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The Importance of Educational Adaptability

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Executive Summary

What is the role of education for preparing the labor force of the middle of the 21st century? The most conventional response is that we need to specify the 21st century skills that will be required. These can then be translated into changes in core curriculum and instructional practices that incorporate increasing use of educational technologies to produce a capable and competitive labor force as well as measures for assessment.

The alternative view is that we cannot predict with any accuracy the specific occupational needs, work roles, and demands a half century hence or the particular educational practices that will get us there. But we can prepare workers with adaptable skills that will be able to accommodate the likely range of changes that will take place, and this can be accomplished by raising educational attainments of the young and providing a more balanced approach to generic skill development. This endeavor will also require expansion of testing to a wider range of educational attributes.

This paper presents both theoretical insights and some empirical results from the economics of education. More specifically, it asserts that the theory of human capital was grounded initially in how education improves worker skills that were largely unspecified. It was also acknowledged that more educated workers have advantages in gaining new skills from experience and training. Economists assumed initially that educational skills were reflected in achievement scores conventionally measured by schools. But, ultimately the theory was expanded to incorporate the view that more educated workers contribute to productivity by having the abilities to make complex and sophisticated decisions in resource allocation and adaptation to new technologies and new forms of organization and respond to unforeseen contingencies beyond the routine activities of work organizations. These attributes are not measured by conventional school testing.

The paper describes recent advances that connect worker characteristics to educational attainment and worker productivity, namely endogenous growth theory and educational externalities in production. Empirical studies consistently show that additional years of education in themselves have a strong economic payoff, independent of test scores, even if propelled by an expansion of compulsory schooling. Recent evidence suggests that interpersonal and intrapersonal skill development are a major missing ingredient that are linked to educational attainments and affect worker productivity in

conjunction with and beyond cognitive knowledge and that a balance among these contributes to worker productivity.

This framework leads to a recommendation for expanding substantially the educational attainment of the workforce, and especially that of marginal populations, with a strong focus on adaptability of workers through their acquisition of both cognitive and non-cognitive skills. Examples of specific dimensions of balanced worker development for adaptability are proposed.

Introduction

How should we prepare the U.S. labor force educationally for an economy that is likely to be very different in the middle of the 21st century? The conventional view is the following: Economic competition around the world will become more intense through forces of globalization driven by the rapid diffusion of information and information technologies. Given the importance of information technology in that future, we will be moving toward a world that will require higher levels of cognitive skill and knowledge to compete with other nations that will seek to outperform us educationally or have lower costs of labor. Therefore we had better improve our educational system quickly and focus specifically on the "new skills" that will be required in a world of new products and new production techniques. The search for the holy grail in education has become one of discovering the specific skills that will be needed in that world that we face a half-century from today and adapting our educational system to meet those new demands. This exigency has promoted the search for the 21st-century skills that schools will need to produce to maintain a competitive economy.

This version of linking schools to the economy is hardly new. It is largely a redux of the message in Nation at Risk, which was issued almost 30 years ago. Yet neither the vast upgrading and improvement in education called for by Nation at Risk nor the deterioration in the economy has taken place as predicted. Educational change has been glacial, and the national economy—even with its bumps and bruises from the financial demise of 2007—still seems to be lively with increasing labor productivity, despite poor macroeconomic conditions that have raised unemployment.

In this presentation, I will suggest that we need to continue to improve the quality of our educational system, but in fairly traditional ways, by increasing the rigor and breadth of studies as well as raising the amount of education of the labor force. By the latter I mean increasing the number of years of schooling of the labor force and improving equity in its distribution by placing a high priority on reducing high school dropouts and increasing college attendance among those populations who are presently at the bottom of the educational distribution. In making this case, I will argue that the increase in number of years of schooling promotes not only improvements in knowledge and cognitive skills but in other skills that are at least equally important in forming productive economic relationships. I will also argue that we do not have a specific understanding of the "transformed" economic demands on the U.S. labor force some 50 years from now, despite the predictions of the soothsayers but that an overall strategy of more education with greater rigor will have great transferability to any economic transformation over this period of time.

More specifically, I will assert that educational attainment has shown a solid economic payoff in itself as measured by years of education achievement. And the historical adaptability of a well-educated labor force to economic change has been a feature of the U.S. that can continue to be a strength in conjunction with employer training to accommodate future changes in the workplace.

Models of Educational Change

What is clear from the conventional wisdom is that schools must somehow change to address future changes in the economy and workplace. Thus it is only necessary to understand what the economy will need in the future and to modify future schooling to meet those needs. But this very mechanical strategy does not capture the facts that (a) there is no solid method for forecasting the types of technological and organizational changes that will take place a half-century from now and (b) even if

there were, the history of U.S. schooling does not offer optimism that purposive changes in policy are either the driving force of change or can be used in that direction.

Forecasting Change in Work Requirements

With respect to forecasting the types of change we can expect in jobs and occupations, we should recognize that even the U.S. Department of Labor, with its decades of experience, faces difficulty in making accurate 10-year projections of labor force needs and occupational employment (Sommers & Franklin, 2012). Projections of change at the level of broad occupations require far fewer assumptions than we would need to provide the detail of how specific technologies, modes of work, and industrial organization will be altered and impinge on the productive activities of workers 50 years from now. Although thoughtful studies of specific industries exist for the recent past (e.g., Autor, Levy, & Murnane, 2003), their applicability has never been validated for predicting trends over a decade or more. Change has become too rapid and unpredictable in the organization of industries, shifts in multinational production, product mix, and technologies of production to extrapolate trends from the recent past to the next five decades.

This does not mean that schools are a powerless instrument to create a future labor force that will meet the requirements of a changing economy. But it may mean that they are effective in ways that are less transparent in preparing a labor force that can accommodate the changes that we might expect. Fortunately, one of those traditional ways is their powerful effect in generating human capital, a central focus of the magisterial publication of Goldin and Katz (2010), which focuses on educational expansion and labor markets in the 20th century. But why has this expansion had such a powerful impact on the U.S. economy, and how should we enlist this to support further economic growth in a changing world?

Education and Economic Productivity

Prior to the advent of the human capital revolution some 50 years ago (Becker, 1964; Schultz, 1961), it was well known that educational attainment and labor earnings were closely related. Those with greater education had higher earnings, but there was little attempt to uncover the dynamics of this relationship. Rather it was just assumed that more educated persons possessed greater human capital and that this vague term was highly related to economic productivity, as evidenced by the higher earnings associated with more human capital, typically as embodied in years of schooling attained. Exactly what aspects of education contributed to productivity were unknown and unexamined. As long as it appeared that employers in competitive labor markets were willing to pay more to obtain the services of educated workers, it could be assumed that education increased productive skills of workers.

If there were any single explanation that might be given for this phenomenon, it was that better educated workers have more knowledge, which translates into higher productivity. Thus studies of what schools actually produced of economic value focused primarily on student achievement as measured by test scores and examinations. Persons with more education not only had higher earnings but higher test scores, and it seemed logical that the higher test scores reflected levels of skill and knowledge that increased productivity and earnings. No direct evidence was provided on this connection, and as we know today, it was overly simplified in a world where productivity depends not only on knowledge and cognitive skills but also on interpersonal and intrapersonal skills.

Within this frame of analysis, it was enough to know that education increased skills and that skills increased productivity and earnings. Workers with greater skills could learn their jobs more quickly and

do them more proficiently. They could work more intelligently and with greater precision and could accomplish more within the same time period. Furthermore, their education qualified them to train for more complex job situations. Thus not only would they be more productive in a given job level but they were more likely to qualify for more demanding jobs because of their higher levels of trainability. It is not surprising that training surveys showed consistently that workers with higher levels of educational attainment also received more formal training by employers (Blundell, Dearden, Meghir, & Sianesi, 1999; Leuven & Oosterbeek, 1997; Lynch, 1992).

In the early days of the human capital revolution, the pattern of economic returns to educational investments were adequate to justify that investment without questioning the precise types of skills that education provided. The economics of human capital investment in education had no specific implications for what should be taught in school and how it should be taught. Whatever the content of schooling, it was considered to be effective because of the tie between the amount of education received and earnings. In those days, the only debate about schooling content raged over whether students should receive a general education at the secondary level or a vocational education when viewing education as an investment in economic growth. Advocates of a general education argued that technical change in the life of a worker and the need to be continually trainable suggested that a more liberal education be provided so that workers could adapt to and be trained for such changes as they occurred. There was no attempt to open the black box of schooling and no particular reason to do so.

In the 1970s, economists began to make more serious inroads into how education improved productivity. Particularly groundbreaking was the contribution of Welch (1970), who argued that education of workers improved their productivity not only in a standard set of work tasks or training for more demanding productive activities but also in raising the productive capacity of the entire work organization. His main contribution was the insight that educated workers could more efficiently allocate the resources of the enterprise. Workers have access to specific productive resources and make tacit or explicit decisions in how those resources are used. Even how they allot their own time to different tasks can have an important productive effect. He viewed more educated workers as better able to gather and process information that signals the relative costs and productivity of different allocative choices and to guide more efficient resource use.

Schultz (1975) generalized this perspective as the ability to deal with disequilibria in production, the situation in which suboptimal input combinations are used relative to those that would maximize output relative to cost. Particularly in a dynamic setting, where there are continuous changes in input prices and productivities and potential bottlenecks in production, independent decisions by workers can assist in regaining equilibrium or maximum efficiency. Clearly the major gains would be expected from workers with postsecondary education from their higher abilities to conceptualize the overall production process along with their greater scope of allocative discretion. Adjustment to disequilibria should be a capacity that rises with each successive level of education but is even found in persons with less education in their more limited occupational setting.

Two other developments took place subsequently that reinforce our understanding of the contribution of education to allocative decisions by workers in contributing to productivity. Economists had long puzzled over why labor contracts are incomplete in the sense that they specify some requirements of the job but are not specific on other aspects of job performance that may even be more important (Bolton & Dewatripont, 2005). That is, although they may specify particular duties and

responsibilities, they also leave a large chasm of ambiguity in what most workers are expected to do, a chasm that grows with higher level occupations that require more education (e.g., professional, technical, and managerial). Often workers are evaluated and rewarded more on their performance on the aspects of their jobs that are not well specified than on the parts that are. Such incomplete contracts are not an oversight. Their purpose is to incorporate provisions for workers to take actions and make decisions beneficial to the firm that cannot be formularized into a contract or stipulated in advance because such actions and decisions will depend on circumstances that arise—often in an unpredictable fashion—and on which performance will vary considerably. This phenomenon has become even more prominent with the rise in adoption of work practices that require greater participation in decision making by workers (Handel & Levine, 2004) further reinforcing the explanation of adjustment to disequilibrium by Welch (1970) and Schultz (1975).

Why Does Education Raise Productivity?

Since the advent of the human capital revolution, numerous studies have estimated the impact of education on economic outcomes at individual and societal levels. These have yielded rates of return on educational investment comparable to or even greater than profitability of investments in physical capital. In general, the rate of return appears to be about 10% for investment in upper levels of secondary education and for postsecondary education, a return that is quite favorable for the individual and society (Psacharopoulos & Patrinos, 2004). This return is calculated from statistical estimates of an earnings function in which the number of years of schooling (or degree) and work experience are considered to be the primary determinants of earnings (Mincer, 1974). Of course, the earliest criticism of this approach was that it does not take into account the differential abilities of persons who attain additional years of schooling so that any estimate of the effect of schooling on earnings will be overstated by not including measures of ability. That is, the unobserved ability of a person accounts for both the higher earnings associated with more education rather than just the schooling itself. In response to this concern, economists have undertaken considerable numbers of studies to adjust for the presumed bias in the "naïve" estimates of returns to education (Card, 1999). Studies have been done on identical twins who share similar genes and family influences but different amounts of education; on fraternal twins; on siblings; and on fathers and sons to control for ability and other differences among persons with different levels of education (Rouse, 2007). In addition, natural experiments have tested the impact of increases in compulsory attendance requirements, where there are arbitrary increases in the minimum education imposed by government that are independent of student and family discretion (Oreopoulos, 2005, 2007). Remarkably, these studies are consistent in finding that the "adjusted" returns when taking account of ability are equal to or larger than those that omit ability adjustments, suggesting that the experience of years of schooling is a powerful determinant of economic productivity in itself (Card, 1999).

Is the Effect of Education due to Higher Achievement Scores?

Greater educational attainment, in itself, seems to have a substantial impact on productivity and earnings. But that does not answer the question of what component of education provides this powerful result. Recent educational policy, such as the No Child Left Behind (NCLB) legislation and the evaluation of teachers by gains in test scores of their students (McCaffrey, Lockwood, Koretz, & Hamilton, 2003), has assumed that education's productivity is primarily reflected in student achievement tests, that is, the

cognitive component of education. These policies have assumed that the quality of education and its impact on creating a productive labor force are linked to the cognitive levels and gains of students as measured by test scores. They are also premised on the view that the economic demands of the future labor force will require higher test scores of its members. But is this assumption substantiated by the evidence?

It seems reasonable to believe that years of educational attainment are merely a rough proxy for what has been learned and that direct measures of achievement would be better indicators of future productivity. Certainly educational attainment in years of schooling is a very crude measure of education; it tells nothing about what was studied, the rigor of the curriculum and standards, the quality of the institution, student effort, and what the student has accomplished beyond attendance. It is merely a measure of the number of years spent in an educational setting. Thus one might expect that test score measures are a superior and more powerful measure of actual attainment, particularly when it comes to acquiring the productive skills that apply in the workplace.

Bowles, Gintis, and Osborne (2001) addressed this question by considering studies of earnings that incorporated not only years of schooling but also measures of achievement. They posited that if the statistical relation between schooling and earning was simply a statistical surrogate for the missing information on test performance, the addition of test scores to the equation would reduce dramatically the apparent effect of years of education. Accordingly, they reviewed 25 studies containing 58 statistical estimates that included both test scores and educational attainment drawn from the early 1950s to the 1990s to test this hypothesis. They found that the addition of test score measures to the earnings equation reduced the apparent impact of educational attainment on earnings by only 18%. That is, 82% of the relationship of years of schooling to earnings remained, even after including test scores in the explanatory equation. Thus they concluded that most of the impact of education on labor force performance is associated with noncognitive measures. These might include worker persistence, worker effort, time management, cooperation, and many other personality traits developed by schools beyond cognitive knowledge (Almlund, Duckworth, Heckman, & Kautz, 2011; Levin, in press; Symposium on the Noncognitive Determinants of Labor Market and Behavioral Outcomes [Symposium], 2008). This perspective is also supported by Heckman, who has studied the impact of noncognitive measures on earnings for more than a decade with impressive findings that have established their importance (e.g., Cunha & Heckman, 2008; Heckman & Rubenstein, 2001).

Bowles et al. (2001) also examined the evidence that the impact of test scores on earnings has increased over time. The contention that test scores are increasingly important in workforce productivity derives from a single study that compared mathematics test score impacts on earnings between 1978 and 1986 which found a rise in hourly wages between those years (Murnane, Willett, & Levy, 1995). But an analysis of a wider range of studies found no such trend among 65 estimates from 24 studies reflecting a 30-year period (Bowles et al., 2001). Not only was there no evidence of a rising trend, but the absolute impact of test scores was small with a very large increase in test scores (from the 50th to 84th percentile) associated with only about a 10% increase in wages, equal to about 1 year of schooling. A study for the United Kingdom also found no increase in the returns to cognitive skills from 1995 to 2004 (Vignoles, De Coulon, & Marcenaro-Gutierrez, 2011). The overall evidence for the rising effect of cognitive skills is both lacking and beset with methodological issues (Cawley, Heckman, & Vytlacil, 2001).

Industrial psychologists have attempted to examine directly the relation between test scores and supervisor ratings of worker productivity. Although these tests are used for employment purposes and are promoted by management consultants, their predictive power for worker productivity is extremely modest, according to the two most important evaluations of the evidence. Both a National Research Council study (Hartigan & Wigdor, 1989) and a more recent summary of the literature found that test scores explain only about 6% of the variance in worker productivity as measured by supervisors, leaving 94% to be explained by other factors (Sackett, Schmitt, Ellington, & Kabin, 2001).

There is considerable additional evidence that although test scores are related to productivity and earnings, the connection is much more modest than assumed by both laypersons and policy makers. For example, multiple surveys of employers' views about what employers seek in their employees consistently set higher priorities for noncognitive qualifications embodying social and emotional behavior rather than academic concerns or qualifications reflected in test scores. Typical areas of priority that are rated highly in such surveys are good interpersonal relationships, worker attitudes, high motivation, customer handling skills, problem-solving skills, and teamwork (Levin, in press). All of these place a considerable emphasis on noncognitive attributes such as interpersonal and intrapersonal skills.

Not only are these noncognitive characteristics associated with worker performance but they are also associated with school performance, as documented in studies of early education (Camilli, Vargas, Ryan, & Barnett, 2010; Nores & Barnett, 2010). There is also strong evidence of the impact that schools can make in developing a range of social and emotional behaviors and attitudes that are linked to both academic achievement and mirror the desired personal attributes of workers sought by employers. The most important survey of this research is that of Durlak, Weissberg, Dymnicki, Taylor, and Schellinger (2011). This work is based on a meta-analysis or summary of 213 school-based social and emotional learning programs from kindergarten through high school, studies encompassing, overall, 270,000 children from ages 5–18. Only intervention studies that had control groups were included. Outcomes included six criteria: social and emotional skills, attitudes toward self and others, positive social behavior, good conduct, handling emotional distress, and academic performance. Socio-emotional Interventions in each of these six domains showed strong positive development for student outcomes.

Traditionally, noncognitive variables have been only rarely incorporated into economic studies of productivity and earnings. Thus the specific interpersonal and intrapersonal variables that connect to productivity are at a much earlier phase of research than the cognitive measures, which have been studied for at least a half-century. The noncognitive domain has been studied far less than the cognitive one, but new studies are emerging rapidly, stimulated by the academic pioneers in this area such as James Heckman and his colleagues (e.g., Borghans, ter Weel, & Weinberg, 2008; Cunha & Heckman, 2008; Symposium, 2008). An example of the progress being made is found in an excellent recent study from Sweden that evaluated cognitive and noncognitive dimensions of military enlistees, enlistment being a mandatory requirement for all Swedish males (Lindqvist & Vestman, 2011). All enlistees filled out an extensive questionnaire with 70–80 questions. A certified psychologist was provided with this information as well as measures of cognitive ability and other attributes and interviewed the enlistees to evaluate their social and emotional profiles. Each conscript was given a score according to the same distribution used for the cognitive ability score. Using a random sample of men born from 1965 to 1984, the authors evaluated the impact of cognitive and noncognitive measures on wages, unemployment, and annual earnings. They found that men who do poorly in the labor market lack noncognitive abilities. In

contrast, cognitive ability is a stronger predictor of wages and earnings for workers with earnings above the median.

Twenty-First-Century Skills and the Workforce

In the previous section, I concluded that we cannot predict with any precision the contours of the economy and its workplace details some five decades from now. Moreover, the types of cognitive skills measured by test scores bear only a modest relation to the economic productivity of the labor force and show little evidence of rising importance. In contrast, there are many other attributes, largely ignored in educational policy, that are embodied in schooling development and that may account for much of the substantial impact of increased educational attainment on individual and societal economic outcomes. In this section, we will review recent additions to economic analysis of education and its implications. Then we will proceed to a promising strategy for guiding educational policy to meet the workforce demands of a productive and competitive economy in the mid-21st century.

Endogenous Growth Theory and Economic Externalities

Traditionally, the economic growth literature viewed technological advance as being exogenous to the economic system, being determined by factors outside the workings of the economy. However, this has raised serious questions about why technological advance and its economic returns differ among nations when its fruits are largely disseminated and available across national lines. More recent interpretations view both the generation of technological progress in pure and applied forms and its productive adoptions as endogenous in nature. That is, they are determined by the economic system through its overall organization and the incentives, information, and investments that are made in education and research and development (Romer, 1994). Educational investments may generate technological advances through creating more adaptable workers as well as promoting research and development. Through education, it is possible to produce more scientists, engineers, and entrepreneurs who capitalize quickly on new knowledge; a higher level of general technical literacy among the population; information flows that provide quick access to the latest developments; and research and inquiry in higher education (and industry) that can generate technical advances. Nations can focus on an educational system that generates new knowledge and ideas and their rapid transmission through the latest information technologies. At the same time, the educational system can focus on producing individuals who seek such information to gain competitive edges in production or establish new product and service markets. Such individuals will have great ability to adjust to disequilibria as new knowledge arises. Thus there is an opportunity for educational systems to consider their internal goals and operations as an instrument of economic policy that provides benefits to the nation as a whole beyond those received by individual workers and firms.

In addition, education produces economic “externalities” by increasing the common stock of knowledge available generally to all individuals and firms. This phenomenon increases the adaptability of the workforce to raise its productivity with an accompanying impact on economic growth independent of the individual productivity increments from each more educated worker. One explanation is that such an accumulation of educated talent makes possible both the production and use of research and development that is not possible at lower levels of general educational development. The precise mechanisms by which these dynamics function are under debate, but there is empirical support for the importance of educational externalities beyond the effects of increased education of individual workers

(Moretti, 2004). It is likely that the type of worker who can adjust to disequilibria and make allocative decisions will not only improve his or her own productivity but also that of colleagues who benefit from better resource allocation. These types of workers will also adjust more quickly to changes in technology at the societal and firm levels.

Adaptability as the Major Goal

The traditional view of the role of education in increasing productivity was that it raised the knowledge of the worker for accommodating work tasks and increasing precision and individual output. Additional education also enhanced the trainability of workers for more complex work roles and higher positions. But the more recent views suggest that the greatest gains in worker productivity, both in the short run in improving the allocation of resources and in the long run in accommodating new technologies and forms of organization, result from the adaptability of workers to change. This goal was first elaborated by Nelson and Phelps (1966) in the early years after the rise of human capital theory. They argued that education has little impact on raising productivity in routine jobs because of limited opportunities to improve results. But "education is especially important to those functions requiring adaptation to change" (Nelson & Phelps, 1966, p 69), particularly as technology advances. In the more modern version of endogenous growth theory, it is not only the adaptability of educated workers to technological change but also the ability of a more educated workforce to advance technological change. And even here we must note that such a contribution of education must depend on how workers collaborate and communicate with each other (interpersonal) and how they are able to respond to different work situations indicating disequilibria through decision making and adjustment of roles to the new reality. More education is an investment not only in cognitive knowledge and trainability but also in adaptability to a changing workplace.

American education has always promoted adaptability, in contrast to other industrialized countries, which have focused on preparing workers for relatively rigid qualifications for specific jobs through narrow educational specialization. In the post–World War II period, the United States eschewed the manpower planning approaches to education promoted by the Organisation for Economic Co-operation and Development (OECD) and adopted by both Eastern and Western European nations. This approach entailed projections of economic output by sector multiplied by a fixed formula of occupational requirements per unit of output per sector that was further translated into a rigid formula of educational needs of a future labor force. These relations were based on fixed ratios of sectoral output to occupational composition and educational requirements per occupation. Needless to say, the manpower forecasts failed, largely because of the rigid assumptions relating educational requirements to occupation and occupational requirements to economic output. Unanticipated changes in technology, organization, market prices of labor and capital and poor projections of sectoral output all undermined the accuracy of the projections of educational need (Blaug, 1967).

In contrast, the human capital model depended on market dynamics in which adjustments would take place through the marketplace and employers' responses to educational utilization according to the costs and productivity of different kinds of labor. What is particularly important from this perspective is that labor supply and demand were expected to adapt through investments in education, training, and experience on the supply side and changes in organization, technology, and composition of final products

on the demand side. It is this adaptability on which the educational system must focus through providing attention to noncognitive and cognitive improvements in schooling and raising educational attainments.

Education for adaptability has been an historical feature of education in the United States, and it has been largely successful accomplished. One might even think of this as American exceptionalism historically, although the rest of the world is catching up. For example, education for adaptability is now being propelled in the European Community as a consequence of seeking harmonization of educational requirements across higher education programs in the attempt to implement the Bologna agreements, which promote a more general and liberal education.

Education for adaptability has been an historical feature of education and educational expansion in the United States, and there is good evidence that it has worked according to the broad sweep of Goldin & Katz (2010). Evidence of adjustments to disequilibria has been substantial. For example, a massive disequilibrium was created by the loss of the male labor force to military duty during the Second World War, with 16 million men transferred from the labor force into the military, a shift experienced by about half of all men between 18 and 44 years of age (Acemoglu, Autor, & Lyle, 2004). Evidence of adaptability of the labor force was demonstrated by the fact that these men were replaced by a large expansion in the labor force participation of women. Despite a lack of previous workforce participation and experience, the new female entrants were able to maintain the high rates of productivity needed to support both the war effort and the economy (Goldin, 1991).

Another measure of adaptability is the elasticity of substitution between workers at adjacent educational levels. If workers are assumed to have specific qualifications for particular jobs and occupations, the ability to substitute a worker at one level of education for another in production is limited. If workers have broader skills (including interpersonal and intrapersonal skills), as relative wages change, there is the possibility of greater substitution of one level for another. That is, as the relative wage of those with more education rises relative to those with less education, more persons with less education will be employed to do the work. The magnitude of this substitutability is one measure of the adaptability of workers among work tasks with greater demands and complexity. In the United States, the elasticity of substitution from 1950 to 1990 has been estimated to be about 1.5. This means that for every 1% in the relative rise of labor costs at a higher level of education, there is a 1.5% decrease in demand for workers at that level as those with less educated are substituted (Ciccone & Peri, 2005). Workers with different levels of education can be substitutes for each other as technologies and relative wages change. The focus here is not the specific mix of education employed in the labor market as much as the flexibility of workers at different educational levels to undertake those roles. Of course, at the same time, there are investments in training that promote a high level of substitutability of educational levels, training possibilities that, themselves, build on previous education. But the basic underlying potential of adaptability through the educational system is a precondition.

What Should Be Done?

Before suggesting some directions for educational policy, let me set out a summary of some of the previous points:

1. We lack capacity to predict the economy and worker needs some 50 years hence despite the claims of futurists.

2. The amount of schooling received is convincingly linked to higher individual productivity and earnings and national economic growth.
3. Recent research has shown that productive aspects of education extend far beyond the cognitive domain and their test score assessments to important noncognitive dimensions of interpersonal and intrapersonal behaviors.
4. The outcomes of the present U.S. educational system show that the adaptability of the U.S. worker is high and can be used to accommodate future changes in technology, product mix, work organization, and relative wages in the manners suggested by the theory of worker adjustment to disequilibrium and that of endogenous growth.
5. The impact of worker adaptability is likely to increase as work organizations follow the long-term trend to enlist their employees to participate in decisions that draw on their skills and abilities to make resource allocation decisions.

For these reasons, I believe that the promotion of worker adaptability to a wide range of potential changes in the workplace is of the highest priority. Of course, one could say that if I have already made the case for existing workforce adaptability, why worry about it in the future? The answer is somewhat obvious. Educational policy in the United States has taken an ominously narrow departure by focusing obsessively on test scores. NCLB has devoted an entire system of federal funding and pressure on states to produce higher test scores, and this narrow focus does not even do justice to the many cognitive needs of workers beyond the subjects evaluated through high-stakes testing. Consider the pertinence of the standardized tests and limited domains to such areas as problem solving or collaborative decision making. The present obsession leads to instructional strategies of test-prep and student memorization and a narrowing of the curriculum to those subjects that are included in the testing regimen. An effort to gain balance among cognitive, interpersonal, and intrapersonal capacities must redress the present imbalance where, increasingly, teachers are evaluated and rewarded on gains in the test scores of their students, and schools are evaluated only on the basis of their test results.

Specific Worker Goals

To develop schools that not only create adaptable workers, as in the past, but increase that adaptability to accommodate future directions of change, it is possible to set out a range of dimensions for consideration. These components have been derived from studies of the requirements of productive workplaces in the latter part of the 20th century, but they are general enough to be pertinent to the quest for adaptability to a wide range of technological and organizational changes that may emerge in the future (Levin & Rumberger, 1989; Secretary's Commission on Achieving Necessary Skills, 1992). These also build on the response of employers to surveys on what they seek in their workers and are compatible with the movement toward greater worker participation in allocative decisions:

- **Initiative.** The drive and creative ability to think and act independently
- **Cooperation.** Constructive, goal-directed interaction with others
- **Working in groups.** Interaction in work groups directed toward both short-term goals of efficient task or activity accomplishment and the long-term goal of group maintenance

- **Peer training.** Informal and formal coaching, advising, and training of peers
- **Evaluation.** Appraisal, assessment, and certification of the quality of a product or service
- **Reasoning.** Evaluation and generation of logical arguments, including both inductive and deductive approaches
- **Problem solving.** Identification of problems, hypothesis testing on causes, generation of alternative solutions and their consequences, selection of an alternative, and implementation of a solution
- **Decision making.** Employing the elements of problem solving on an ongoing basis in the workplace
- **Obtaining and using information.** Deciding which information is relevant, knowing where to obtain it, obtaining it, and putting it to use
- **Planning.** Establishing goals as well as scheduling and prioritizing work activities to achieve them
- **Learning skills.** Cognitive and affective skills that facilitate the acquisition of new knowledge, including metacognitive knowledge and strategies
- **Multicultural skills.** Understanding how to work with persons from other cultures in terms of language, communication styles, and diverse values

Note that none of these are strictly cognitive, interpersonal, or intrapersonal but require interaction among all three dimensions. None of these behaviors can be assessed accurately by conventional test instruments, and many of them are associated with what is learned in higher education in terms of the instructional strategies and educational experiences of that level.

According to Goldin and Katz (2010), it was the enormous expansion of education in the late 19th and 20th centuries that both produced the technology and kept up with its educational and workplace demands that increased productivity beyond that of other nations. But that educational precedent has been reversed. In 2009, the United States was 21st in terms of high school completion and 16th in college completion among the industrialized countries of the OECD (2011, Charts A2.1 and A3.1). And in consequence, the U.S. labor force productivity advantage may be eroding (OECD, 2005).

In my view, the most important single goal must be to increase vastly the numbers of high school and college completers, especially those from minority and poverty populations. Bailey (2007) has argued that without improving high school completion and college graduation among the new entrants to the labor force, the absolute level of educational attainment of the labor force will decline in the next decade. That is, retirees will be replaced by labor market entrants with lower educational attainments than those leaving the labor force. The urgency of increasing high school and college completion rates cannot be overstated if we expect to have a capable and adaptable labor force that can compete effectively with those of other nations. This policy will necessarily improve the education of those populations who are most affected by poor educational attainment today. In the long run, it will not only improve labor force productivity but save taxpayers because of the increase in tax revenues and reductions in the costs of public services used to support those at the margins of society (Belfield & Levin, 2007). And it is important to note that increasing educational attainments of the young and the labor

force must be done without diluting the quality (cognitive, interpersonal, and intrapersonal outcomes) of the educational experience. There is good reason to believe that devices as "credit recovery" or reducing standards for student progress are partial explanations for the claims of higher graduation rates, expecially given the fact that so many high school graduates are unprepared to undertake college instruction (U.S. Department of Education, 2011, p. 70).

The consistent evidence that increases in educational attainment that are mandated through extension of compulsory education requirements have an economic return comparable to noncompulsory years suggests that this reform should be considered (Oreopoulos, 2005). In particular, requiring students to attend school to age 18 years should increase high school completion rates as well as postsecondary education participation through raising eligibility for college admission. More years of compulsory attendance also seem to show a causal increase in health status (Oreopoulos, 2007). The evidence in these studies suggests that dropping out is due less to an aversion to school than to the tendency to undervalue the future benefits of completing high school.

Indeed, the improvement of standards should be pushed, even though it is challenging to increase graduation rates and improve standards simultaneously. Whether the new Common Core Standards that many states have adopted will be the impetus in this direction is an open question. However, at this time, the breadth of the new standards is countered by the narrowness of testing and assessment and the absence of consideration of the noncognitive dimensions, which are also ingredients of adaptability. Increasing the educational attainment of the labor force and maintaining and expanding its adaptability ought to be the top two educational priorities for meeting workplace requirements in the middle of the 21st century. This cannot be done without creating greater balance and interaction in the educational system among the cognitive, interpersonal, and intrapersonal goals. The single-minded focus on narrowly measured student achievement may be the greatest obstacle to creating the productive labor force of the future.

References

Acemoglu, D., Autor, D. H., & Lyle, D. (2004). Women war and wages: The effect of female labor supply on the wage structure at midcentury. *Journal of Political Economy*, *112*(3), 497–551.

Almlund, M., Duckworth, A. L., Heckman, J., & Kautz, T. (2011, January 25–27). *Personality psychology and economics*. Paper presented at the IZA Workshop: Cognitive and Non-cognitive Skills, Bonn, Germany. Retrieved from http://iza.org/conference_files/CoNoCoSk2011/heckman_j130.pdf

Autor, D., Levy, F., & Murnane, R. (2003). The skill content of recent technological change: An empirical exploration. *Quarterly Journal of Economics*, *118*(4), 1279–1334.

Bailey, T. (2007). Implications of educational inequality in a global economy. In C. Belfield & H. M. Levin (Eds.), *The price we pay* (pp. 74–98). Washington, DC: Brookings Institution Press.

Becker, G. (1964). *Human capital*. New York, NY: Columbia University Press.

Belfield, C., & Levin, H. M. (Eds.). (2007). *The price we pay.* Washington, DC: Brookings Institution Press.

Blaug, M. (1967). *Approaches to Educational Planning. The Economic Journal. 77*(306), 262-287.

Blundell, R., Dearden, L., Meghir, C., & Sianesi, B. (1999). Human capital investment: The returns from education to the individual, the firm, and the economy. *Fiscal Studies*, *20*(1), 1–23.

Bolton, P., & Dewatripont, M. (2005). *Contract theory.* Cambridge, MA: MIT Press.

Borghans, L., ter Weel, B., & Weinberg, B. A. (2008). Interpersonal styles and labor market outcomes. *Journal of Human Resources, 43*(4), 815–858.

Bowles, S., Gintis, H., & Osborne, M. (2001). The determinants of earnings: A behavioral approach. *Journal of Economic Literature, 39*(4), 1137–1176.

Camilli, G., Vargas, S., Ryan, S., & Barnett, W. S. (2010). Meta-analysis of the effects of early education interventions on cognitive and social development. *Teachers College Record*, *112*(3), 579–620.

Card, D. (1999). The causal effect of education on earnings. In O. Ashenfelter & D. Card (Eds.), *Handbook of labor economics* (pp. 1802–1863). New York, NY: Elsevier.

Cawley, J., Heckman, J., & Vytlacil, E. (2001). Three observations on wages and measured cognitive ability. *Labour Economics*, *8*(4), 419–442.

Ciccone, A., & Peri, G. (2005). Long-run substitutability between more and less educated workers: Evidence from U.S. states, 1950–1990. *Review of Economics and Statistics*, *87*(4), 652–663.

Cunha, F., & Heckman, J. J. (2008). Formulating, identifying and estimating the technology of cognitive and noncognitive skill formation. *Journal of Human Resources*, *42*(4), 738–782.

Durlak, J. A., Weissberg, R. P., Dymnicki, A. B., Taylor, R. D., & Schellinger, K. 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.

Goldin, C. D. (1991). The role of World War II in the rise of women's employment. *American Economic Review*, *81*(4), 741–756.

Goldin, C., & Katz, L. (2010). *The race between education and technology*. Cambridge, MA: Harvard University Press.

Handel, M., & Levine, D. I. (2004). Editors introduction: The effects of new work practices on workers. *Industrial Relations*, *43*(1), 1–43.

Hartigan, J., & Wigdor, A. (1989). *Fairness in employment testing: Validity generalization, minority issues, and the general aptitude test battery*. Washington, DC: National Academy Press.

Heckman, J., & Rubenstein, Y. (2001). The importance of noncognitive skills: Lessons from the GED testing program. *American Economic Review*, *91*(2), 145–149.

Leuven, E., & Oosterbeek, H. (1997). Demand and supply of work-related training. In *Research in Labor Economics* (pp. 303–330). Bingley, UK: Emerald.

Levin, H. M. (in press). The utility and need for incorporation of non-cognitive skills into large-scale educational assessments. In M. von Davier, I. Kirsch, K. Yamamoto, & E. Gonzalez (Eds.), *The role of international large-scale assessments: Perspectives from technology, economics, and educational research*. New York, NY: Springer.

Levin, H. M., & Rumberger, R. (1989). Education, work, and employment in developed countries: Situation and future challenges. *Prospects*, *19*, 205–224.

Lindqvist, E., & Vestman, R. (2011). The labor market returns to cognitive and noncognitive ability: Evidence from the Swedish enlistment. *American Economic Journal: Applied Economics, 3*, 101–128.

Lynch, L. (1992). Private sector training and earnings. *American Economic Review*, *82*(1), 299–312.

McCaffrey, D. F., Lockwood, J. R., Koretz, D. M., & Hamilton, L. S. (2003). *Evaluating value-added models for teacher accountability*. Santa Monica, CA: RAND.

Mincer, J. (1974). *Schooling, experience, and earnings*. New York, NY: Columbia University Press.

Moretti, E. (2004). Workers' education, spillovers, and productivity: Evidence from plant-level production functions. *American Economic Review*, *94*(3), 656–690.

Murnane, R., Willett, J., & Levy, F. (1995). The growing importance of cognitive skills in wage determination. *The Review of Economics and Statistics, 77*(2), 251–266.

Nelson, R. R., & Phelps, E. S. (1966). Investment in humans, technological diffusion, and economic growth. *American Economic Review*, *56*(1/2), 69–75.

Nores, M., & Barnett, W. S. (2010). Benefits of early childhood interventions across the world: (Under) investing in the very young. *Economics of Education Review*, *29*, 271–282.

Oreopoulos, P. (2005). Estimating average and local average treatment effects of education when compulsory schooling laws really matter. *American Economic Review*, *96*(1), 152–175.

Oreopoulos, P. (2007). Do dropouts drop out too soon? Wealth, health, and happiness from compulsory schooling. *Journal of Public Economics*, *91*(11/12), 2213–2229.

Organisation for Economic Co-operation and Development. (2005). *International comparison of labour productivity levels: Estimates for 2004*. Retrieved from http://www.oecd.org/dataoecd/31/7/29880166.pdf

Organisation for Economic Co-operation and Development. (2011). *Education at a glance.* Paris, France: Author.

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

Romer, P. (1994) The origins of endogenous growth. *Journal of Economic Perspectives*, 8(1), 3-22.

Rouse, C. E. (2007). Consequences for the labor market. In C. Belfield & H. M. Levin (Eds.), *The price we pay* (pp. 99–124). Washington, DC: Brookings Institution Press.

Sackett, P. R., Schmitt, N., Ellington J. E., & Kabin, M. B. (2001). High stakes testing in employment, credentialing, and higher education: Prospects in a post–affirmative action world. *American Psychologist*, *56*(4), 302–318.

Schultz, T. W. (1961). Investment in human capital. *American Economic Review, 51*(1), 1–17.
Schultz, T. W. (1975). The value of the ability to deal with disequilibria. *Journal of Economic Literature*, *13*(3), 827–846.
Secretary's Commission on Achieving Necessary Skills. (1992). *Learning a living: A blueprint for high performance*. Washington, DC: U.S. Department of Labor.
Sommers, D., & Franklin, J. C. (2012, January). Overview of projects to 2020: Employment outlook: 2010–2020. *Monthly Labor Review*, pp. 3–20.
Symposium on the noncognitive determinants of labor market and behavioral outcomes [Special issue]. (2008). *Journal of Human Resources, 43*(4).
U.S. Department of Education. (2011) *The condition of education 2011* (NCES 2011-033). Washington, DC: U.S. Government Printing Office.
Vignoles, A., De Coulon, A., & Marcenaro-Gutierrez, O. (2011). The value of basic skills in the British labour market. *Oxford Economic Papers*, *63*(1), 27–48.
Welch, F. (1970). Education in production. *Journal of Political Economy*, *78*(1), 35–59.

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