Introduction

Common wisdom along the hallways of development agencies preaches the importance of human capital for development, whereas one of the most important issues policy-makers in developing countries often face is unemployment among educated youth. While evidence from Organization for Economic Co-operation and Development (OECD) countries shows that human capital accumulation is associated with growth accelerations, the massive efforts to improve access to and quality of schooling in developing countries have not translated, on average, into higher income per capita. Moreover, cross-country differences in schooling per worker and output per capita have moved in opposite directions, with the near-universal expansion in schooling reducing the former while per capita income gaps widened.[1] How do we reconcile these seemingly contradictory positions? Is the problem that some developing countries have a relative abundance of skills, but other constraints are preventing these from being demanded and utilized? Is it that schooling is not producing skills so that there is demand for human capital that existing schooling and training programs do not meet? Or is it instead that there is demand for human capital and relative abundance skills, but labor market failures are preventing skilled people from being hired? In this Element, we argue that the answer to this puzzle depends on country-specific factors and propose a framework to assess whether improvements in a country's human capital can reasonably be expected to have an impact on economic growth.

When can we expect improvements in the provision of a factor – human capital – to be good for growth? Solow (1956) proposed modeling and studying economic output as a production function with complementary inputs: physical capital and labor, and a productivity factor that depends on the level of technological progress. Mankiw, Romer, and Weil (1992) introduced an augmented model by incorporating the notion of human capital. The model assumes diminishing returns to capital – as capital accumulation increases, the incentive to save and invest in capital decreases – leading to a level of income per capita that is determined by savings rates, population growth, and technological progress, all exogenous variables. Under these assumptions, growth in output per capita is exogenous: any permanent increases in the provision of a production factor will lead to temporary positive growth rates that allow the income level to shift permanently. The economic growth delivered thereby can only be transitional in nature. Within this context, investments in the stock of human capital yield a shift in income level but do not boost growth.

[1] See Pritchett (2006).

Escaping Solow invariance and the exogeneity of growth requires an endogenous growth engine and relaxing the assumption of diminishing returns. Romer (1986) proposed a growth model of endogenous technological change, expanding the concept of factor accumulation as a determinant of growth from physical and human capital to include knowledge. The accumulation of knowledge leads to externalities – as knowledge is non-rivalrous in nature – and thereby exhibits increasing returns to scale. Hence, growth in output per capita is no longer a temporary and exogenous phenomenon but rather the product of knowledge accumulation by profit-maximizing agents and as such can increase over time. Within this context, investments in human capital may have a significant impact on long-run growth if they are related to the production, adoption, and diffusion of knowledge.

A policy implication of Romer's model is that knowledge can be transferred to developing countries as blueprints, and the only constraint to economic growth is the speed of physical and human capital accumulation. Yet, by the early 2000s, economic growth outcomes of developing countries showed income divergence in most regions except for East Asia and South Asia, mostly due to the slow or lack of convergence of total factor productivity (Bosworth and Collins, 2003). Decades of standard growth accounting exercises between 1960 and 2000 show that capital accumulation – physical or human – only partially explains the cross-country output gap (Hall and Jones, 1999; Bils and Klenow, 2000; Caselli, 2005).

The Growth Diagnostics framework introduced by Hausmann, Rodrik, and Velasco (2008) argues for the prioritization of growth reforms contingent on a country's economic environment. They propose a simple model in which economic growth is determined by the returns on factor accumulation, the appropriability of these returns and the costs of financing factor accumulation. Within this context, distortions on the provision of the underlying production factors constrain investment and growth. The distortion with the highest estimated growth yield is called the most binding constraint and shall be prioritized within the allocation of policy attention and government resources. The range of factors that underlie the economic growth process is broad, including finance, infrastructure, human capital, macroeconomic and microeconomic risks, and market failures.

We build on the principles of Growth Diagnostics proposed by Hausmann, Rodrik, and Velasco (2008) and propose a framework to investigate and assess *whether improvements in the accumulation of human capital shall be prioritized to accelerate economic growth in a specific country.* We illustrate the application of the framework by drawing on Harvard University's Growth Lab's fifteen

years of experience in applying Growth Diagnostics at the national and sub-national levels worldwide. We demonstrate the deployment of four principles of differential diagnosis to test whether human capital is the most binding constraint. Practitioners will find in this Element a combination of econometric tests, characteristics of the data required and proposed visualizations for their results, as well as more descriptive calculations derived from data available through various enterprise surveys, international financial institutions, or other publicly available sources. Additionally, we take stock of common policy interventions aimed at alleviating or overcoming distortions in cases where human capital is diagnosed as the most binding constraint.

The Element is organized as follows. Section 1 reviews the evolution of the concept of human capital in the economic literature, contrasts definitions against recent research outputs on schooling – an avenue to acquire human capital – in developing countries, and proposes a framework to assess the adequacy of human capital to support the process of economic growth in a specific country. Section 2 describes the four diagnostic principles to assess the adequacy of the human capital supply and access to it, as well as illustrates their use through examples from national and sub-national contexts. In doing so, we consider means to acquire human capital that are different from schooling: On-the-job training and experience can account for skill accumulation in ways that are not captured by schooling alone. Section 3 provides guidance on distilling the analysis results to judge whether human capital is indeed a binding constraint to growth and formulate policies that governments may adopt to overcome shortages in the supply of human capital. Conclusions, limitations, and potential avenues for further applied research work are presented in Section 4.

1 What Is Human Capital?

The term *capital* has traditionally referred to assets generated through a deliberate investment and whose operation is associated with a return. The most obvious forms of capital are physical and financial assets. The notion of human skills and knowledge as a form of capital, while alluded to by Adam Smith as early as 1776 (Smith, 1776), was formalized by pivotal contributions from Schultz, Becker, and Mincer in the late 1950s and early 1960s, which gave rise to a literature that sought to define the concept and study the return on investments in human capital.

Schultz (1960) defined human capital as the skills and knowledge that constitute an individual's productive capacity and ought to be treated as capital,

since individuals in jobs apply their abilities and "provide a productive service of value to the economy (p. 571)." As such, human capital formation, through schooling and training, promised positive growth-promoting externalities making human capital essential for economic development (Myrdal, 1957; Schultz, 1960). Schultz also emphasized the need to understand the return on investment in human capital and, ultimately, how it contributes to national income. Building on this literature, Schultz (1960, 1961, 1963) and Lucas (1988) extended the neoclassical economic growth model to incorporate human capital as a cumulative factor contributing to economic productivity and growth, beyond manual labor and similar to physical capital. In these models, individuals' human capital affects not only their own productivity but also that of other factors.

In parallel, the contributions of Becker and Mincer provided the foundational frameworks and methods to measure the return on schooling and other human capital investments. Becker (1962) argued that some activities affect future individual well-being rather than the present, by "embedding" individuals with resources that impact their future real earnings. He proposed a theory connecting "investments in human capital" to worker earnings, which would increase with the value of investments in skill accumulation, on or out of the job. Becker and Chiswick (1966) provided empirical estimates of the return to different levels of schooling on earnings. Mincer (1958, 1974, 1984) contributed empirical models to measure the effects of skills accumulation – with schooling and work experience as proxies – on income distributions.

Schooling and on-the-job training are the most common forms of human capital investment. Other investments that contribute to productivity include physical and mental healthcare, nutrition, other means of acquiring knowledge or information, or noncognitive skills (Becker, 1962). Healthcare and nutrition are critical to build cognitive abilities and keep individuals engaged in economic activities beneficial for them and their societies. The impact of deteriorating health on human well-being and the economy has been studied (Rosen, 1988; Becker, 2007) and echoed stronger than ever in the wake of the COVID-19 pandemic. Interestingly, Schultz (1961) also discusses migration, particularly internal relocations where individuals migrate from rural to urban areas to benefit from job opportunities, as a form of investment in human capital. Under this view, individuals incur a "cost of migration" to be able to employ their human capital in opportunities in the destination. These opportunities, over their lifetime, will generate a larger return than in the location of origin and compensate for the costs associating to migration.

Before we proceed to discuss a framework to determine whether policy interventions aimed at augmenting human capital shall be the priority to

accelerate growth in a specific country, we note three points regarding human capital accumulation and economic growth.

First, despite near-universal school enrollment achieved as part of the international drive to promote schooling under the second Millennium Development Goal, evidence suggests that little human capital was created to generate literacy, let alone provide children with skills and knowledge. Pritchett (2013) documents extensively the paradox that while the average years of schooling in the developing world went from two years in 1950 to seven years in 2010, the poor quality of schooling worldwide had not led to *education* or learning. Assessments from several developing countries, such as India, Indonesia, Pakistan, Nigeria, and Peru, show that students' learning outcomes in these countries lag those of students in OECD countries. Kaffenberger and Pritchett (2017) study the learning profiles of young adults between eighteen and thirty-seven years of age in ten developing countries to examine the association between schooling completion and learning outcomes. They find that in six out of the ten countries, half or more than half of young adults who completed primary schooling cannot read a few sentences without assistance. Moreover, according to a 2017 survey of learning outcomes of youth between fourteen and eighteen years old in rural communities in India carried by ASER Centre,[2] 45 percent of those enrolled in tertiary education were not able to tell the time (Look Beyond Basics: Annual Status Education Report, 2017). In short, there has been a lot of schooling in the developing world but no accumulation of human capital, in any of the senses implied by the set of definitions previously reviewed.

Second, it goes without saying that investing in human capital may carry numerous noneconomic or nonmonetary benefits. Increasingly, the international development agenda has emphasized and sought to study the impact of investments in human capital on a broad range of life outcomes (United Nations Economic Commission for Europe, 2016). For example, investing in women's schooling is expected to positively influence their own well-being and that of their families. Kaffenberger and Pritchett (2020) leverage cross-national data on schooling and assess literacy to compare the association of child mortality, fertility, women's empowerment with women's literacy (i.e., learning resulting from schooling) versus schooling (assuming schooling often does not translate into literacy). Not surprisingly, they find the associations to be larger than initially estimated when using schooling levels only – not adjusted for learning. An important implication of this study is that the life or nonmonetary

[2] ASER Centre is an autonomous assessment, survey, evaluation, and research unit within the Pratham network.

impact to schooling as an investment in human capital depends on the transmission mechanism through which it generates the benefit. The study points toward learning – that is, the effectiveness of the investment at generating human capital.

Third, in line with the previous two points and also with the Growth Diagnostics framework, empirical evidence from developing countries demonstrates that the marginal return to schooling was lower than expected in many countries (Temple, 1999; Pritchett, 2006). Higher levels of schooling did not translate into higher levels of national development or human well-being. Figure 1 compares cross-country schooling levels and income per capita across four different countries. The data show convergence in schooling with a divergence in income. While schooling levels in Ghana, Thailand, and Mexico were much lower than in a more developed country like France before 1970, these countries (and many other developing countries) witnessed an expansion in schooling after 1970. By 2005, Mexico's level of schooling was similar to that of France in 1995. Ghana was not much further behind. Thailand showed the least progress among this group of countries – by 2005, it achieved the 1985 and 2000 level of schooling of France and Ghana, respectively. Yet comparing the countries' per capita income levels shows a massive boom in income per capita in Thailand, which comes with an improvement in the country's socioeconomic indicators. Yet Ghana's income per capita stagnated.

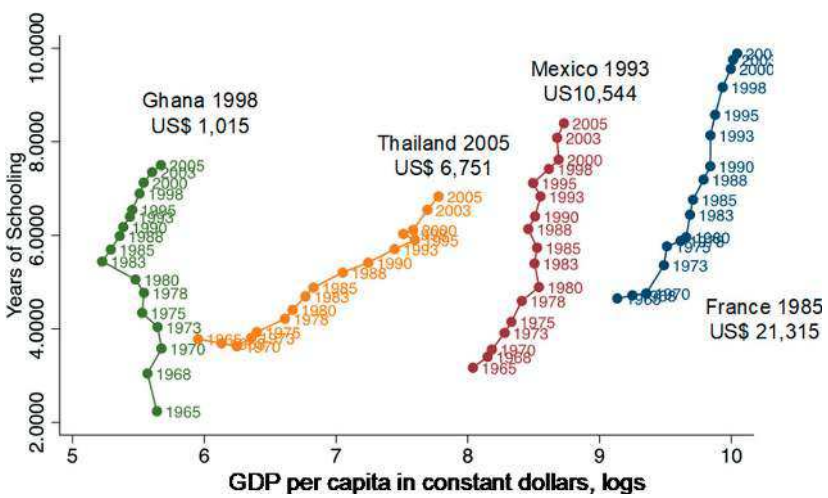

Figure 1 Years of schooling versus per capita income
Source: World Development Indicators

Human Capital as a Binding Constraint to Growth: A Framework

For the purposes of this Element, we will adopt different definitions of human capital at the individual and the country levels. *The human capital of an individual refers to the physical and cognitive capabilities, acquired through schooling and training, that allow individuals to increase the productivity of their efforts. Consequently, a country's human capital is the spectrum of skills available through its working-age population.* The skill spectrum enables economic activities, the adoption of new technologies, and the development of new products and services, which are all tightly linked to the process of economic growth.

The starting point of a Growth Diagnostic exercise is a growth model with different distortions leading to two potential problems constraining investments: (1) low expected private returns to asset accumulation and (2) high cost of finance (Hausmann, Klinger, and Wagner, 2008). Potential constraints to growth coming from human capital fall under the former: firms might be hesitant to carry out investment as the expected returns are low due to low levels of human capital. As such, the question of whether human capital is a binding constraint to growth refers to whether the skill spectrum *in the country* is adequate and accessible to firms looking to make a return on their investment.

Figure 2 lays out the framework to study the motivating question: Do firms have access to adequate skills to invest and generate competitive returns? Firms might not be investing because (1) the stock of skills in the country is inadequate, (2) they are unable to access available skills due to misallocations, or (3) the cost or risk associated with hiring needed skills is high. Constraints (1) and (2) can be characterized as problems of low social returns on investments because the needed skills are not available in the economy or are not accessible to high-growth potential sectors and firms. That is, firms expect a low return on their investment due to a shortage of needed skills. Low levels of human capital or inadequate spectrum of skills might hinder returns because either they prevent firms from operating at the frontier of their production possibilities (forcing them to be less efficient) or firms have to bid up for scarce skills, and this renders their returns less competitive when compared to other potential locations.

Constraint (3) is a problem of appropriability, where firms' ability to privately appropriate the returns to their investment is low due to microeconomic risks, such as, labor market rigidities like binding minimum wage or employment regulations that reduce firms' ability to generate an acceptable return on their investment.

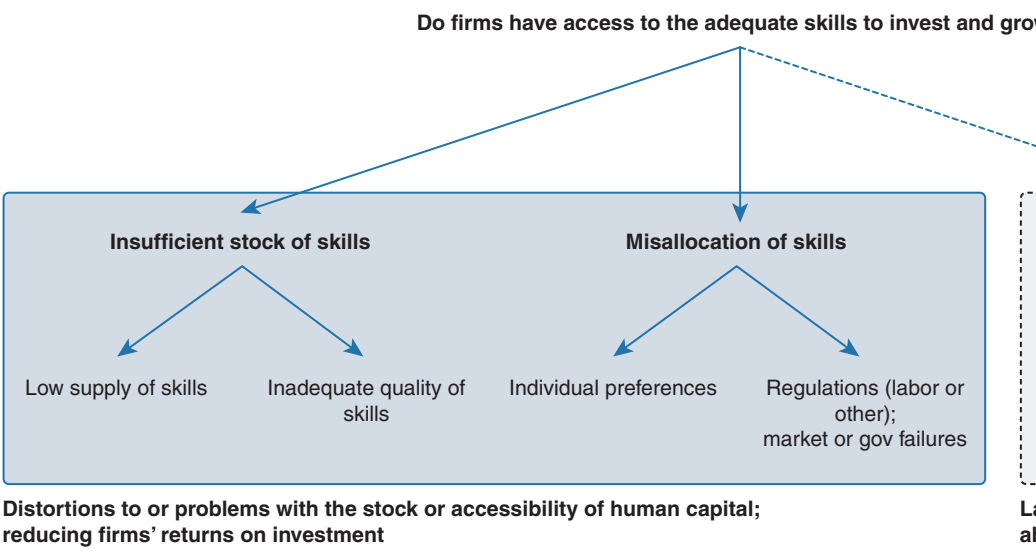

Figure 2 Diagnostic tree for human capital constraints

In this Element, we focus on the problem of low social return (constraints [1] and [2]) and leave out appropriability problems (constraint [3]), as the latter requires a different set of diagnostic tools and policy strategies.

We define constraint (1) – insufficient stock of skills – to be a shortage in the quantity or poor quality of skills supplied to meet existing demand. We define constraint (2) – misallocation of skills – as a mismatch or limited firm access to available skills. Several country-specific institutions, rules, regulations, or norms can lead to the misallocation of skills. For example, cultural norms leading women to work in traditional and culturally "acceptable" occupations or young talent queueing for public sector employment might deprive economic activities of needed skills and possibly hinder human capital accumulation in the country. Other sources of misallocation include labor regulations such as professional licensing rules creating barriers to entry to certain occupations or outright exclusion of foreign labor from certain occupations that are reserved for nationals. Market failures can also lead to the misallocation of skills across sectors or geographies: here, the extensive margin of labor supply constrains investments in potential sectors and poses as fixed cost preventing the emergence of potential sectors (Blundell, Bozio, and Laroque, 2011; Michau, 2011).

Finally, it is necessary to reiterate that under the Growth Diagnostics framework, the question of whether human capital is the most binding constraint to growth cannot be answered in isolation. A country's skill spectrum exists along with other complementary factors that enable its deployment in economic activities. As such, the conclusion on the binding constraint must be made in relative terms, after diagnosing other complementary factors. Human capital only becomes a binding constraint to growth when it is relatively scarcer than the supply of other complementary factors and capabilities.

2 Testing for Human Capital as a Binding Constraint to Growth

Hausmann, Klinger, and Wagner (2008) propose four principles of differential diagnosis to establish whether a factor is a binding constraint to private investment and economic growth. Is the factor's price high, signaling higher relative scarcity? Would a relaxation in the constraint be associated with an increase in private investment and growth? Are firms that rely on the factor more intensively less prevalent than those that do not? Are there firms attempting to bypass the potential constraint? (Table 1). These four signals aim to reveal whether private firms are incurring high costs or facing distortions in securing the supply of certain production inputs. This section is devoted to illustrating how to deploy these diagnostic signals to test whether human capital is the binding constraint.

Table 1 The four diagnostic signals

Diagnostic signal: if human capital is a binding constraint to growth	**Description**
The shadow price of human capital should be high; there should be high-wage premiums for skilled workers.	• High Actual or implied market prices (wages) • A high shadow price implies that relieving the constraint would have a large impact on private investment.
Changes in the stock of human capital should be associated to changes in private investment and growth.	• If a human capital is a binding constraint to investment or growth, relaxing the constraint should be associated with incremental private investments or growth.
Agents attempting to overcome or bypass skill shortages.	• Agents in the economy are likely responding to the constraint through various interventions or investments to circumvent human capital shortages.
Camels and Hippos: Agents less intensive in human capital are more likely to thrive (and vice versa).	• Sectors that rely more intensely on human capital should be less prevalent or have a relatively lower contribution to exports, value added, or employment than sectors that those that do not.

Note: Authors' adaptation is based on the principles of Hausmann, Klinger, and Wagner (2008).

Before we jump into testing the four diagnostic signals, a natural starting point in our quest would be to examine the characteristics of the labor market against comparable countries. A thorough understanding of the demographics, employment trends, schooling, and quality of education would help frame the results of our empirical tests within the specifics of the country's labor market.

Demographics

It is important to start the Growth Diagnostic exercise by framing the question of growth and human capital in the larger context of the country under study.