CHAPTER 2

An Economic Rationale for Investing in Human Capital

Abstract

There are compelling economic arguments for governments to invest in the human capital of their people—limited access to credit narrows household choices, information failures distort investments, and spillover effects lead to suboptimal family investments. Lack of access to capital is one reason for governments to invest little in human capital—a problem that natural resource revenues can help to overcome. Investing in human capital should be an important part of the portfolio of investments using resource revenues—along with investing in infrastructure and saving through mechanisms, such as sovereign wealth funds, that allow countries to earn international rates of return on investments. A balanced portfolio is desirable, and investing in human capital has a special role to play in resource-rich settings—especially in poor countries—where the need for human capital and infrastructure investments is large. The indirect effects of enhancing human capital on reducing the incidence and cost of conflict are also a large part of the story.

Why Governments Should Invest in Human Capital

"Perfect Markets" as a Reference Point

When markets are functioning perfectly, households have a full range of choices about how to invest their disposable income. They can use their cash for consumption, savings, investing in education and training, and various other types of spending or investing. Since each type of spending has diminishing benefits, at least eventually, people would adjust their spending so that, as economists put it, the marginal returns are equalized across different types of spending. If markets were "perfect," an additional dollar spent on building human capital would yield the same return as the interest rate obtained through savings. If it were higher, households would increase their spending on skills acquisition (perhaps financed

by borrowing) until the marginal return were equalized—and the ultimate household level of investment in human capital would be optimal.

In such perfect and complete markets, there would typically be no scope for the government to invest in building human capital, since households would behave optimally. However, markets are rarely perfect or complete. Indeed, the economic literature has identified several market "failures" that motivate public investments in human capital. This chapter reviews capital market failures, incomplete information, behavioral biases, and externalities.

Credit Constraints

Since private returns to human capital are high (box 2.1), it would seem inconceivable that households might choose not to send children to school. Even for very poor households, borrowing to invest in at least some years of education would be optimal. But financial markets are obviously not perfect, and studies

Box 2.1 Private Returns to Human Capital

While human capital is a broad concept that encompasses not only formal education but also skills, capabilities, and even health, estimating the effects of formal schooling has received the lion's share of scholarly attention. The literature on returns to education gives solid support to the notion that private returns are meaningful. A long economic tradition estimates private returns to education following a human capital approach and estimating so-called "Mincer regressions" that relate earnings to schooling and experience while controlling for a battery of factors (Becker 1975; Mincer 1958, 1974; Schultz 1960, 1961). Mincer regressions typically show large returns from education. For example, Psacharopoulos and Patrinos (2004) found that the average rate of return on an additional year of schooling is 10 percent and that the returns are especially high for primary education in low- and middle-income countries. Schultz (2004) and Filmer and Fox (2014), focusing specifically on Africa, found that returns increase at higher levels of education.

It is difficult to separate the effects of schooling on productivity from its signaling value. It could be that graduates of higher education do not earn more because of the productivity-enhancing skills they have learned but because their admission to prestigious schools acts as a signaling device for classifying whether individuals have high or low innate ability (Brown and Sessions 2004; Spence 1973). The use of "natural experiments" allows analysts to distinguish the two effects. Card (2001) surveyed the growing literature that draws on natural experiments for estimating the return to schooling and found that, in many cases, the returns are similar to those of traditional Mincer regressions. For example, the estimate of Leigh and Ryan (2008) for Australia is about 10 percent, in line with Mincer regression estimates for comparable countries. Ozier (2015) found that attaining secondary school in Kenya causally leads to a decrease in the probability of low-skill (and low-earning) self-employment and an increase in the probability of (higher-earning) formal employment.

Formal schooling is, of course, not the only way to raise human capital and earnings. A substantial literature shows that better nutrition for pregnant women and infants raises schooling

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Box 2.1 Private Returns to Human Capital *(continued)*

levels and economic productivity (Victora and others 2008). Strauss (1986), for example, found a very substantial positive impact of caloric intake on labor productivity in Sierra Leone. Further, comparing twins, Behrman and Rosenzweig (2004) and Black, Devereux, and Salvanes (2007) found that lower birthweight has a serious impact on future educational attainment and earnings. These findings suggest that government programs to promote sufficient and balanced nutrition during pregnancy can help to boost human capital and economic output. Weil (2007) used such microeconomic estimates from various sources to estimate aggregate returns to health. He found that eliminating health differences between countries would reduce the variance of gross domestic product (GDP) per worker by nearly a tenth.

Substantial scholarly attention has also been devoted to early childhood development. It has been found that both cognitive and noncognitive skills acquired in preschool significantly shape later education and labor market outcomes (Almond and Currie 2011). Several preschool intervention programs have had very high returns (Heckman 2006). For example, the Perry Preschool Program in the United States, which enrolled disadvantaged children starting at ages 3–4 and included both school programs and home visits, resulted in later-life higher scores on achievement tests, high school graduation, and homeownership and lower rates of receipt of welfare assistance, out-of-wedlock births, and arrests for crime. The economic return rates for the program were 15–17 percent. The Abecedarian Program, also in the United States, enrolled participants at only 4 months of age and provided intensive day-long child care. It was found to permanently raise intelligence quotient (IQ) scores and noncognitive skills. A long-run study in Jamaica showed that cognitive stimulation in early childhood resulted in substantial increases in earnings in adulthood (Gertler and others 2014), as did a nutritional intervention among severely stunted children in Guatemala (Hoddinott and others 2008).

show that households underinvest in education when capital markets are imperfect (Becker 1967; Cordoba and Ripoll 2013; Fiszbein and others 2009; Lochner and Monge-Naranjo 2012). Because poverty and inequality today can breed poverty and inequality tomorrow, state intervention may be desirable (Banerjee and Newman 1993; Galor and Zeira 1993).

The evidence is not only theoretical. Empirically, capital market frictions have been found to drive underinvestment in education (Lochner and Monge-Naranjo 2011). This has been shown for the United States (Carneiro and Heckman 2002) and for Mexico (Attanasio and Kaufmann 2009; Kaufmann 2014), as well as in an analysis of cross-country data (Flug, Spilimbergo, and Wachtenheim 1998). Borrowing constraints are a significant factor contributing to the large schooling-wealth gap in developing countries, with children from rich families much more likely to be enrolled at all levels of education (Filmer and Prichett 1999).

Incomplete Information

Though important, capital constraints are not likely to be the whole story. Even when returns on human capital are high, people may be reluctant to invest in it

if they are poorly informed about its benefits. Indeed, inaccurate beliefs about the average returns to education seem to play a major role. For example, studies in Madagascar (Nguyen 2008) and the Dominican Republic (Jensen 2010) found that many young people drastically underestimate the returns to schooling, and this reduces school attendance. Disseminating information to correct this underestimate was effective at boosting enrollment rates in both countries.

Behavioral Biases

Even with appropriate information, people have behavioral biases that help account for underinvestment in human capital (see Fiszbein and others 2009 for a comprehensive discussion). An extreme case, "hyperbolic discounting," gives rise to a wide range of time-inconsistent behavior and self-control problems, such as procrastination. More concretely, when individuals put a much higher value on the present and a much lower value on the future, they tend to defer all actions that have high short-run costs and long-run gains, such as saving or investing in education. When tomorrow comes, the same distinction is made, and the individual continues to procrastinate (Akerlof 1991).

A related behavioral bias is "myopia," where individuals only take the next few periods into account in their decisions, ignoring implications that are far in the future. When individuals do not fully account for returns that will materialize in the future, they may opt not to invest in assets that have short-run costs and long-run gains, such as education or balanced nutrition.

While not strictly speaking a "behavioral bias," an additional factor affecting household investments in education is the distinction between the persons deciding on the investment (typically parents or guardians) and the direct beneficiaries of that investment (children themselves). To the extent that the parents' objectives are not perfectly aligned with those of their children—for example, they are not perfectly altruistic—then investment in human capital may not be optimal from the child's perspective (Becker 1991), and this perception may vary according to the sex and birth order of the child.

Externalities

Even where there are no credit constraints, incomplete information, or behavioral biases, optimizing individuals or families may underinvest in human capital if there are positive externalities to investment. Individuals balance the costs and benefits to themselves; they do not necessarily account for externalities—the benefits (or costs) to other people. If the externalities are positive, the level of investment will be socially suboptimal.

Research has documented a variety of positive externalities for education (Appiah and McMahon 2004; Lochner 2011; Moretti 2004a). Positive spillovers of being around educated people have not only been found in businesses (Moretti 2004b), but also within a local geographic area (Foster and Rosenzweig 1995; Moretti 2004a). Put differently, working next to somebody more educated not only boosts productivity within the firm but also has cross-firm spillovers arising through more efficient interactions and the spread of ideas.

In addition, some externalities are not strictly economic in nature. Four main types of externalities have been documented:

1. Higher education levels lead to better public health (Schultz 1999), lower fertility, and hence lower population growth rates (Grossman and Kaestner 1997). A substantial literature has highlighted such effects using "natural" or "quasi" experiments in developing countries. Unexpected increases in schooling age that have had different effects on different regions, age cohorts, or population groups have been used to study the effect of schooling on health and fertility outcomes in Indonesia, Malawi, Nigeria, and Uganda (Alsan and Cutler 2013; Behrman 2015; Duflo 2001; Osili and Long 2008). Clearly, rational individuals may take into account the effect of education on household fertility and health and the direct effect on them. However, having large families not only directly affects the households that make fertility decisions but also indirectly affects other households through the congestion costs of high fertility and high rates of population growth. For a recent review of fertility and its relationship to education in Sub-Saharan Africa (SSA), see Canning, Raja, and Yazbeck (2015). Similarly, if education leads to healthier people who do not transmit infectious diseases to others, ignoring this positive externality will, from a social point of view, lead to underinvestment in health-promoting assets such as education or balanced nutrition.
2. Education has also been consistently found to decrease crime rates (Currie 2001; Lochner and Moretti 2004; Schweinhart 2004). One channel driving this effect is the higher opportunity cost of forgone work income when educated individuals choose to spend time in criminal activities. When fewer people become criminals, the negative externalities of crime on the rest of the population are lower. Also, the values transmitted through socialization in school can operate to reduce crime.
3. Education promotes civic values and good citizenship (Dee 2004; Milligan, Moretti, and Oreopoulos 2004). Educated people vote more often and participate more intensively in civic associations, which may help to foster society-wide social capital. It is not just the amount of schooling that matters for building social capital; the content of education is also crucial: teaching practices have a considerable impact on social capital (Algan, Cahuc, and Shleifer 2013).
4. The likelihood of civil conflict has been found to be lower when education levels are higher (Barakat and Urdal 2009; Collier and Hoeffler 2004; Østby and Urdal 2010; Thyne 2006). As discussed later in more detail, multiple channels link education to conflict. The essential point here is that when individuals select their education levels, they do not take into account the effect their choices may have on society as a whole—in this case, through lowering the likelihood of armed fighting. There are externalities to conflict from better health as well. Indeed, worse health (proxied by high exposure to infectious diseases) has been found to increase the risk of conflict (Cervellati, Sunde, and Valmori 2014).

Why Governments Do Not Invest More in Human Capital

If public investment in human capital is indeed good policy, why is such investment insufficient? Again, in a world of perfect capital markets, the state would compute the level of human capital investment that equalizes the marginal returns to one additional dollar invested in human capital and the international interest rate. If a country had too little domestic resources to achieve this level of investment, it would borrow to finance it; if a country had excess resources, it would select the same optimal level of human capital investment and lend the surplus money on international markets. In such a frictionless world, one would expect all countries to be at their optimal level of human capital investment, and the rents made available from natural resources would not affect the observed level of human capital. Resource-poor countries would be borrowers and resource-rich countries would be lenders, but both would always reach their optimal investment in human capital.

However, the world is not frictionless. Two specific frictions lead to substantial underinvestment in human capital: credit constraints (at the national level) and poor governance.

Credit Constraints

Not all countries have equal access to international credit markets, and many—especially those with poor records of credit repayment—are severely cash-constrained. Once it reaches its borrowing limit, even a benevolent government may not be able to invest the optimal amount in human capital. When borrowing constraints are binding, a discovery of natural resources may relax budget constraints enough that a government can invest more in human capital (Van der Ploeg 2011). This implies that, in a world where credit markets are imperfect, the relationship between resource revenues and human capital investments will be positive.

Poor Governance

As discussed in chapter 1, however, resource-rich SSA countries do not invest more in human capital, even though they have the funds to do so; borrowing limits cannot be the full story. Countries with poor governance and high corruption tend to have greater discrepancies in what is earmarked for human capital investments and what is actually invested. For example, one expenditure tracking survey found that virtually no funds dedicated to health in Chad made it to the facility level (Gauthier and Wane 2005). Hence, even if there are no borrowing constraints, underinvestment in human capital can occur if governance is poor. Unfortunately, if anything, resource discoveries may exacerbate existing governance problems, as discussed in more detail in chapter 3 of this book (see also Ross 2001, 2012).

Natural Resource Revenues and Investment in Human Capital

The previous section describes why a government might want to invest in human capital and why investment might be low even when fiscal space is not an issue. This section assesses the factors that influence the trade-off between using resource revenues to invest in human capital and in other types of investment.

It starts from the perspective of a government acting as a "benevolent social planner" that maximizes social welfare and then accounts for situations where the government has other objectives.

Studies of how to invest resource revenues (surveyed by Bannon and Collier 2003 and Barma and others 2012) are still relatively rare. While some research has been done on the optimal speed of resource extraction (for example, van der Ploeg and Rohner 2012) and on investment options in resource-rich countries (van der Ploeg and Venables 2011), these studies do not take into account the option of investing in human capital. Theoretical analysts have used a so-called overlapping generations model framework (box 2.2) or dynamic stochastic general equilibrium (DSGE) modeling (box 2.3) to provide insights into these questions.

Box 2.2 Modeling Natural Resources and Human Capital across Generations

One of the key objectives for policy in countries with high levels of natural resources is to enable a finite resource to support improvements in income and welfare over a long time horizon—in particular, beyond the current generation. As described in this book, higher levels of human capital reverberate across generations: higher levels of education of parents lead to higher levels of education and health among children, and higher levels of health among parents lead to better outcomes among children.

Economists have developed theoretical models that include multiple "overlapping generations" in order to understand how natural resources might affect the incentives to accumulate human capital and how this affects growth and levels of welfare attained over the long term. Different analysts specify models differently, but the models typically break a generation's life span into two or three periods. In early periods, a generation invests in human capital, works and saves, and, in late periods, consumes its savings. The models are then used to explore and understand particular features. Different studies have emphasized alternative aspects of these relationships.

Papyrakis and Gerlagh (2006) develop a model that seeks to illustrate how natural resource wealth crowds out other forms of investment—ultimately resulting in lower long-term welfare. Their model focuses mostly on investment in physical capital, but includes the feature that human capital is more productive at higher levels of physical capital. This sets in motion a positive feedback loop, in which higher returns to human capital lead to more investment in human capital on the part of individuals (and their families). They show, however, that natural-resource-rich countries tend to have lower levels of investment, setting in motion a negative feedback loop that results in lower human capital investment and, ultimately, low levels of long-term welfare. A companion empirical study (Papyrakis and Gerlagh 2004) estimates that a 10 percent higher level of resource income decreases long-term income by 60 percent, about half of which is because of lower levels of investment. Frederiksen (2008) extends the approach and explicitly models the role of intergenerational altruism and bequests. She shows that, when bequests are low (either because of low levels of altruism or because of policy), then policies that direct transfers to the current generation lead to lower savings and investment and, ultimately, a "resource curse" (Sachs and Warner 2001).

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Box 2.2 Modeling Natural Resources and Human Capital across Generations *(continued)*

Valente (2007) develops an overlapping generations model that incorporates two features. First, human capital is a substitute for natural resources in production; second, there are intergenerational spillovers in human capital. The key policy decisions in this model are the speed of extraction of the finite resource and the degree of public investment in human capital. According to the model, if the discount rate is relatively low (that is, the welfare of future generations matters a lot to the social planner), the optimal strategy is to invest heavily in human capital and to extract the natural resource at a slow pace. In the words of Valente (2007), "Knowledge formation and resource preservation are thus complementary targets."

Araji and Mohtadi (2014) model the situation in which natural resource rents are distributed to individuals as lump-sum transfers. Their model suggests that the transfers reduce the expected returns to human capital in the long run, thereby reducing the incentive to invest in what they term "professional" human capital (in contrast to "entrepreneurial" human capital) in the short run. According to their overlapping generations modeling, when levels of technology are low (and therefore the current return to professional human capital is low), the transfers and disincentives result in a low-level equilibrium, with low levels of income in the long run. High-technology economies avoid this trap because the return to professional human capital is sufficiently high that the incentive for investment remains. Araji and Mohtadi (2014) support their argument empirically by showing that countries with both natural resources and high levels of transfers tend to have lower public spending on tertiary education.

Box 2.3 Using Dynamic Stochastic General Equilibrium Modeling to Guide Investments

Low-income, capital-scarce economies with financial and fiscal constraints face severe challenges in managing revenues from newly found natural resources. They face demands for scaling up public investment to meet public infrastructure needs and high risks of rising public sector deficits and Dutch disease—all in an uncertain world characterized by a high occurrence of shocks and price volatility.

DSGE modeling can be used to provide insights into how to invest effectively. Specifying a small, open economy DSGE model, consistent with low-income African economies, and calibrating it with Ugandan data yield the following implications:

1. When public capital is almost unproductive, it is best to save the resource income in a sovereign wealth fund (SWF) for future generations.
2. The model considers three stylized fiscal policy approaches for managing a resource windfall: (a) investing all in public capital, (b) saving all in an SWF, and (c) taking a "sustainable-investing" approach, which proposes directing a constant share of the resource's revenues to finance public investment and saving the rest in an SWF. The gradual scaling-up of public investment (option c) yields the best outcomes, as it minimizes macroeconomic volatility.
3. When the objective is to minimize the volatility of three separate macroeconomic aggregates—private consumption, private investment, and total employment—the

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Box 2.3 Using Dynamic Stochastic General Equilibrium Modeling to Guide Investments *(continued)*

volatility function has a convex shape. If the objective is to minimize private consumption volatility, then the model suggests that the optimal portfolio would save 30 percent of resource income in an SWF; to minimize private investment volatility, the share would be 25 percent; and to minimize total employment volatility, the share would be 15 percent.

4. The optimal oil share to be saved in an SWF decreases with the persistence of the oil shock, suggesting that the optimal share to be saved should decrease with production.

Source: Kopoin and others 2016.

Alternatives to Investing in Human Capital

Infrastructure Spending: Buying Bridges Rather Than Books

The economic logic of infrastructure spending is very similar to that of human capital investment. The direct return on infrastructure investments—such as building roads, bridges, and airports—is positive but decreasing, as is true for human capital. It starts out high when existing infrastructure is very poor and then drops until, at some point, it becomes lower than the international interest rate. From then on, investments in infrastructure yield lower marginal returns than the opportunity cost of placing funds in international capital markets.

Several recent studies have advocated that countries with poor infrastructure should invest at least part of their windfall gains in physical infrastructure (Collier and others 2010; van der Ploeg and Venables 2011).

Sovereign Wealth Funds: Saving Instead of Schooling

The idea of putting a substantial share of resource wealth into an SWF has gained support in recent years among academics and policy makers. In terms of its economic nature, an SWF boils down to investing money on international capital markets, with expected yields corresponding to the exogenously determined international interest rate. The marginal returns on SWFs are constant and equal to the international interest rate—unlike the returns to investments in physical or human capital, which decline as the level of infrastructure or human capital increases.

There are a variety of economic, fiscal, and political economy reasons to establish an SWF (Davis and others 2001; Davis, Ossowski, and Fedelino 2003; Humphreys and Sandbu 2007; Truman 2011). Putting money in an SWF enables a country to smooth resource windfalls, which can fluctuate widely over time (because of either prices or reserves). As a savings vehicle, an SWF makes it possible to spread the gains from resource revenues over several generations.

One major advantage invoked is also that an SWF is beyond the immediate reach of the government in power, which lowers the risk that resource revenues will be appropriated by the leaders. This argument, however, is controversial. One can well imagine current or future government officials abolishing the SWF and

redirecting the funds for their own benefit (Rodríguez, Morales, and Monaldi 2012). That SWFs will protect windfalls from elite appropriation is thus uncertain, especially when opposition governments reaching power do not feel bound by the decisions of former rulers or in states suffering from widespread corruption.

Direct Dividends: Decentralizing Decision Making to Individuals

Chapters 3 and 4 of this report discuss the role that cash transfers—conditional or unconditional—can play in building human capital. These types of transfers have been shown to reduce poverty and to encourage families to invest more in building the human capital of their children (Fiszbein and others 2009). Cash transfers have also been discussed explicitly as a way of sharing revenues from natural resources with the population as a whole. The goal of such "direct dividends" is to distribute resource revenues to citizens, who then use the dividends as they see fit and pay taxes on them (Devarajan and Giugale 2013; Moss 2011; Sala-i-Martin and Subramanian 2013). If individuals have investment options that mirror those of an SWF (that is, fixed return given by international interest rates), one could treat investment portfolios with direct dividends as very similar to those operated by an SWF—from the standpoint of economic logic and in a frictionless world.

This does not, however, mean that direct dividends are more or less equivalent to an SWF. From an investment portfolio point of view, they may be similar if (1) all people are fully rational and knowledgeable about finance and investments and (2) the government is a benevolent social planner that makes investments in the best interests of its citizens. However, neither assumption is likely to hold. Individuals may be myopic, not feel perfectly altruistic to their offspring, or be badly informed. And governments may pursue agendas that are not necessarily those of a benevolent social planner (Ross 2012).

It has been argued that direct dividends give governments incentives to improve. According to the line of political science research that studies "rentier states" (Mahdavy 1970; Baland and François 2000), one of the main difficulties with very-resource-rich governments is that they command enough revenues to keep the state running and do not need to democratize to gain enough popular support to raise taxes. Direct dividends could break this vicious cycle because they are taxable. Hence, to get part of the money back, a state needs to trade representation for taxation. Advocates of direct dividends hope that this trade could bring a major improvement in governance.

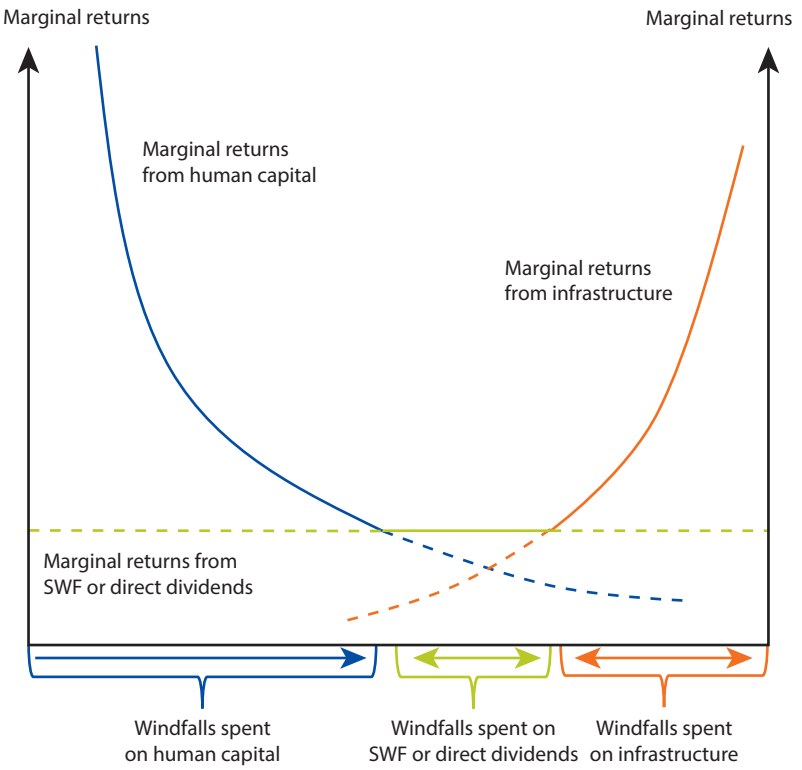
Human Capital and the Alternatives

To be able to assess how desirable it is to channel additional funds into human capital formation, it is necessary to compare the returns to human capital formation with the returns to the main alternatives—particularly if the goal of investment is to "achieve optimal and equitable outcomes, for current and future generations."[1] This section first outlines the basic economic characteristics of the main investment options, then discusses complementarity issues, and closes with a summary of political economy concerns that affect the comparison of ways to invest resource windfalls.[2]

To summarize the points so far: human capital and infrastructure investments both start out with high marginal returns at low initial stocks; but as these marginal returns decline, the larger the stocks of human capital and infrastructure grow.[3] In contrast, the marginal returns of SWF investments (and perhaps those of invested direct dividends) are constant and driven by international capital markets. The basic logic of building a portfolio composed of different assets suggests that the marginal returns of all investment options should be equalized in equilibrium. Hence, investments in human capital should take place as long as the returns are higher than the constant returns from investments in international capital markets. Figure 2.1 illustrates this basic logic. The x-axis reflects the resource windfalls available to invest, and the vertical axis corresponds to the marginal returns of two options for capital investment; the returns from human capital investments are plotted from left to right, and those from infrastructure investments are plotted from right to left.

As illustrated in figure 2.1, in such a situation it would typically be preferable to make all three types of investments: given decreasing marginal returns, the optimal mix is achieved when the marginal returns of all three are equalized. Thus, a country with high amounts of physical capital but very little human capital would benefit from shifting some resources from physical to human capital

Figure 2.1 The Rationale for an Optimal Investment Portfolio



Note: SWF = sovereign wealth fund.

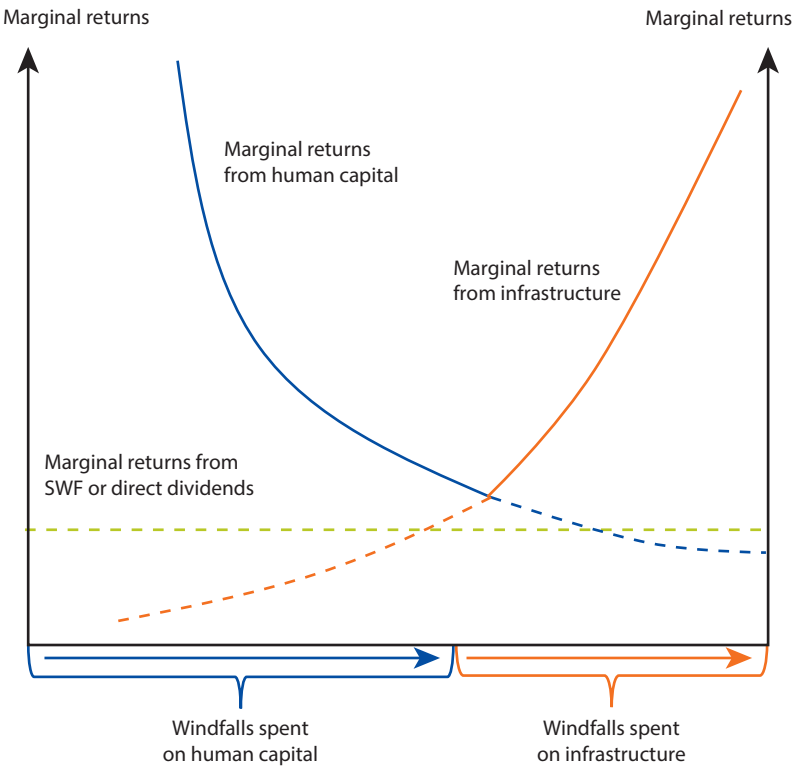
investments, and a country with high human capital but a complete lack of physical infrastructure would be better off doing the opposite.

The next question is what may be different in a country with initially very low levels of both human capital and physical infrastructure that has relatively small resource windfalls. This case reflects the situation of an initially poor country that suddenly discovers substantial but limited natural resource deposits.

Figure 2.2 illustrates the case: the shape of the marginal return curves for human capital, infrastructure, and the SWF is the same as in figure 2.1, but there is less resource revenue, reflected by the fact that the figure is narrower (the length of the x-axis corresponds to the resource money available). Given that investable resource cash is fairly limited in this situation, the marginal return curves of human and physical capital intersect above the international interest rate line (that is, the returns from investing in the SWF), which means that the marginal returns of human capital and physical infrastructure always lie above the opportunity cost of international capital market returns. In this case, it is best to channel all natural resource cash into human capital and physical infrastructure improvements and to defer investing in an SWF.

A central point of this analysis is that, in countries with little physical or human capital, it may be optimal to invest domestically rather than abroad

Figure 2.2 Optimal Portfolio Composition for a Less Resource-Rich Country



Note: SWF = sovereign wealth fund.

(see the formal models by van der Ploeg and Venables 2011 for physical infrastructure and by Rohner 2014 for human capital and physical infrastructure).

As figures 2.1 and 2.2 illustrate, the share of natural resource rents that should be invested in the various options (human capital, infrastructure, international markets) will depend on several factors. Key will be the relative shape of the marginal returns to investments in each option (which, in the case of human capital and infrastructure, will also depend on their initial levels) and, as the difference between figures 2.1 and 2.2 illustrates, the size of the resource rents. Given the large number of variables, it is hard to draw implications that would be valid across all contexts. The economic modeling underpinning this discussion (described by Rohner 2014) suggests that, at lower levels of mineral wealth, countries should prioritize human capital, while, at higher levels of mineral wealth, countries should diversify, notably in infrastructure. But even this implication should be taken with some caution because it relies on assumptions that may not be met in all situations.

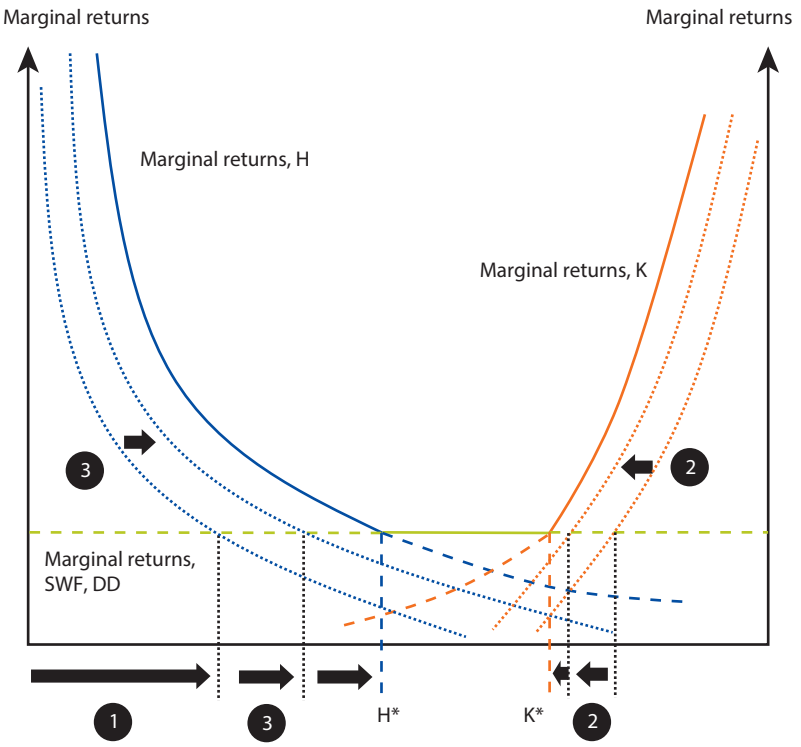
Complementarity between Investing in Both Human Capital and Infrastructure

Figures 2.1 and 2.2 abstract from complementarities between human and physical capital. This makes sense in situations where the complementarities are relatively small (that is, where the elasticity of substitution of the factors of production is large). In many situations, however, the complementarities between human capital and physical infrastructure may be large—higher levels of human capital boost the returns from spending on infrastructure and, similarly, infrastructure increases the returns on human capital investments.

The main logic is very similar to what is shown in figure 2.1. The marginal returns on human capital and physical infrastructure still start out very high and then decrease, and the optimal mix equalizes the marginal returns to all investment options. Complementarity means that the marginal return curve for human capital investments shifts upward with more improvements in physical capital, and the marginal return curve for physical capital shifts upward when human capital is higher. Both of these forces shift the optimal portfolio mix toward human and physical capital and away from international investment schemes, such as an SWF.

This complementarity is illustrated in figure 2.3, which is structured like figures 2.1 and 2.2. The left downward-sloped curve still corresponds to the marginal returns of human capital (H), and the right downward-sloped curve captures the marginal returns of physical capital (K). The starting point is a situation where the resource cash has been obtained, but where there is some investment in an SWF and in physical capital, but not yet in human capital. At this point, the marginal return curves are still relatively low (represented by the dotted lines). Then, some resources are invested in human capital (1). Through the complementarity, this results in an upward shift of the marginal return curve for physical capital (2). This implies that the optimal level of physical capital investments rises, which in turns leads to an upward shift of the marginal return curve

Figure 2.3 Complementarities between Human and Physical Capital



Note: DD = direct dividend; H = human capital; K = physical capital (infrastructure); and SWF = sovereign wealth fund.

for human capital (3). The country should now also increase the amount invested in human capital, which again pushes upward the marginal returns from physical capital, and so on. There are ever smaller upward shifts of both marginal return curves until equilibrium is reached, as represented by the two solid marginal return curves and the equilibrium investment amounts of human and physical capital (H* and K*, respectively).

The Role of Political Economy

For each investment option, feasibility is the main consideration. Certainly, all investment options that imply direct state intervention rise and fall with the quality and reliability of the state; the best policies can go awry when the governance environment is not conducive to effective or efficient implementation (chapter 3).

While public investment projects require management by civil servants—whose performance will be influenced by the governance environment—investing in an SWF or providing direct dividends may seem less amenable to corruption. Indeed, the experience of the República Bolivariana de Venezuela shows that governments can "raid" SWFs for their own purposes; the SWF, which

was designed to guarantee majority control by the president, became a means for him to spend at his discretion and bypass normal budgetary procedures (Rodríguez, Morales, and Monaldi 2012). Media reports regarding other so-called "oil funds" suggest that these are often ripe targets for corruption.

While direct dividends money may not be subject to the same distortions as investments that have a substantial service delivery component, they may also be reoriented by rent-seeking civil servants. The political economy of how direct dividends are distributed can become an issue in itself. In Mongolia, popular pressure led politicians to offer very large transfers that resulted in half of national income being earmarked for distribution; this was more than the government had received in resource revenues (Collier 2013).

Violent Conflict: Human Capital Investment and Political Instability

Violent conflicts play a crucial role in many developing countries, and ignoring the ensuing instability could potentially lead to misguided advice (Collier and others 2003). Considering that many natural-resource-producing states suffer from political instability and violent conflict (box 2.4) and that natural resources have a substantial impact on conflict (box 2.5), it is important to take into account the risk of conflict when analyzing the relative virtues of human capital investments in resource-rich economies. Indeed, introducing the potential for armed rebellion and violent conflict into the framework outlined here suggests an additional rationale for such investments.

Violent civil conflict can be thought of as costly appropriation.[4] An opposition group forms a rebellion and tries to appropriate valuable resources. Conflict can induce inefficiencies in two main ways: (1) actors can distort their decisions to decrease the scope for appropriation, and (2) conflict has direct costs, such as the

Box 2.4 Natural Resources and Conflict

In recent decades, civil wars have increasingly been recognized as one of the major obstacles to development. Between 1945 and the end of the twentieth century, an estimated 16.2 million people died in 127 civil wars (Fearon and Laitin 2003). Poor countries were, and still are, hit particularly hard: 20 of the world's 34 poorest countries are affected by armed conflict (OECD 2009). According to Collier (2007, 27), "Civil war tends to reduce growth by around 2.3 percent per year, so the typical seven-year war leaves a country around 15 percent poorer than it would have been."

The theoretical literature on natural resources and conflict aims to distinguish the channels that make resource windfalls raise the risk of armed fighting. In particular, it has been argued that (1) resource revenues drive up the motivation for investing in fighting by increasing the "pie" that is up for appropriation (recent work includes Caselli and Coleman 2013; Esteban, Morelli, and Rohner 2015; Rohner, Thoenig, and Zilibotti 2013a); (2) resource abundance

box continues next page

Box 2.4 Natural Resources and Conflict *(continued)*

weakens state capacity because the state has less incentive to build legal and fiscal capacity (Besley and Persson 2011; Fearon 2005); (3) capturing resource rents relaxes rebels' borrowing constraints and makes armed rebellion financially feasible (Berman and others 2015; Collier, Hoeffler, and Rohner 2009; Fearon 2004; Guidolin and La Ferrara 2007; Nunn and Qian 2014); and (4) the unequal geographic distribution of natural resource deposits fuels the risk of secessionism and interstate wars (Caselli, Morelli, and Rohner 2015).

The empirical literature on natural resources and conflict has shown that the outbreaks and duration of conflicts are linked to the abundance of primary commodities in general (Collier and Hoeffler 2004; Collier, Hoeffler, and Rohner 2009); the presence of oil and natural gas (Dube and Vargas 2013; Fearon and Laitin 2003; Humphreys 2005; Lei and Michaels 2014; Morelli and Rohner 2015; Ross 2006), and deposits of diamonds and precious minerals (Aragon and Rud 2013; Berman and others 2015; Humphreys 2005; Lujala, Gleditsch, and Gilmore 2005; Ross 2006).

Box 2.5 Angola: Conflict, Natural Resource Wealth, and Low Human Development Outcomes

Angola is the second-largest producer of oil in Africa, and oil exports drive the country's economy (about 95 percent of total exports). Oil was first discovered in 1955, and large-scale extraction began in the 1960s. The state-owned oil company Sonangol has controlled the sector since 1976. Besides petroleum products, Angola is also the world's fifth-largest producer of diamonds (in value). More recently, large natural gas deposits have been identified, although the production of liquefied natural gas has been slow to take off.

Political stability and economic growth in Angola came only recently—in 2002. The war for independence from Portugal lasted from 1961 to 1974, and it was followed immediately by 27 years of civil war. Since 2002, Angola has achieved considerable economic growth; by 2012 gross national income (GNI) per capita was US $6,258 (in purchasing power parity terms)—almost triple what it was in 2002. Extreme dependence on oil makes the country vulnerable to volatility in commodity prices. This became evident in 2009, when a fall in real GDP—resulting from a fall in oil prices during the 2008 global financial crisis—led the country to seek assistance in a standby arrangement from the International Monetary Fund.

The civil war in Angola claimed about 1 million lives, displaced more than 4 million people, and decimated infrastructure and basic service provision. Since then, the government has made sustained efforts to rebuild its physical infrastructure. Spending on health, education, and social protection programs has accounted for more than 30 percent of the budget in recent years. But this spending has not been associated with good outcomes. The under-5 mortality rate is 164 deaths per 1,000 births, which is very high for a country at this level of income. While 85 percent of children of primary school age are enrolled in school, only 45 percent complete primary education. The secondary-level enrollment rate is currently only 32 percent. Despite the fact that 11 percent of fiscal receipts were allocated to social protection in the 2013

box continues next page

Box 2.5 Angola: Conflict, Natural Resource Wealth, and Low Human Development Outcomes *(continued)*

budget, the social safety net system remains fragmented and limited in scope and suffers from inefficient targeting of beneficiaries.

The long history of armed conflict has made the country's path toward transparent and accountable governance difficult. Oil revenues were used throughout the civil war by the Popular Movement for the Liberation of Angola to fund its activities, while the rival National Union for the Total Independence of Angola used diamond sales for the same purpose. While Sonangol has remained a robust institution in Angola's economy and politics, it has frequently been used for political funding and patronage.[a]

Angola has low scores for the transparency of its budget, receiving a score of 28 out of 100 on the Open Budget Index in 2012 (classified as providing "minimal" information). The government publishes an executive budget proposal, an enacted budget, and year-end reports, but it does not produce a citizen's budget or a midyear review. While a prebudget statement, in-year reports, and audit reports are produced for internal use, they are not made public. The legislature has limited oversight powers, with no ability to hold open discussions on the budget. Corruption is frequently reported as a problem in business and politics. The country ranked very low on Transparency International's 2013 Corruption Perception Index, at 153rd out of 177 countries.

a. In 2011, the International Monetary Fund reported that Sonangol spent US$32 billion on "quasi-fiscal" activities on behalf of the government.

destruction costs of fighting and the opportunity costs of the rebels' forgone production. The discussion that follows starts with the distortions caused by the fact that people try to protect their income and then moves to the more direct effects and how human capital helps to avert some of these inefficiencies.

Conflict Appropriation as a Tax on Investments

Consider first the case of a fixed risk of appropriation, which, however, varies with different types of assets. The effects of such an exogenous political risk on business are similar to a tax rate that varies by type of investment. For example, presumably, it would be harder to appropriate economic production than liquid assets such as those in an SWF. While financial assets can be transferred relatively easily and hence appropriated, it is harder to hide economic output to protect it from appropriation. Also, short of slavery, it is hard to appropriate people's human capital (Acemoglu and Wolitzky 2011), and, when too large a part of earned income is confiscated, people tend to work less. Thus, the worse the political instability, the relatively more attractive it becomes to channel resource windfalls into productive investments, such as building up human or physical capital. In other words, leaving political instability and conflict appropriation out of the picture would underestimate the optimal level of human capital investment. The fact that human capital investments flow into relatively hard-to-appropriate assets such as domestic economic output makes them an

even more attractive option in an investment portfolio where there is political instability and conflict risk.

Human Capital as a Conflict Deterrent

While treating political risk as fixed yields a simple intuition about some of the mechanisms at work, it is important to ask what drives rebellion. Potential rebels choose whether to spend their time working or fighting. Depending on the relative returns from productive versus appropriative activities, incentives will push rebels toward more or less fighting effort, which determines the intensity of conflict and political instability.

Appropriation is typically a negative-sum game. The "pie" to be appropriated becomes smaller when fewer people work and more engage in appropriation; moreover, combat operations may physically destroy part of the pie. Thus, economic output declines due to both (1) the opportunity cost of spending time on unproductive appropriation activities, which leads to forgone production, and (2) direct destruction in combat. If building human capital can reduce the incentives to fight, it can indirectly enhance productivity by reducing rent dissipation from conflict.

Empirical studies of conflict have indeed found that welfare expenditures are associated with a lower risk of conflict (Bodea, Higashijima, and Singh 2016); education reduces the risk of civil war (Barakat and Urdal 2009; Collier and Hoeffler 2004; Østby and Urdal 2010; Thyne 2006); and where people suffer from poor health, there is more scope for conflict (Cervellati, Sunde, and Valmori 2014). Human capital can reduce the scope for conflict and the level of political instability through three channels, which are discussed next (Rohner 2014). Human capital investment lowers the potential spoils from looting and raises the opportunity cost of fighting; education may raise the "moral costs" of fighting.

Human Capital Investment and Potential Spoils from Looting

Human capital contributes to the production of economic output, which is less appropriable than cash or financial assets. Hence, when more windfall money is transformed into human capital, the pie that successful rebels can appropriate shrinks.

Even when economic production collapses, looting potential remains. When war completely ravages some parts of a country, economic activity in the region may collapse and, whenever possible, successful rebels plunder the factors of production. When a factor of production has a high so-called "scrap value," such as infrastructure made of copper that can be sold at world market prices, potential rebels have greater looting potential and hence incentives for conflict. Given the difficulty of appropriating human capital, its scrap value is basically zero (Acemoglu and Wolitzky 2011).

Human capital investments not only lead to better outcomes for the current generation but also beget further accumulation of human capital in the generation that follows (box 2.6). This future human capital is also hard to appropriate and has a low scrap value, so human capital investments today lower looting opportunities in the long as well as the short runs.

Box 2.6 The Effect of Parents' Education on the Education of Their Children

It has long been known that a close association exists between the level of parents' education and that of their children. In recent years, a growing literature has been studying the question of whether this association is a simple correlation driven by unobservable confounding factors, such as genetically transmitted innate ability, or whether there is a causal effect. The approaches to studying this question can be classified into three groups:

1. Comparing twins who have different levels of education and who may nurture their own offspring differently (for example, Behrman and Rosenzweig 2002).
2. Estimating intergenerational education spillovers using adoptees, who do not share the same genetic pool as their families (for example, Bjorklund, Lindahl, and Plug 2006; Plug 2004; Sacerdote 2007).
3. Using educational reforms to characterize shocks to education attainment (for example, Black, Devereux, and Salvanes 2005).

The survey article by Holmlund, Lindahl, and Plug (2011) concludes that the growing body of studies aiming for a causal explanation shows a significant and robust effect of parents' education on their children's educational attainment; for the Scandinavian countries, the causal estimate is about 0.1, suggesting that an additional year of parents' schooling increases their children's schooling by one-tenth of an additional year.

Human Capital and the Opportunity Cost of Fighting

Robust public programs for human capital formation that reach all parts of society can result in a general, society-wide increase in human capital. Higher human capital boosts economic output, and thus the returns citizens receive from production. In an economy with higher human capital, working is more attractive, and the opportunity cost of giving up productive work to engage in rebellion is much higher. As stressed in the "feasibility" theory of conflict (Collier, Hoeffler, and Rohner 2009), it is much cheaper, and hence much more feasible, to put together a rebel organization in a poor country with high unemployment than in a rich country with an educated, skilled, and healthy workforce.

Empirical studies have shown that civil war participation is fueled by low opportunity costs for productive work. For example, when bad weather drives down agricultural productivity, rebel recruiting and armed combat operations surge (Hidalgo and others 2010; Jia 2014; König and others 2015; Miguel, Satyanath, and Sergenti 2004; Vanden Eynde 2011).

Education and the Moral Costs of Fighting

Schooling transmits not only knowledge but also values of cooperation and social norms (Algan, Cahuc, and Shleifer 2013); the values transmitted in the schoolroom may well foster peace. Education that emphasizes tolerance and cooperation can significantly reduce the scope for armed conflict (Davies 2003). The intellectual "enlightenment" and capacity for self-reflection transmitted through education may well sharpen the sense of moral wrongdoing and generate, at least

in some cases, higher moral costs of engaging in violent fighting. While there is relatively little rigorous evidence at the micro level that education, on average, makes people less conflict-prone in politically unstable countries, there is indirect evidence that this conclusion is plausible. For instance, it has been found that educational attainment fosters good citizenship (see, for example, Dee 2004; Milligan, Moretti, and Oreopoulos 2004) and that educated individuals display much lower propensities for racism and much higher tolerance for people from other groups (Hainmueller and Hiscox 2007; Hodson, Sekulic, and Massey 1994).

Moreover, if education also transmits values of tolerance, intercultural exchange, and the knowledge of several national languages, it can help to raise levels of interethnic trust and social capital in a society. Several recent studies have found that interethnic trust is indeed crucial to curb the incentives for civil war; higher trust goes along with more intensive interethnic business dealings, which increase the opportunity cost of ethnic conflict (Rohner 2011; Rohner, Thoenig, and Zilibotti 2013a, 2013b).

However, schooling per se is not a panacea. In some countries and at some points in time, public schooling has been used to enforce the hegemony of a powerful group within society. The dynamics that this engenders can lead to greater tension and even contribute to conflict, as in apartheid-era South Africa.

Conflict Reduction, Human Capital, and Other Investment Options

How do these channels affect the trade-off between investing in human capital and the alternatives? First, take the case of an SWF. In terms of the three channels discussed, higher human capital stocks make a country less conflict-prone relative to investing in an SWF: (1) human capital is less easily appropriated than financial assets; (2) human capital raises the opportunity cost of productive work, while international financial investments do not; and (3) human capital formation, especially education, carries values and transmits social norms, while financial asset investments do not. In sum, for all three channels considered, fostering human capital unambiguously reduces conflict incentives, and investments in financial assets do not. Less wasteful conflict, of course, means an increase in economic output.

Next, consider the contrast with investments in physical capital. Both types of investment methods raise the opportunity cost of taking up arms. Hence, the opportunity cost channel is also present for infrastructure investments. But there are important differences between the other two channels. First, physical infrastructure has a much higher scrap value than human capital. When war ravages a region, parts of the physical infrastructure—for example, those parts made of metal—can be dismantled and sold on the black market. In contrast, because the scrap value of human capital is zero, having more human capital and less infrastructure depresses the gains that rebels expect from war.

Last, education and infrastructure affect the moral cost of fighting differently. While physical capital investments do not affect social norms and values, education has the potential to do so, and schooling that stresses the value of cooperation and tolerance may well raise the moral costs of engaging in fighting. This effect makes peace—and hence prosperity—more likely with education investments.

Conclusions

The state has a role to play in promoting human capital formation. The returns, both private and social, to enhancing human capital are in general very large, and there are reasons why families do not invest in it at the socially optimal level, including borrowing constraints, incomplete information, behavioral biases, and the presence of positive externalities. The state may, however, also be providing suboptimal levels of public human capital investments because of borrowing constraints or political economy factors.

A simple economic model suggests that investments that build human capital as well as those that build physical capital make sense, especially when both types of investment complement each other. The marginal returns from human capital start out high when stocks of human capital are low and then keep falling as stocks rise. Although investments in infrastructure also have decreasing marginal returns, financial asset investments, such as those in an SWF, yield constant marginal returns equaling the international interest rate. Countries with large natural resource rents should diversify windfalls into human capital, infrastructure, and an SWF, selecting investment levels that equalize the marginal returns from all three; small resource producers with relatively modest initial stocks of human capital and infrastructure may want to channel almost all windfall cash into investments in human and physical capital. In the poorest economies where the human capital needs are largest—and the returns to this investment are greatest—prioritizing the creation of human capital is justified.

Introducing the fact that a large share of natural-resource-rich countries suffer from conflict and political instability reinforces the possible role of human capital investments. Political instability raises the relative attractiveness of investing in human capital because it boosts economic output, which can be less easily appropriated than financial assets. In addition to directly raising productivity, investing in human capital also has an indirect positive effect on economic growth by curbing conflict. A higher opportunity cost of forgone production, relatively little potential for looting, and the possibility of raising the moral costs of fighting make fostering human capital a peace-promoting policy.

In light of this discussion, it is not surprising that several studies have found that human capital can modulate the resource curse. Behbudi, Mamipour, and Karami (2010) and Gylfason (2001) show that it is possible to break the resource curse if human capital investments are high enough. In a cross-country analysis of the impact of natural resources on growth, Bravo-Ortega and de Gregorio (2007) found that, although there is, on average, a negative effect, it masks the fact that it is only negative at low levels of human capital (measured by years of schooling) and is positive at high levels.

However, turning *investments* in human capital into *actual* human capital is difficult. The next two chapters address (a) the factors that enhance or diminish the effectiveness of those investments, especially factors that are prevalent in resource-rich countries (chapter 3); and (b) the types of investments that should be prioritized (chapter 4).

Notes

1. This is "Precept 7" of the Natural Resource Governance Institute's approach to natural resource management.
2. This part of the chapter draws extensively from a background paper by Rohner (2014).
3. Studies have shown that at the level of individuals, there may be increasing returns to schooling, at least for certain schooling levels (Belzil and Hansen 2002; Filmer and Fox 2014; Söderbom and others 2006). The model assumes that, at the macro level, further investments in human (and physical) capital come to a point of diminishing returns at some point.
4. This discussion draws heavily on the formal model developed by Rohner (2014).

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