Roberts, Harms, Caspi & Moffitt, 2008). Habitual absenteeism at work over

time (which is also positively correlated with absenteeism in high school) and across changing environments may in part be due to its enduring, personality-based determinants. An internal locus of control—attributing success or failure to one’s own effort rather than to external circumstances—predicts substantially higher earnings in German data (Heineck & Anger, 2010). As Hamilton, Papageorge & Pande (2014) point out, the noncognitive skills that contribute to effectiveness likely differ between types of employment. For example, they cite Barrett and Mount (1993) as showing that “conscientiousness and extraversion are associated with better job performance, especially for managers who exercise more autonomy at work. Since autonomy is a hallmark of self-employment, this finding suggests that the relationship between personality and success differs in paid versus self-employment.”

The personality trait of grit, defined as the tendency to be organized, responsible and hardworking, and focused on pursuing long-term goals with sustained zeal, has been shown to predict achievement in academic, vocational, and avocational domains (Duckworth et al., 2007; Duckworth & Quinn, 2009; Duckworth et al., 2009; Duckworth, Weir, Tsukayama, & Kwok, 2012). Von Culin et al. (2014) note that “[g]rit is driven by different motivations: the pursuit of engagement and meaning, as opposed to pleasure. Whereas the desire for meaning and purpose in life seems to contribute to both facets of grit, the drive toward engagement and flow seems to facilitate sustained effort over time, whereas the drive toward immediate pleasure seems to undermine sustained, focused interests over time.”

Dweck’s self-theories about motivation emphasize that: “The hallmark of successful individuals is that they love learning, they seek challenges, they value effort, and they persist in the face of obstacles” (Dweck, 2000). And positive self-concept is related to increased levels of job and life satisfaction (Judge, Bono, Ilies, & Gerhardt, 2002; Judge, Heller, & Mount, 2002), better job performance (Hogan & Holland, 2003), higher work motivation, and higher income (Judge & Hurst, 2007), as well as which types of jobs people are interested in, therefore helping to shape the career pathways people choose (Mount, Barrick, Scullen, & Rounds, 2005).

c. Creativity

One important element of individual skills and a contributor to economic outcomes—including labor market success at the individual level, and economic prosperity at the macro level—is *creativity*. Creativity has many definitions, but they generally encompass the core idea that it is the ability or tendency to generate novel ideas or products that are of value. An individual’s creativity, then, depends on both the cognitive and noncognitive skills that the education system may have nurtured in her, building on her underlying intelligence and personality traits.

Sweeping technological changes in the workplace and global competition seem to have fueled an increasing call for creative workers, especially in the industries that are facing these pressures. The *creative class* is seen by some to be an important driver of modern economies (Florida, 2002). Regions with "3 T's of economic development: Technology, Talent and Tolerance" also

have high concentrations of creative professionals and tend to have a higher level of economic development. Scores of media articles provide advice on how to unlock an employee's or an entrepreneur's imagination, including discussions of how Google has allowed its workers to spend 20 percent of their time on their own projects and how 3M has allowed every engineer on its staff to spend an hour a day on a side project or hobby of his/her choice (e.g., Goetz, 2011). The impression one gets from these articles is that creativity is complex to define, difficult to measure and, judging by the plethora of popular articles on the topic of how to unleash creativity in the workplace, even harder to develop in a systematic way.

Studies of creativity as a process conclude that stimulating creativity isn't only about sparking a person's imagination. Research identifies common traits in personality, lifestyle, and environment that stand out for creative people: Most creative people show an interest in their field at an early age, and most have benefitted from a highly supportive mentor in their area of interest. One characteristic of creative people, as measured by some psychologists, is the skill for *divergent production*, the ability to generate a diverse but appropriate response to a given situation. Researchers also point to sustained cognitive processes of problem-solving and building expertise in a specific field, requiring a huge number of hours. The lives of creative people are typically marked by a cycle of hard work and breakthroughs as a result of their determination. One well-known and successful creative thinker, Bill Gates of Microsoft, says that a positive attitude towards failure is also necessary to create something new: according to him, “[i]t’s fine to celebrate success, but it is more important to heed the lessons of failure;” and “[s]uccess is a lousy teacher. It seduces smart people into thinking they can't lose.”⁷

The above-mentioned ideas profess an *investment theory of creativity*—that a person with specific characteristics in a particular environment recognizes an opportunity for creating something new in something that may have been overlooked by others and resolves to invest a high level of their time and energy to use that opportunity. From a *personality-traits perspective*, research indicates that creative people tend to be more open to new experiences, are more self-confident, more ambitious, self-accepting, impulsive, driven, and dominant, compared to people who are less creative (Feist, 1998). They may be motivated by intrinsic factors (personal interest) or extrinsic rewards (such a monetary payments or approval), with some research indicating the extrinsic motivation alone may not be conducive to creativity.

⁷ Sir Ken Robinson (2006) makes a similar point about creativity and making mistakes in his TED talk “How schools kill creativity”: “Now, I don't mean to say that being wrong is the same thing as being creative. What we do know is, if you're not prepared to be wrong, you'll never come up with anything original—if you're not prepared to be wrong. And by the time they get to be adults, most kids have lost that capacity. They have become frightened of being wrong . . . We stigmatize mistakes. And we're now running national education systems where mistakes are the worst thing you can make. And the result is that we are educating people out of their creative capacities.”

Researchers have developed many ways of measuring creativity in people. Perhaps the best-known tool for assessing divergent production is the Torrance Tests of Creative Thinking, which assess the diversity, quantity, and appropriateness of participants' responses to a variety of open-ended questions. These tests have been used to track changes over time in creativity, such as an apparent decline in scores of U.S. students in recent decades (Kim, 2011), and have been shown to help predict individuals' achievements as much as 50 years later (Runco, Millar, Acar, & Cramond, 2010).

Two key questions that researchers of creativity try to address are whether or not creativity can be taught and, if so, how to do so. The evidence on the characteristics of creative people suggests that an education system that promotes both cognitive and non-cognitive skills should also be able to promote creativity. However, some have argued that traditional schools are impeding, not stimulating, creativity. Sir Ken Robinson's (2006) assessment of school systems is an example of this view: "One of the myths of creativity is that very few people are really creative. The truth is that everyone has great capacities but not everyone develops them. One of the problems is that too often our educational systems don't enable students to develop their natural creative powers. Instead, they promote uniformity and standardization. The result is that we're draining people of their creative possibilities and, as this study reveals, producing a workforce that's conditioned to prioritize conformity over creativity."

We will return to this topic in the next three sections. As a preface, however, we note that there are at least four responses to the question of how an education system can promote a creative and innovative economy, which the remainder of this paper reflects:

- *Promote overall cognitive and noncognitive skill development:* First, education systems that successfully develop cognitive and important non-cognitive skills will also promote creativity in students. The evidence indicates that cognitive skills and substantive knowledge contribute to creativity, and it is likely that certain noncognitive skills do as well. For example, giving students greater autonomy in choosing activities to complete may allow them to become more intrinsically motivated and therefore creative in completing the tasks.
- *Identify specific interventions that could foster creativity as an outcome:* Second, there are particular educational interventions and policy actions that may be more likely to lead to the development of creative skills in learners. For example, allowing students to solve problems that do not have well-defined answers is one way to foster their creativity. This is accomplished by allowing students to explore problems and redefine them, possibly drawing on knowledge that at first may seem unrelated to the problem in order to solve it.
- *Promote a more creative, happier learning environment:* Third, there are measures that could promote the "joy of learning" within the education system, rather than just the "pressure for learning", and that are associated with a more creative, less

structured learning environment. Whether or not these measures lead to substantially more creative graduates, they may be able to reduce costs to students and families in the present and thereby achieve results more efficiently.

- *Ensure that skills translate into a creative, innovative economy:* Fourth, the economic impact of any creative skills that students develop will depend on whether they are translated into economic innovation and higher productivity. Therefore economic and social policies and institutions that allow a country's skill base to be used more effectively for innovation will have the effect of promoting a creative economy.

4. The education system and the environment for cognitive and noncognitive skills and creativity

Figure 4 highlights that *schools and the education system* as a whole determine academic outcomes by working with, honing, and enhancing the innate intelligence and personality traits of students, given the incentives and constraints that stem from students' socioeconomic background. The education policy challenge that faces countries is how to enhance the ability of the education system to unleash as well as develop a student's multidimensional abilities. For example, education policy reforms can take the shape of curricular and pedagogical changes that transform teaching and learning within classrooms, from the primary level to the tertiary level, combined with teacher incentives; or a major reorientation of the education system from one, say, that implements tracking or streaming of students early in the education process to one that allows students greater freedom to choose or alter their educational path.

Figure 4: Spotlight on influence of the education system

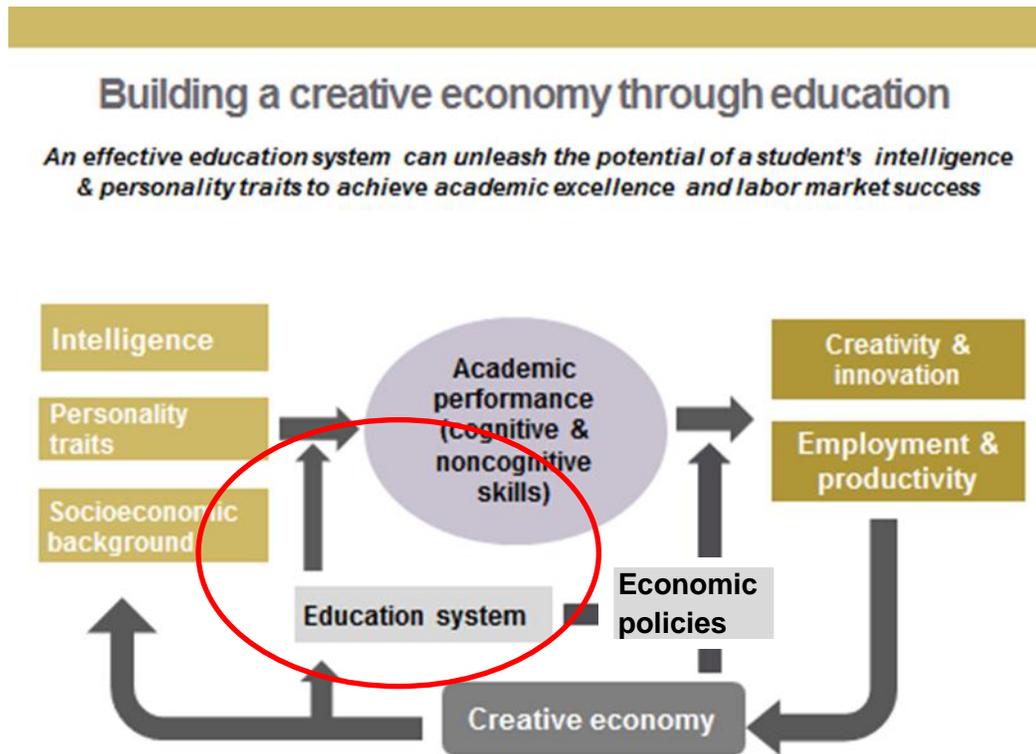


Figure 4 also posits that an education system can directly forge the links between students' academic achievement and their contributions to a creative economy, such as by fostering connections with employers, providing job information and career counseling, and promoting entrepreneurship among youth. At the same time, a creative economy is one that rewards productivity, not only credentials; kindles research and innovations; and encourages smart risk-taking.

Forging and strengthening these links is a significant policy challenge. This section returns to the question of how to promote and unleash the potential of skills through reforms in the education system. Compared with the large literature on the determinants of cognitive skills, the literature on the development of noncognitive skills is relatively thin. Because the question of how to promote cognitive skills through education is covered so extensively in the literature, we will not cover it here. Instead, this section gives some examples of the types of educational policies, institutions, and interventions that might contribute to or inhibit the formation of noncognitive skills and creativity, and discusses how different routes to high levels of cognitive achievement might promote these skills at different rates. Creativity is likely to be fostered and encouraged when the education system provides diverse approaches or ways of learning, to allow greater alignment between children's own interests and the educational offerings, and when education helps students build a diverse mix of cognitive and noncognitive skills.

a. Investing early: Early Childhood Development programs

One type of intervention that is likely to have important effects on noncognitive skills as well as cognitive skills is early childhood development programs. Cognitive ability and personality traits are not set in stone but evolve over the life cycle. Research has established, however, that cognitive and noncognitive skills and behaviors begin to take root early in life. And while the evidence of the effects of particular interventions on noncognitive skills is somewhat sparse, it is suggestive of the importance of early childhood development (ECD). Eisenberg et al. (2014), who review the accumulated evidence on this, conclude that the elements of conscientiousness and self-regulation emerge in early childhood and that these skills foster conscientiousness that is evident later in life, both directly and via academic motivation and compliance with norms.

For example, by fostering the ability of children to plan tasks, execute their plans, and review their work in social groups, in addition to teaching reading and math skills, a preschool program can begin to develop a range of skills of children. In the U.S., research on the Perry Preschool Program found that traits other than those measured by IQ and achievement tests causally determine life outcomes of former students well into their 40s. The program enriched the early social and emotional environments of disadvantaged children ages 3 and 4 with subnormal IQs (Heckman, Moon, Pinto, Savelyev, & Yavitz, 2010). The Perry sample of students is admittedly quite small, but the results are suggestive.

Another example is provided by Montessori education. The Montessori philosophy of teaching is based on the belief in the single-mindedness of preschool children's powers of concentration, that "children not only work seriously but [that] they have great powers of concentration" (Montessori, 1946; Rathunde & Csikszentmihalyi, 2005). Task-focused students are intrinsically motivated; they are drawn to novelty and the desire to master challenging tasks, while performance-focused students are worried about public evaluations of their ability, and this can disrupt learning by diminishing risk taking and effort (Dweck & Leggett, 1988). Teachers trained in a Montessori perspective emphasize, from early childhood onward, attention to the individual interests of students. For example, classrooms are less hierarchical, allow substantial amounts of unstructured time to allow students to collaborate around shared interests, and give students freedom to research a topic of interest to them and present it to the class. While rigorous evidence on this is limited, a small-scale comparison of five Montessori middle schools in the U.S. found that Montessori students were more intrinsically motivated and interested in their academic activities at school (Rathunde & Csikszentmihalyi, 2005).

b. Teachers and curriculum

Policies aiming at the promotion of noncognitive skills should be reflected in teacher education and training and in what teachers teach, and personality traits should figure prominently also in hiring new teachers. Brunello and Schlotter (2011) offer a number of examples of how noncognitive skills can be taken into account in these areas. For example, one issue is what

noncognitive skills the teachers themselves have. In New York City, research shows that young teachers are more effective if they have “a well-balanced mix of competencies, including personality traits, such as conscientiousness and extraversion”, and that their own noncognitive skills make them more effective in encouraging those skills in their students (Rockoff, Jacob, Kane, & Staiger, 2011).

What the teachers teach also matters for the development of noncognitive skills. A variety of programs explicitly target the socioemotional skills of students, through training teachers and others to help develop those skills. An example is the Collaborative for Academic, Social, and Emotional learning (CASEL) in the U.S. which promotes a program on social and emotional learning (SEL) that “focuses on the development of self-awareness, social awareness, responsible decision making, self-management, and relationship skills among students” in order to prepare students for life as well as school. Another program cited by Kautz et al. (Kautz, Heckman, Diris, ter Weel, & Borghansy, 2014) as being particularly well evaluated is the Seattle Social Development Program, a primary-school program that promotes attachment and interaction between children and their parents and teachers. A recent meta-analysis reviewed the effects of 213 universal-intervention programs aimed at improving SEL, concluding that they have substantial positive effects on students’ development (Durlak, Weissberg, Dymnicki, Taylor, & Schellinger, 2011). Not only do they lead on average to substantial improvements in the targeted socioemotional skills, but they also improve academic performance significantly.

c. System structure and the incentives it provides

Education systems can use a range of incentives to motivate and promote the development of cognitive and noncognitive skills of students. These incentives are often embedded in their institutional design or structure. Two examples discussed here are: (1) the system’s ability to let students align their education to their interests; and (2) the structure of university admissions, with a focus on entrance examinations.

Alignment to student interests: One feature of an education system affecting the development of noncognitive skills and creativity is whether it offers students the opportunity to choose courses of study—programs, sports, activities—that align with their interests. By contributing to intrinsic motivation, better alignment should help students to build noncognitive skills and creativity.

One such structural element is whether students are tracked into technical and vocational education (TVE) too early in their schooling. While TVE is an appropriate choice for some students, early tracking has tended more to reflect a student’s socioeconomic background than his or her own interests, which may be why it is associated with poorer cognitive outcomes (Hanushek & Woessmann, 2006). When Poland decided in 1999 to reverse early tracking by increasing the age at which students were streamed into the vocational track, one result was a substantial improvement in PISA scores (Jakubowski, Patrinos, Porta, & Wisniewski, 2010).

Early streaming or tracking of students runs counter to research findings from neuroscience about brain development and from psychology about the evolution of noncognitive skills (e.g., self-control, self-image) during schooling years.

Another such structural element is the degree of choice offered by the system. Greater school choice by students and their family and greater school autonomy in matters such as hiring and staffing decisions have been shown to lead to a higher level of morale and commitment and better behavior of school actors. They may also lead to stronger noncognitive skills. Brunello and Schlotter (2011) cite evidence from the U.S. (Sobel and King (2008)) showing that counties that introduced school choice saw higher rates of youth entrepreneurship, perhaps because administrators and teachers responded to the competitive incentives by creating more innovative environments in their schools.

University entrance examinations and admissions policies: One of the key elements driving incentives for skills acquisition is the institutional setup controlling access to higher levels of education. In some education systems, the behavior of students, families and education professionals is driven particularly strongly by university entrance exams. These entrance-exam-driven systems are of special interest for this paper because they include Korea, as well as other East Asian countries whose students have historically scored highly on international assessments, such as China and Japan. What distinguishes these systems is not just that there are examinations for university admission, but that the systems combine two key features:

1. *Transparent, exam-driven admissions:* While there have been some recent changes, university admission has historically been determined by scores on a single entrance examination. In addition, the entrance examination process is relatively transparent and well understood: the “rules of the game” are standardized, and entrance exams are administered relatively cleanly by international standards, with few irregularities stemming from corruption or influence.
2. *Clear university ranking used heavily as labor-market signal:* There is a clear and widely agreed-upon ranking of universities and university faculties, with the ranking of each university corresponding closely with the entrance exam scores of its students (Chae, Hong, & Lee, 2004). These rankings have consequences for lifetime income, because employers rely heavily on the signal provided by which university an applicant attended—in effect outsourcing a portion of the hiring decision to admissions committees (Chae et al., 2004).

The result is that the system provides strong incentives for students and their families to invest heavily in the long-term challenge of getting into a high-ranked university—which in turn means focusing on improving exam scores.

Of course, the extent to which a system is entrance-exam-driven is a continuum, not a binary choice, and in fact most education systems have some elements of the situation described above.

But because the exam-driven university competition is particularly intense in Korea and some of its neighbors, it is a key determinant of the way the system converts intelligence and personality traits into cognitive and noncognitive skills.

This key feature of system characteristics and incentives appears to lead to (and result from) differences in behaviors and investments that affect the acquisition of skills. One significant difference is the time allocation of children and education expenditures of parents—most concretely, in greater use of private tutoring in countries with high-stakes examinations (Bray, 2009). In such systems, in fact, the value of attending a high-ranking university may even be so high that it makes economic sense to spend extra years studying to retake the entrance exam to attain a better admission (see Ono, 2007). Enough students choose this path that they have a label—*ronin* students in Japan, *jaesusaeng* in Korea. In the exam-driven systems, there may also be more shared aspirations of success through educational achievement. Finally, some of these systems achieve very high levels of cognitive skills, in part because of the time and resources devoted by students and parents to out-of-school study.

But how do differences in incentives driven by university admissions affect *noncognitive skills* such as grit that aren't typically captured by standard cognitive tests and thus may be neglected? And do these incentives engender or stifle creativity?

Exam-driven systems may be helpful in building *grit* (Duckworth et al., 2007) because the avenue for success through academics is so clearly delineated and long-term goals are so clear. For the same reason, such systems may help students defer gratification and build *self-control* or willpower (Baumeister, Vohs, & Tice, 2007). There does not appear to be comparative evidence on noncognitive skills of adults to support or refute these hypotheses, but observers of these systems have argued in favor of it (for a recent example, see Choi, 2014a). These effects could benefit even those students who do not “succeed” in the university-entrance competition, as long as they participate in that competition, if it allows them to develop persistence, goal orientation, and self-control that can help them in their careers and lives.

These structures also have implications for *creativity*. A common view is that compared with other leading systems, East Asian systems often inhibit creativity (Niu & Sternberg, 2003), because of the excessive focus on rote memorization and excessive respect for hierarchy. But what is the evidence that in the exam-driven systems, the process of learning is inhibiting creativity of students and graduates?

The OECD's assessment of creative problem-solving on PISA 2012 (discussed further below) found that East Asian students—in Singapore, Korea, Japan, Chinese Taipei, Hong Kong-China, Macao-China, and Shanghai-China—outperformed those in all other countries (OECD, 2013c). At the least, this pattern suggests that the entrance-exam-driven systems do not prevent high rates of acquisition of some creative skills. And in the world of work, patent performance of some East Asian countries with exam-driven systems is strong and improving on a per-capita

basis, suggesting that industry is able to find creative workers (Veugelers, 2013). Finally, the success of East Asian émigrés in dynamically innovative areas like Silicon Valley also suggests that coming through the cauldron of the exam-driven systems may not block creativity (Wadhwa, Saxenian, & Siciliano, 2012); the top five source countries for immigrant entrepreneurs there include China and Japan (as well as India, where there is also intense entrance-exam-based competition for entry to elite tertiary institutions). Therefore, there are at least questions that can be raised about whether the East Asian-style systems are really doing poorly in turning out graduates who are creative—especially if cognitive skills and noncognitive skills like persistence contribute to practical creativity and innovativeness.

At the same time, it is important not to ignore the psychological and social costs of the exam-driven systems, even beyond the financial costs. The exam-driven educational culture may have a variety of other costs that inhibit the “joy of learning” and life satisfaction of families, whether or not they impair the measured creativity of graduates. For example, the cognitive achievements of the exam-driven systems sometimes come at a heavy psychological cost for students; Section 6 provides some evidence on this point from Korea. In addition, high financial costs may have a knock-on effect of reducing desired family size, as parents may forgo a larger number of children for the ability to invest sufficiently in each child’s education (Lee, 2008). And the desire of mothers to help children succeed in the educational competition may reduce female labor-force participation below levels that women would otherwise prefer (Brinton, 1994). By enforcing a relatively narrow, homogeneous set of aspirations and metrics that do not necessarily reflect all children’s abilities, exam-driven systems like these may inhibit intrinsic motivation and stifle creativity.

This subsection has focused on university entrance examinations because of their prominence in the Korean context (although Korea is, by no means, alone in this regard). But of course other types of high-stakes testing—and not just testing for university admissions—will also provide incentives for different types of skills acquisition by students, and for teachers to teach using different approaches.⁸ These include school-leaving exams, for example.

5. Economic policies to promote greater creativity and innovation

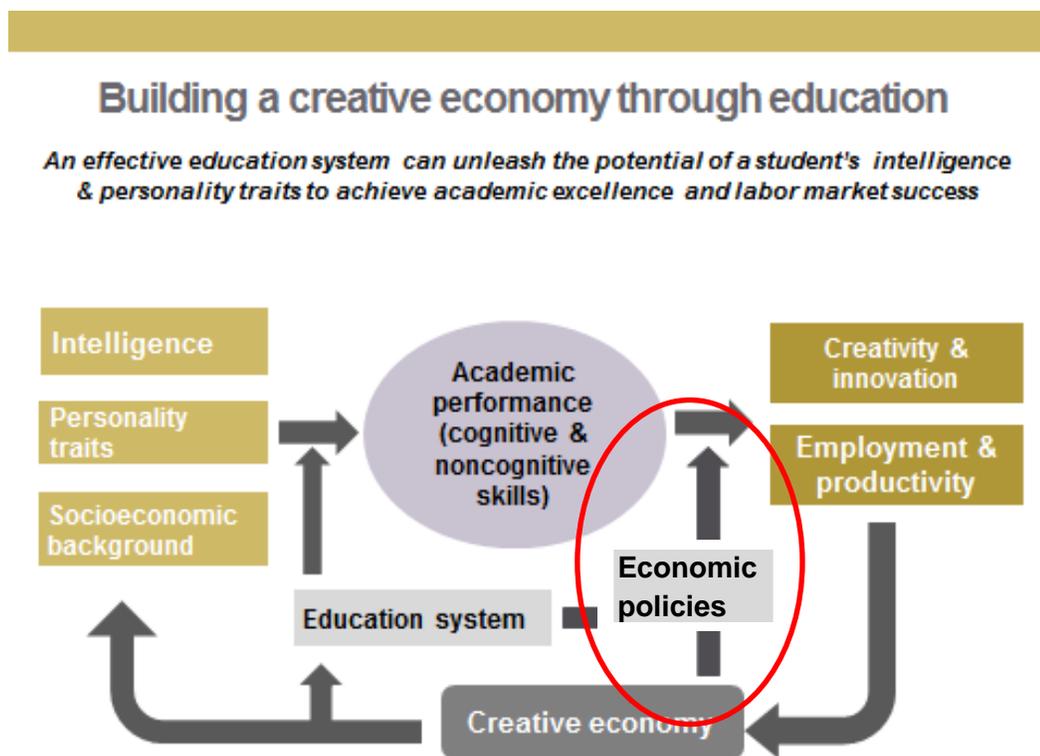
Figure 5 spotlights explicitly that incentives from both the education system and the economy can be powerful forces in fostering greater creativity and innovation. The term “creative economy” in the figure refers to a broader idea than the specific set of programs adopted by Korea under its Creative Economy strategy: it means an economy that is able to use the creative

⁸ See, for example, the discussion of exam influences on observed practice of teachers in Indonesia in Al-Samarrai et al. (2013, 140)

skills of its people and innovate at high rates, allowing it to enjoy more rapid growth in productivity and living standards.

The level of innovativeness and creativity in the economy is determined not just by skills, but also by the economic policies and cultural factors affecting labor markets and entrepreneurship—specifically, the extent to which they allow the economy to make use of workers’ skills and creativity. Countries that do not produce the highest levels of skills in their graduates may still generate high levels of innovation if their economic policies and culture, and perhaps their historical advantages, support that outcome and allow them to use efficiently the skills that they do have.

Figure 5: Spotlight on the influence of economic policies



In this section, we focus on sources of pressure from the economy and economic policies on the ability and motivation of education systems to produce more creative graduates, as well as the economy’s ability to use those skills for innovation. Note that even if a country is producing graduates who are highly skilled in both cognitive and noncognitive areas, the economy may fail to make full use of their innovative and creative potential if it does not align their abilities toward productive employment and entrepreneurship. What this means is that if policymakers observe shortcomings in creativity and innovation in the economy—that is, if they aim to build a more

creative economy—they need to look for solutions not only in the education system, but also in the policies in other economic sectors.

Policies and practices in other areas help determine whether the broader economic context allows workers to make productive and creative use of the cognitive and noncognitive skills they have acquired through education. The goal should be to maximize the use of those skills that the education sector is able to generate, which will also provide incentives for acquisition of those skills. Here are some important examples:

Business environment: Innovation-driven employment growth is supported by a “pro-competitive business environment” that gives new and young firms access to the financing, information, and opportunities that they need to grow (Dutz, Kessides, O’Connell, & Willig, 2011). In particular, competitive pressure among domestic firms and from international firms motivates innovation in pursuit of commercial rewards (Yusuf, 2007).

The supply of entrepreneurial skills is an important factor, but it does not ensure innovation and economic growth unless the economy has the policies and institutions that make it dynamic and competitive. The Global Competitiveness Report 2014-15 of the World Economic Forum (WEF) assesses the competitiveness landscape of 144 economies and provides insight into the drivers of their productivity and prosperity. The report defines competitiveness as *the set of institutions, policies and factors that determine the level of productivity of a country*. The level of productivity, in turn, sets the level of prosperity that can be earned by an economy. According to the WEF, the ten most “competitive” countries are Switzerland, Singapore, USA, Finland, Germany, Japan, Hong Kong, Netherlands, UK, and Sweden, in that order. Korea ranks 26th.

As an example of the incentives for skills acquisition generated by economic change in a dynamic business environment, in the U.S., Murnane, Willett & Levy (1995) find that changes in the occupational landscape from the late 1970s to the mid-1980s resulted in a rising demand for skilled workers. During this period, cognitive skills were more important predictors of wages after high school in the mid-1980s than in the late 1970s in the U.S. This was largely due to a decline in the proportion of young workers employed in occupations such as machine operators which paid relatively high wages but did not require mastery of basic math skills.

Openness: Another factor is the *openness of the economy*. Openness to trade and investment allows the free flow of ideas and the goods and services that embody them, and gives a skilled workforce access to the knowledge that best uses its skills. Another aspect of openness, one that pertains to human capital, is openness to immigration. While the focus in this section is on providing an incentive for and using the creative skills of those educated domestically, not all of the creativity in the labor force needs to have been produced by the country’s own education system. Historically, many countries have relied on immigrants as a source of their creative workforce and entrepreneurs. In Silicon Valley, for example, it is estimated that 44 percent of start-ups in recent years had at least one key founder who was an immigrant (Wadhwa et al.,

2012). Because there are often significant complementarities between the skills of immigrant and native-born workers, an economy that takes advantage of the skills of immigrants may be able to increase the returns to the creative skills of the native-born.

Technological change. The pace of technological change can dramatically change the use of skills and in turn change the type of skills that are in demand (Lederman & Maloney, 2003). For example, evidence from the U.S. indicates that the adoption of computers and computer-based technologies has shifted demand towards the increased use of workers who have superior problem-solving and technical skills relative to workers who are trained for routine production (Autor, Levy, & Murnane, 2003). As a result, better and more schooling that develops these technical skills may have greater value in the economy. In East Asia, the creative industries have all the characteristics of high-tech industries that demand a diverse mix of skills and are likely to gravitate towards urban areas that have the institutions and other attributes needed to meet the labor requirements of the creative sector (Yusuf & Nabeshima, 2005).

Workplace culture: Another potentially important factor is the culture of the workplace. Within firms, if younger workers are not given the opportunity to have their ideas heard and tried out, the creative skills that they have developed may never lead to innovation. For example, cultural values that promote hierarchy may make employees reluctant to share their ideas, for fear of encroaching on the territory of management⁹. It may be possible to reorient the workplace culture to emphasize other aspects of the value system—such as respect for knowledge-based meritocracy, in Confucian-influenced cultures—and create more space for creative ideas. In some settings, gender barriers in the workplace also prevent women from using and developing their skills fully, and thereby reduce their contributions to building a creative economy (World Bank, 2011).

6. Korea's experience

Drawing on this global framework, we will briefly explore Korea's educational successes in generating and using skills, as well as on what the international evidence on intelligence, personality, and creativity suggests about the possibilities for Korea's education system.

a. Cognitive and noncognitive skills and creativity

In terms of *cognitive skills*, Korea has consistently been among the highest-performing countries on international assessments of numeracy and literacy (such as PISA and TIMSS). In the OECD's 2012 PISA assessment, for example, Korean students scored in the top 5 in both

⁹ For example, see Wang, Wang, Ruona, & Rojewski (2005) for the case of Chinese firms and Kee (2008) on Korea.

mathematics and reading and 6th in science. Moreover, Korea began achieving high levels of performance from the early stages of economic development, despite the cross-country correlation between income and scores on international assessments that we see at lower income ranges; that is, it has consistently outperformed other countries at its level of income. It has done this even as it has achieved very high levels of educational attainment—the highest in the world today—meaning that the students being tested are not a select group of high achievers.

Do these advantages in cognitive skills among secondary-school students persist into adulthood? New internationally comparable evidence on adult skills, through the OECD’s PIAAC assessments, suggests that they do. The average test scores of the Korean adult population as whole are around the OECD average in tests of adult literacy, but it is important to disaggregate by age, because Korea has a particularly large score gap between older and younger adults. Given the rapid increase in educational attainment in recent decades, and consequently the difference in average years of education for the two groups, the difference is unsurprising. When we focus on the youngest adults, age 16 to 24, Koreans have the second-highest proficiency of any country in the assessment (OECD, 2013a).¹⁰

To date, there are few similarly comparable measures that can be used to compare a full set of *noncognitive skills* of Korean adults with their counterparts in other countries. Such measurements are being done systematically elsewhere; the World Bank, for example, is collecting data on both cognitive and noncognitive skills of adults in 13 non-OECD countries through its STEP¹¹ skills measurement program (World Bank, 2014a). In the Asia-Pacific region, a research project led by UNESCO-Bangkok has been exploring integration of transversal/non-cognitive skills in ten countries in the Asia-Pacific region, including Korea, but that project does not appear to have collected skill measures (Hwang, 2014). So for now, it is necessary to rely on more qualitative evidence on Korean adults.¹²

As discussed above, the long-term goal-oriented nature of the exam-focused Korean education system seems likely to promote the noncognitive skill of “grit”, which has been the subject of considerable study by Duckworth and her co-authors. Grit combines perseverance and passion

¹⁰ Younger adults in Korea could also score better in relative terms if skills learned in school decay more rapidly in Korea than elsewhere, perhaps because of greater focus on rote memorization. That is, it is possible that older Korean adults had initially acquired high levels of skills but lost them over time more rapidly than adults in other countries, perhaps due to a lack of lifelong learning opportunities. However, the differential rates of educational attainment are likely to explain much of the gap.

¹¹ Skills toward Employment and Productivity (StEP)

¹² An exception is Schmitt et al (2007), who administered a Big-Five personality assessment to populations in 56 countries. However, their findings may not be directly relevant here. First, the samples in most countries were college students, who are not representative of the population as a whole. Also, as the authors note, some of the results run against other types of evidence and may “have been detrimentally confounded by different response styles”; for example, three of the countries that ranked lowest in self-reported conscientiousness were China, Japan, and Korea, despite long hours worked in those countries.

for long-term goals. Ability to persist at challenging tasks predicts success not only in the educational arena but also in the labor market, so this would be a strength of the Korean system. The question raised by many is whether the single-minded drive for exam success encourages certain aspects of grit at the cost of other non-cognitive skills, such as ability to cooperate and work effectively in a team setting.

New data are available on some noncognitive skills of 15-year-old *students*, from the PISA 2012 student survey (OECD, 2013d). From the survey responses, the OECD has constructed an index of perseverance, using responses to questions like “When confronted with a problem, I give up easily”. When the OECD looks at the statistical relationship between this index and mathematics scores, it finds a positive relationship that is stronger in Korea than in any other participating country except Finland. Each gain of one unit in the index of perseverance is associated with a score gain of 35 points. This may mean that the system provides particularly high rewards for perseverance in terms of student performance, creating an incentive for developing that skill. Surprisingly, Korean students report average scores on the perseverance index that are slightly below the international average, but as Kautz et al (2014) caution, international comparisons of noncognitive skills can be misleading because of reference bias: “If different groups have different standards or reference points” [for example, on what constitutes persistence], “comparing traits across groups can be highly misleading.” They too point out that Korea ranks first in hours worked among OECD countries, despite rating low on self-reported conscientiousness in other comparative surveys.

Creativity of Korean students and adults is also hard to measure systematically. It has long been argued that the education system orients students toward rote memorization, which would come at the expense of creativity. Korean students’ consistently high scores on PISA, ever since the first assessment in 2000, show that their mastery of the material extends far beyond memorization, because success on PISA requires a deeper conceptual understanding and ability to apply general competencies to real-life challenges. Nevertheless, the standard PISA assessments do not directly assess creativity.

However, a more recent PISA assessment does. As noted above, in 2012, the OECD fielded a “Creative Problem-Solving” assessment along with the usual reading, math, and science tests. This type of problem-solving assessment measures just one aspect of creativity, but it is an important one. As the OECD notes, “When asked to solve problems for which they have no ready-made strategy, they [students] need to be able to think flexibly and creatively about how to overcome the barriers that stand in the way of a solution” (OECD, 2013c).

In this inaugural edition of the creative problem-solving assessment, Korean students scored highly: their average score put them at the top of the rankings, together with students from Singapore. Korea also trailed only Singapore in the percentage of its students who were “top performers”, meaning that they achieved 5 or 6 on the 6-point scale. Nor did their scores simply reflect strong basic cognitive competencies; when the OECD calculated an expected

performance in problem-solving, based on each country's performance in math, reading, and science, Korean students outperformed their expected performance by a wider margin than students elsewhere (OECD, 2013c). In other words, in relative terms they were better at creative problem-solving than they were at the underlying competencies. What this implies is that, at least on this narrow measure of creativity, 15-year-old Koreans are doing well.

Nevertheless, this is only one metric of creativity. Other indicators may tell a different story, and the creativity outcomes of education are difficult to disentangle from an education experience that does not emphasize a creative learning process as much as it could (see next section). And as noted above, it has been argued that the Korean education system does not promote effectively some noncognitive skills—such as an ability to work harmoniously with others (Lee, Jeong, & Hong, 2014)—that would improve the employability and productivity of graduates.

b. The Korean educational experience and the high costs of high achievement

Thus the evidence indicates that: Korean students and young adults excel at the foundational cognitive skills that are essential to creativity and innovation; the educational experience may also encourage development of noncognitive skills that will help in innovation; and students, at least, are able to apply their skills in creative ways to solve problems better than students in other countries. In addition, as we will see below, Korean firms innovate at relatively high rates, suggesting that adults are able to apply some creative skills effectively to their work.

So where do the biggest challenges in the area of creative education lie? At least when we compare Korea internationally, the shortcomings of the system are most evident in the *educational experience* of Korean students than in what skills they emerge with. In other words, the emphasis of reforms may need to be on *lightening the costs* of all this learning—especially the psychological costs on students and financial costs on their families—and *improve the learning process* to emphasize creativity and intrinsic rewards to learning.

It is in these areas that Korea appears to be more of a negative outlier by international standards. One area in which it stands out is in the high rates of private tutoring (Dang & Rogers, 2008; Kim, 2005). The considerable investment by Korean parents in private tutoring to boost their children's academic achievement, and the parental investment their children's educational success, is widely known inside and outside Korea (Kim & Lee, 2001). While assessing whether these expenditures pay off is challenging, there is some evidence that parents are making a rational choice, such as a longitudinal study of 7th graders that demonstrates that parents' effort in selecting and monitoring private tutoring is indeed positively associated with math and English test scores (Park, Byun, & Kim, 2011).

Tutoring expenditures are very large, with the total figure equal to about 80 percent of total public spending on primary, secondary, and nontertiary postsecondary education (Kim & Lee, 2010). Education is among the largest items in the budget of households around the median,

consuming 9 percent of household income and trailing only food and lodging and debt payment (Choi et al., 2013). Expenditures specifically on private tutoring rose from 1.2 percent of GDP in 1999 to 1.8 percent in 2010 (OECD, 2014). Not only is tutoring costly for the average household, but it also risks exacerbating social inequality. The OECD calculates that the only 34 percent of students from the lowest-income households participate in tutoring, compared with 84 percent for the highest-income groups, and that expenditures for students from middle-income households are 4 times higher than for those from the lowest-income households (OECD, 2014). If tutoring improves test outcomes, then these patterns give an educational and career advantage to students with higher incomes.

Tutoring is costly in terms of time as well as money, of course. When students spend many hours in tutoring academies after the regular school day ends, it crowds out time for other activities that would spur the development of noncognitive and other cognitive skills.

The stresses on Korean students are also quite high by international standards, as outlined above. From an international perspective, one striking feature of the Korean educational landscape is what has been called a culture of “sleep four hours and pass, sleep five hours and fail.” This expression (which has also been used in Japan) captures the idea that if an upper-secondary student sleeps just four hours a night, she can study enough to do well on the entrance exam and gain admission to a top university; but if she sleeps five hours a night, she will fail. This culture can be costly to students’ health, given that research shows that non-restorative sleep and short sleep duration are significantly associated with suicidal ideation in adolescents. In 2007, 4.6 out of every 100,000 Korean adolescents aged 10–19 years committed suicide, making suicide the second-highest cause of adolescent death in Korea that year, according to data from 2007 Korean Youth Risk Behavior Web-based Survey (KYRBWS), among middle and high school students (Park, Yoo, & Kim, 2013). Other indicators too suggest high levels of dissatisfaction with these education-related stresses. Anecdotal evidence shows that school pressures often contribute to decisions to emigrate or to send children abroad for schooling (in the so-called *kirogi* families), if families are able to afford this (Lee & Koo, 2006). Finally, these stresses can have repercussions after graduation as well. Career decisions rely on a student’s readiness to make planned, informed, and appropriate career choices, but it has been argued that maladaptive perfectionism characteristics could lead to a high level of career-related stress.

These behaviors and investments appear to be driven by excessively homogeneous aspirations; most students and families are aiming to succeed along the same university-based track, and by credentialism practiced by firms and by the society as a whole. The result is likely inefficiently high levels of university education, at least from an economic perspective. Lee, Jeong & Hong (2014) estimate that students from the lowest-ranking universities end up with a negative college

premium, earning less than high school graduates without a university degree. Also, McKinsey Global Institute's estimates suggest that, in net present value terms, lifetime earnings for privately educated college graduates are lower than those of workers with high school diplomas, after netting out the high cost of private schooling (Choi et al., 2013).¹³

Educators have identified many shortcomings in the educational experience within the schools (Korean Educational Development Institute, 2014). What is important to note is that many of these shortcomings can be traced to the system's need to produce graduates who can succeed on the all-important entrance exams, and to the influence of the private tutoring sector on the schools.¹⁴ The result appears to be many students who are uninspired by their educational experience. In the PISA 2012 survey, on average across participating countries 80 percent of students agreed with the statement "I feel happy at school," but only about 60 percent in Korea reported themselves as happy. This figure ranked Korea lowest among all the participating countries (OECD, 2013b).

For all these reasons, it is appropriate that the Korean government's strategy is focusing on reforms that will improve the happiness of students and families and the joy of learning, because too often these appear to be missing elements in the Korean education system, and that will increase the "efficiency" of learning (by sustaining strong results but at lower social costs). The key question for policymakers is whether it is possible to provide a more creative, "happier" educational experience that involves lower levels of stress and private costs for students and families—and to do so without losing the strengths of the Korean system in equipping students with cognitive and some noncognitive skills, which already contribute to creativity and innovativeness in Korea's economy. It will be important to recognize the potential for tradeoffs, and to manage them. At the same time, the fact that there is some variation in models for high cognitive achievement internationally suggests there may be room for improvements in these aspects of the experience.

c. Elements of change: Promoting creativity and innovation sustainably

Creative and happy education: There are many areas of the education system in which reforms could be made to enhance creativity and increase the "joy of learning." The report presented at this Symposium by the Korea study team¹⁵ (Korean Educational Development Institute, 2014) lays out numerous possible areas for reform, in such dimensions of the education system as:

- Curriculum
- Teacher training and support

¹³ This calculation does not include any nonmonetary returns.

¹⁴ See, for example, the evocative description of the classroom experience in Ripley (2013).

¹⁵ The study team includes six research institutes: KEDI, KDI, KICE, KRIVET, KERIS, and NILE.

- Educational culture and assessment
- Creative job training
- Use of educational technology for learning communities
- Higher education
- Lifelong learning policies

Rather than reiterating the team’s findings here, this section makes complementary points about sustainability and complementarity of reforms. First, if there is a desire for reform, it will be important to include mechanisms that can lead to lasting change. A key lever for change that can complement these changes will likely be sustaining and perhaps deepening reform of *university admissions*. As discussed in Section 4, the incentives created by competition for university drive much of the behavior in the system, including behavior that undermines the goal of a happier, less stressful education.

Other changes to the system—such as restricting tutoring or making the secondary-school curriculum less test-oriented—seem unlikely to lead to major shifts on their own, because they run up against strong incentives that the students and their parents face in university admissions and labor markets. As long as hiring by employers is based heavily on university rankings and entrance to university is governed by entrance exam scores, students will rationally invest heavily in improving their exam scores. Those scores become a relatively good signal of ability—at least a combination of cognitive ability and grit—and the exam-driven nature of the system becomes a self-reinforcing equilibrium (Lee, 2006; Rogers, 1996). In this setting, partial reforms sometimes fail or have to be reversed because they do not succeed in changing incentives and moving away from this equilibrium. For example, Korea’s attempt to ban private tutoring in 1980 had to be reversed: “the ban was difficult to enforce, and it was extremely unpopular among students and parents” (Kim & Lee, 2001), presumably because families believed that tutoring could yield real benefits in increasing the students’ lifetime incomes.

Korea has already begun some changes in admissions, most notably by introducing the admissions officer system (now called the “school records system”) several years ago. This system offers applicants the option of being evaluated for admission on a variety of criteria, rather than simply based on their CSAT scores. If adopted widely enough, this system should provide incentives for students to explore and prove themselves across a wider range of activities and interests, rather than conforming to a single set of criteria of excellence. This should lead to a greater diversity of noncognitive skills and provide greater room for creativity. However, a large majority of students continue to enter university through the traditional CSAT-based route. The continuity in many of the behaviors of students and families suggests that these reforms may not yet be broad or deep enough to shift to a new equilibrium.

The newer system is not a panacea, and it comes with a new set of incentives that can lead to unscrupulous behaviors, in part because it is less transparent than the entrance exam.¹⁶

Transparency has value in promoting the legitimacy of outcomes, and so Korean society will need to consider whether the tradeoff is a desirable one. But the key point is that whatever the system, the structure of admissions will likely have a major effect on skills acquisition elsewhere in the system, and therefore warrants a strong policy focus as the government tries to spur creativity-promoting change throughout the system.

Second, to complement this change in incentives at the university level, it is important also to offer attractive, high-return alternative education tracks other than the general education track to university. While the global evidence does not suggest that high rates of *technical and vocational education* are always desirable, if the TVE schools are well integrated with the needs of employers, and if they are well articulated with higher education, they can be a good option for some students. In Korea, however, students have been discouraged from exploring TVE by the relative homogeneity of educational aspirations in Korea. To overcome the bias, there is likely to be value in continuing to make TVE more attractive—for example, by expanding the *meister* high school program, which now covers only a small share of students—while also encouraging alternative views of what constitutes educational success.

Third, in addition to shifting incentives, reform may require a change as well in the *educational culture*, including preferences of teachers, students, and parents. Changes in mental models or societal norms can reinforce new incentives, in the way, for example, that changing social attitudes against “drinking and driving” have reinforced stiffer legal penalties in recent decades in the U.S. (World Bank, 2014b). Although incentives are important, it could be a mistake to focus solely on them. Reforms and new programs such as those outlined by the Korea study team may well help educational actors discover the value of alternative approaches and shift their preferences, and so may be complementary to changes in incentives.

An example is the government’s “free semester” policy which provides middle-school students in pilot schools with a semester free of examinations and provides opportunities for more innovative, student-driven learning (Choi, 2014b). By reducing exam-oriented demands on students and teachers, it may increase understanding of the possibilities of an educational experience that is more oriented to student-centered learning, and less to preparing only for exams. Changes like these could support a shift to a more balanced, more creative educational experience, with less reliance on the private tutoring sector. Encouraging students to explore less direct routes to their careers—for example, by taking time to work or explore between schooling cycles—could have similar effects, by fostering a greater understanding of how education is

¹⁶ One example is cheating on the teacher recommendations that are now included in the students’ applications (Park & Choi, 2014)

linked to real-world experience. Changes in public preferences and perceptions could also allow greater differentiation of educational tracks according to the needs and interests of students, supporting the changes described above.

Fourth, there is room for *learning* more from countries with similar education systems to Korea's but different results on key outcomes. Even among countries that also have exam-driven systems with similar environments propelling student effort, there appears to be substantial variation in the student experience and in some outcomes. One simple indicator of this is the PISA 2012 "happiness in school" metric, on which Korean students reported the lowest ratings. Students in other neighboring systems such as Singapore, Chinese Taipei, and Hong Kong reported much higher levels of happiness, even as their students managed to attain similarly high cognitive scores on the PISA assessment.

Economic policies for using skills for a creative economy: As discussed in Section 5, it is not only within the educational system, but also in the economic and business arena that changes in policies and practices could spur greater and more effective use of skills to promote a creative and innovative economy. (As noted above, here we define creative economy more broadly than in the "Creative Economy" strategy.) The Korean innovation system is very developed, ranking 17th on the innovation pillar of the World Economic Forum and 16th on the Global Innovation Index. Broadly speaking, it has a strong research infrastructure that works with industry (especially large firms), a favorable business environment (ranking 7 in "Doing Business 2014"), and a strong human capital foundation to build on, as discussed above. Moreover, the government implemented substantial reforms to the insolvency framework, which constituted a barrier to risk-taking and new entrepreneurial activities. These reforms have improved Korea's rankings in the World Bank Group's "Doing Business 2014" on the ease of resolving insolvency to 15. Not all entrepreneurial initiatives are expected to succeed and thus measures that facilitate the exit of firms are integral to vibrant and dynamic economies. However, the country still faces a number of challenges that need to be overcome to continue innovating and to achieve further productivity increases especially in the services sector.

One area where reforms could unleash greater use of creative skills, thereby providing incentives to develop them further, is the services sector. The productivity of the services sector relative to manufacturing is just 45 percent, almost half that of the OECD average (86 percent), preventing it from being an important source of growth. The manufacturing sector, at the fore of Korea's historical development, has historically absorbed its best human resources. In addition, a myriad of regulations have distorted entry and healthy competition in the services sector, discouraging investments in business innovation and the reallocation of resources towards more productive

firms. Strengthening competition policy, stepping up regulatory reforms,¹⁷ and decreasing obstacles to trade and foreign direct investment will be important to stimulate competition and innovation in the services sector.

Over the years, Korea has put in place a wide range of programs to stimulate the growth of small and medium enterprises (SMEs). SMEs are responsible for close to 90 percent of employment in the services sector. In the context of the “Creative Economy” strategy, SMEs and entrepreneurship initiatives (e.g., support to stimulate the growth of the venture capital industry) have further expanded and new initiatives have been put in place. To promote innovation and productivity growth, care should be taken to focus programs on growth-oriented firms and to avoid duplications among programs. Moreover, further embedding evaluation in program design will help gauge the impact of public programs and allow for needed adjustments.

At the same time, efforts to commercialize publicly supported research can be further strengthened. While the private sector is the main driver of R&D, there are opportunities to transform a larger share of publicly financed R&D into products and services. Further increasing the expertise in public research organizations (PROs) on commercialization would be helpful as well as expanding their networks to encourage more commercialization. Programs to support public-private research collaboration could place greater emphasis on engaging SMEs, which tend to collaborate less with research organizations. In addition, the mission and financial arrangements of public research organizations could be revised in light of emerging international best practices. The mandate of many PROs could be strengthened by linking it more closely to long-term mission-oriented research, where the private sector does not typically engage in, and greater cooperation among PROs could be encouraged. More flexibility on day-to-day operations would also enhance their efficiency.

No matter how robust the knowledge base of a country is, much of the knowledge that promotes effective use of skills will still be produced outside its boundaries. Trade and foreign direct investment, as well as other forms of international linkages, are important sources of knowledge transfer. Foreign direct investments into the Korean economy were the third-lowest within the OECD, and its barriers to trade and investment were also among the highest within the OECD area (OECD, 2014). There are opportunities for strengthening other forms of knowledge transfer relevant to innovation as well. For example, measures of international co-inventions in patents were close to 5 percent, one of the lowest in the OECD area, compared to more than 15 percent in Germany (OECD, 2014). Removing restrictions to trade and foreign direct investment, as noted earlier, and promoting greater international research collaborations could contribute to knowledge transfer in support of the creative economy.

¹⁷ The OECD Product Market Regulation (PMR) score places Korea 38th among 56 countries with PMR indicators.

References

- Al-Samarrai, Samer, Chang, Mae Chu, Ragatz, Andrew B., de Ree, Joppe, Shaeffer, Sheldon, & Stevenson, Ritchie. 2013. *Teacher Reform in Indonesia: The Role of Politics and Evidence in Policy Making*. Washington, DC: World Bank.
- Autor, David H, Levy, Frank, & Murnane, Richard J. 2003. The Skill Content of Recent Technological Change: An Empirical Exploration. *The Quarterly Journal of Economics*: 1279-1333.
- Barrett, Paul T, Petrides, KV, Eysenck, Sybil BG, & Eysenck, Hans J. 1998. The Eysenck Personality Questionnaire: An examination of the factorial similarity of P, E, N, and L across 34 countries. *Personality and Individual Differences*, 25(5): 805-819.
- Baumeister, Roy F, Vohs, Kathleen D, & Tice, Dianne M. 2007. The strength model of self-control. *Current directions in psychological science*, 16(6): 351-355.
- Bowles, Samuel, & Gintis, Herbert. 1976. *Schooling in capitalist America*: New York: Basic Books.
- Bowles, Samuel, Gintis, Herbert, & Osborne, Melissa. 2001. The determinants of earnings: A behavioral approach. *Journal of economic literature*: 1137-1176.
- Bray, TM. 2009. *Confronting the shadow education system: What government policies for what private tutoring?*: United Nations Educational, Scientific and Cultural Organization; International Institute for Educational Planning.
- Breton, Theodore R. 2011. The quality vs. the quantity of schooling: What drives economic growth? *Economics of Education Review*, 30(4): 765-773.
- Brunello, Giorgio, & Schlotter, Martin. 2010. The effect of non cognitive skills and personality traits on labour market outcomes. *Analytical report for the European Commission prepared by the European Expert Network on Economics of Education*.
- Brunello, Giorgio, & Schlotter, Martin. 2011. Non-cognitive skills and personality traits: Labour market relevance and their development in education & training systems.
- Chae, Sunhee, Hong, Jong-Haak, & Lee, Tae Jeong. 2004. Anatomy of the Rank Structure of Korean Universities: Toward a design of integrated policies for education reform in Korea. Global Development Network Regional Research Evaluation Conference (October 5-7).
- Chamorro-Premuzic, Tomas, & Furnham, Adrian. 2003. Personality predicts academic performance: Evidence from two longitudinal university samples. *Journal of Research in Personality*, 37(4): 319-338.
- Choi, Amy S. 2014a. What the Best Education Systems Are Doing Right, *Ideas.TED.Com (September 4)*.
- Choi, Sang-Duk. 2014b. The Free Semester Program: Current Trend and Future Prospect. Korean Educational Development Institute.
- Choi, Wonsik, Dobbs, Richard, Suh, Dongrok, Mischke, Jan, Chon, Eunjo, Cho, Hanjip, Kim, Boyoung, & Kim, Hyunmin. 2013. Beyond Korean Style: Shaping a New Growth Formula. *McKinsey Global Institute*.
- Dang, Hai Anh, & Rogers, F Halsey. 2008. The Growing Phenomenon of Private Tutoring: Does It Deepen Human Capital, Increase Inequality, or Waste Resources? *World Bank Research Observer*, 23(2): 161-200.

- de Coulon, Augustin, Meschi, Elena, & Vignoles, Anna. 2011. Parents' skills and children's cognitive and non-cognitive outcomes. *Education economics*, 19(5): 451-474.
- Deke, J, & Haimson, J. 2006. Valuing Student Competencies: Which Ones Predict Postsecondary Educational Attainment and Earnings, and for Whom? Mathematica Policy Research Inc.
- Duckworth, Angela L, Peterson, Christopher, Matthews, Michael D, & Kelly, Dennis R. 2007. Grit: perseverance and passion for long-term goals. *Journal of Personality and Social Psychology*, 92(6): 1087.
- Duckworth, Angela L, & Seligman, Martin EP. 2005. Self-discipline outdoes IQ in predicting academic performance of adolescents. *Psychological science*, 16(12): 939-944.
- Duckworth, Angela L, Weir, David, Tsukayama, Eli, & Kwok, David. 2012. Who does well in life? Conscientious adults excel in both objective and subjective success. *Frontiers in psychology*, 3.
- Duckworth, Angela Lee, & Quinn, Patrick D. 2009. Development and validation of the Short Grit Scale (GRIT-S). *Journal of personality assessment*, 91(2): 166-174.
- Duckworth, Angela Lee, Quinn, Patrick D, & Seligman, Martin EP. 2009. Positive predictors of teacher effectiveness. *The Journal of Positive Psychology*, 4(6): 540-547.
- Durlak, Joseph A, Weissberg, Roger P, Dymnicki, Allison B, Taylor, Rebecca D, & Schellinger, Kriston B. 2011. The impact of enhancing students' social and emotional learning: A meta-analysis of school-based universal interventions. *Child development*, 82(1): 405-432.
- Dutz, Mark A, Kessides, Ioannis, O'Connell, Stephen, & Willig, Robert D. 2011. Competition and innovation-driven inclusive growth.
- Dweck, Carol S. 2000. *Self-theories: Their role in motivation, personality, and development*: Psychology Press.
- Dweck, Carol S, & Leggett, Ellen L. 1988. A social-cognitive approach to motivation and personality. *Psychological review*, 95(2): 256.
- Eysenck, Hans J. 1997. Personality and experimental psychology: The unification of psychology and the possibility of a paradigm. *Journal of Personality and social Psychology*, 73(6): 1224.
- Feist, Gregory J. 1998. A meta-analysis of personality in scientific and artistic creativity. *Personality and Social Psychology Review*, 2(4): 290-309.
- Fiszbein, Ariel, Schady, Norbert Rüdiger, & Ferreira, Francisco HG. 2009. *Conditional cash transfers: reducing present and future poverty*: World Bank Publications.
- Gagné, François, & St Père, François. 2002. When IQ is controlled, does motivation still predict achievement? *Intelligence*, 30(1): 71-100.
- Gardner, Howard. 1985. *Frames of mind: The theory of multiple intelligences*: Basic books.
- Glewwe, Paul. 2002. Schools and Skills in Developing Countries: Education Policies and Socioeconomic Outcomes. *Journal of Economic Literature*, 40(2): 436-482.
- Goetz, Kaomi. 2011. How 3M Gave Everyone Days Off and Created an Innovation Dynamo, *FastCoDesign.com*.
- Hamilton, Barton H, Papageorge, Nicholas W, & Pande, Nidhi. 2014. The Right Stuff? Personality and Entrepreneurship. *Personality and Entrepreneurship (May 19, 2014)*.
- Hanushek, Eric A, Schwerdt, Guido, Wiederhold, Simon, & Woessmann, Ludger. 2013. Returns to Skills around the World: Evidence from PIAAC: National Bureau of Economic Research.

- Hanushek, Eric A, & Woessmann, Ludger. 2006. Does Educational Tracking Affect Performance and Inequality? Differences-in-Differences Evidence Across Countries. *The Economic Journal*, 116(510): C63-C76.
- Hanushek, Eric A, & Woessmann, Ludger. 2008. The role of cognitive skills in economic development. *Journal of economic literature*: 607-668.
- Heckman, James J, Moon, Seong Hyeok, Pinto, Rodrigo, Savelyev, Peter A, & Yavitz, Adam. 2010. The rate of return to the HighScope Perry Preschool Program. *Journal of Public Economics*, 94(1): 114-128.
- Heckman, James J, Stixrud, Jora, & Urzua, Sergio. 2006. The Effects of Cognitive and Noncognitive Abilities on Labor Market Outcomes and Social Behavior. *Journal of Labor Economics*, 24(3): 411-482.
- Heineck, Guido, & Anger, Silke. 2010. The returns to cognitive abilities and personality traits in Germany. *Labour Economics*, 17(3): 535-546.
- Hogan, Joyce, & Holland, Brent. 2003. Using theory to evaluate personality and job-performance relations: a socioanalytic perspective. *Journal of applied Psychology*, 88(1): 100.
- Hojo, Masakazu, & Oshio, Takashi. 2012. What Factors Determine Student Performance in East Asia? New Evidence from the 2007 Trends in International Mathematics and Science Study. *Asian Economic Journal*, 26(4): 333-357.
- Hwang, Jin A. 2014. Integrating Transversal Competencies in Education Policy and Practice in the Asia-Pacific. In -. A. Presentation from the ERI-Net Steering Group Meeting (Ed.).
- Jakubowski, Maciej, Patrinos, Harry A, Porta, Emilio Ernesto, & Wisniewski, Jerzy. 2010. The impact of the 1999 education reform in Poland. World Bank Policy Research Working Paper Series, No. 5263.
- Jensen, Arthur Robert. 1998. *The g factor: The science of mental ability*: Praeger Westport, CT.
- Judge, Timothy A, & Bono, Joyce E. 2001. Relationship of core self-evaluations traits—self-esteem, generalized self-efficacy, locus of control, and emotional stability—with job satisfaction and job performance: A meta-analysis. *Journal of applied Psychology*, 86(1): 80.
- Judge, Timothy A, Bono, Joyce E, Ilies, Remus, & Gerhardt, Megan W. 2002. Personality and leadership: a qualitative and quantitative review. *Journal of applied Psychology*, 87(4): 765.
- Judge, Timothy A, Heller, Daniel, & Mount, Michael K. 2002. Five-factor model of personality and job satisfaction: a meta-analysis. *Journal of applied Psychology*, 87(3): 530.
- Judge, Timothy A, & Hurst, Charlice. 2007. Capitalizing on one's advantages: role of core self-evaluations. *Journal of applied Psychology*, 92(5): 1212.
- Kautz, Tim, Heckman, James J. , Diris, Ron , ter Weel, Bas , & Borghansy, Lex 2014. *Fostering and Measuring Skills: Improving Cognitive and Non-Cognitive Skills to Promote Lifetime Success*. Department of Economics, University of Chicago.
- Kee, Tan Soo. 2008. Influences of Confucianism on Korean corporate culture. *Asian Profile*, 36(1): 9.
- Kim, Kyung Hee. 2011. The creativity crisis: The decrease in creative thinking scores on the Torrance Tests of Creative Thinking. *Creativity Research Journal*, 23(4): 285-295.
- Kim, Sunwoong, & Lee, Ju-Ho. 2001. Demand for Education and Developmental State: Private Tutoring in South Korea. Seoul: Korea Development Institute, School of Public Policy and Management.

- Kim, Sunwoong, & Lee, Ju-Ho. 2010. Private tutoring and demand for education in South Korea. *Economic development and cultural change*, 58(2): 259-296.
- Kim, Taejong. 2005. Shadow education: School quality and demand for private tutoring in Korea. *KDI School of Public Policy and Management*.
- Korean Educational Development Institute. 2014. Korean Education Innovation Plans for the Training of Creative Human Resources. Seoul. Jointly authored by KEDI, KICE, KERIS, KDI, KRIVET, and NILE.
- Kuhn, Peter, & Weinberger, Catherine. 2005. Leadership skills and wages. *Journal of Labor Economics*, 23(3): 395-436.
- Lederman, Daniel, & Maloney, William F. 2003. R&D and development.
- Lee, Ju-Ho, Jeong, Hyeok, & Hong, Song-Chang. 2014. Is Korea Number One in Human Capital Accumulation? KDI School of Public Policy.
- Lee, Jungmin. 2008. Sibling size and investment in children's education: An Asian instrument. *Journal of Population Economics*, 21(4): 855-875.
- Lee, Sanghoon Conan. 2006. The Timing of Signaling: To Study in High School or in College? Unpublished paper, University of British Columbia.
- Lee, Yean-Ju, & Koo, Hagen. 2006. 'Wild geese fathers' and a globalised family strategy for education in Korea. *International Development Planning Review*, 28(4): 533-553.
- Lindqvist, Erik, & Vestman, Roine. 2011. The labor market returns to cognitive and noncognitive ability: Evidence from the Swedish enlistment. *American Economic Journal: Applied Economics*: 101-128.
- Montenegro, Claudio E, & Patrinos, Harry A. 2014. Comparable estimates of returns to schooling around the world. *World Bank Policy Research Working Paper*(7020).
- Montessori, Maria. 1946. Unpublished Lectures. London: AMI.
- Mount, Michael K, Barrick, Murray R, Scullen, Steve M, & Rounds, James. 2005. Higher-order dimensions of the big five personality traits and the big six vocational interest types. *Personnel psychology*, 58(2): 447-478.
- Murnane, Richard J, Willett, John B, Duhaldorbe, Yves, & Tyler, John H. 2000. How important are the cognitive skills of teenagers in predicting subsequent earnings? *Journal of Policy Analysis and Management*, 19(4): 547-568.
- Murnane, Richard J, Willett, John B, & Levy, Frank. 1995. The growing importance of cognitive skills in wage determination. *Review of Economics and Statistics*, 77(2): 251-266.
- Niu, Weihua, & Sternberg, Robert J. 2003. Societal and school influences on student creativity: The case of China. *Psychology in the Schools*, 40(1): 103-114.
- OECD. 2013a. OECD Skills Outlook 2013: First Results from the Survey of Adult Skills.
- OECD. 2013b. PISA 2012 Results in Focus: What 15-year-olds know and what they can do with what they know.
- OECD. 2013c. PISA 2012 Results: Creative Problem Solving. Students' Skills in Tackling Real-life Problems. Volume V.
- OECD. 2013d. Students' Drive and Motivation. *PISA 2012 Results: Ready to Learn (Volume III): Students' Engagement, Drive and Self-Beliefs*, OECD Publishing.
- OECD. 2014. Reducing income inequality and poverty and promoting social mobility. *OECD Economic Surveys: Korea 2014*.
- Ono, Hiroshi. 2007. Does "examination hell" pay off? A cost-benefit analysis of "ronin" and college education in Japan. *Economics of Education Review*, 26(3): 271-284.

- Orazem, Peter F, & King, Elizabeth M. 2007. Schooling in developing countries: The roles of supply, demand and government policy. *Handbook of development economics*, 4: 3475-3559.
- Park, Hyunjoon, Byun, Soo-yong, & Kim, Kyung-keun. 2011. Parental involvement and students' cognitive outcomes in Korea focusing on private tutoring. *Sociology of Education*, 84(1): 3-22.
- Park, Jae Hong, Yoo, Jae-Ho, & Kim, Seong Hwan. 2013. Associations between non-restorative sleep, short sleep duration and suicidality: Findings from a representative sample of Korean adolescents. *Psychiatry and clinical neurosciences*, 67(1): 28-34.
- Park, Ki-yong, & Choi, Woo-ri. 2014. Korea's educational fever leads to illicit parent-teacher collusion, *The Hankyoreh*.
- Rathunde, Kevin, & Csikszentmihalyi, Mihaly. 2005. Middle school students' motivation and quality of experience: A comparison of Montessori and traditional school environments. *American Journal of Education*, 111(3): 341-371.
- Ripley, Amanda. 2013. *The smartest kids in the world: And how they got that way*: Simon and Schuster.
- Robbins, Steven B, Allen, Jeff, Casillas, Alex, Peterson, Christina Hamme, & Le, Huy. 2006. Unraveling the differential effects of motivational and skills, social, and self-management measures from traditional predictors of college outcomes. *Journal of educational psychology*, 98(3): 598.
- Roberts, Brent W. 2009. Back to the future: "Personality and Assessment" and personality development. *Journal of Research in Personality*, 43(2): 137-145.
- Rockoff, Jonah E, Jacob, Brian A, Kane, Thomas J, & Staiger, Douglas O. 2011. Can you recognize an effective teacher when you recruit one? *Education*, 6(1): 43-74.
- Rogers, Frederic Halsey. 1996. *Four Pass, Five Fail: Multiple Ability Signals and Cross-Country Differences in Educational Effort*. Unpublished Dissertation, University of California, Berkeley.
- Runco, Mark A, Millar, Garnet, Acar, Selcuk, & Cramond, Bonnie. 2010. Torrance tests of creative thinking as predictors of personal and public achievement: A fifty-year follow-up. *Creativity Research Journal*, 22(4): 361-368.
- Schmitt, David P, Allik, Jüri, McCrae, Robert R, & Benet-Martínez, Verónica. 2007. The geographic distribution of Big Five personality traits patterns and profiles of human self-description across 56 nations. *Journal of Cross-Cultural Psychology*, 38(2): 173-212.
- Sobel, Russell S, & King, Kerry A. 2008. Does school choice increase the rate of youth entrepreneurship? *Economics of Education Review*, 27(4): 429-438.
- Sternberg, Robert J. 1985. *Beyond IQ: A triarchic theory of human intelligence*: CUP Archive.
- Veugelers, Reinhilde. 2013. The world innovation landscape: Asia rising?: Bruegel Policy Contribution.
- Von Culin, Katherine R, Tsukayama, Eli, & Duckworth, Angela L. 2014. Unpacking grit: Motivational correlates of perseverance and passion for long-term goals. *The Journal of Positive Psychology*, 9(4): 306-312.
- Wadhwa, Vivek, Saxenian, AnnaLee, & Siciliano, F Daniel. 2012. *America's New Immigrant Entrepreneurs: Then and Now*.
- Wanberg, Connie R, Glomb, Theresa M, Song, Zhaoli, & Sorenson, Sarah. 2005. Job-search persistence during unemployment: a 10-wave longitudinal study. *Journal of applied Psychology*, 90(3): 411.

- Wang, Jia, Wang, Greg G, Ruona, Wendy EA, & Rojewski, Jay W. 2005. Confucian values and the implications for international HRD. *Human Resource Development International*, 8(3): 311-326.
- World Bank. 2011. *World development report 2012: Gender equality and development*: World Bank Publications.
- World Bank. 2014a. STEP Skills Measurement: Snapshot 2014. Washington, DC.
- World Bank. 2014b. World Development Report 2015. Mind and Society: How a Better Understanding of Human Behavior Can Improve Development Policy.
- Yusuf, Shahid, & Nabeshima, Kaoru. 2005. Creative industries in east Asia. *Cities*, 22(2): 109-122.