Volume Title: African Successes, Volume II: Human Capital

Volume Author/Editor: Sebastian Edwards, Simon Johnson, and David N. Weil, editors

Volume Publisher: University of Chicago Press

Volume ISBNs: 978-0-226-31605-5 (cloth)

Volume URL: http://www.nber.org/books/afri14-2

Conference Dates: December 11–12, 2009; July 18–20, 2010; August 3–5, 2011

Publication Date: September 2016

Chapter Title: The Returns to the Brain Drain and Brain Circulation in Sub-Saharan Africa: Some Computations Using Data from Ghana

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Chapter URL: http://www.nber.org/chapters/c13450

Chapter pages in book: (p. 305 – 345)

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The Returns to the Brain Drain and Brain Circulation in Sub-Saharan Africa

Some Computations Using Data from Ghana

Yaw Nyarko

10.1 Introduction

Over the past several decades, African nations have been spending large amounts of their limited government revenues on education, particularly higher education. Many African leaders and many in the press in many African countries often express the view that higher education is critical for African economic development. There are those, however, who criticize spending on higher education because of statistics showing that a high percentage of those who are educated leave the country (the brain drain)—they point to statistics showing that for some countries, around 50 percent of the tertiary educated leave, and that many of those who leave were educated at government expense.

The question we pose is fairly simple. Could it be that the huge investments in education, particularly at the tertiary level, were actually the right thing to do during the period we study—roughly the period from postindependence to around the middle of the first decade of the twenty-first century? Specifically, could it be that spending on higher education, knowing full well the extent of the brain drain, could have been the right thing to do for many sub-Saharan African nations, at least in terms of yielding positive and high net returns on investment?

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I thank Bill Easterly with whom I collaborated on a precursor of this chapter. I also thank David N. Weil, Oliver Babson, Murray Liebbrandt, and participants in NBER Africa Project conferences for very useful comments. I also thank the NBER Africa Project for funding related to the research presented here. I thank my research assistants over the past few years for research work related to this chapter: Victor Archavski, Moussa Blimpo, Silvana Melitsko, and Nicole Hildebrant. For acknowledgments, sources of research support, and disclosure of the author's material financial relationships, if any, please see http://www.nber.org/chapters/c13450.ack.

We show that taking into account remittances of brain drainers provides a metric under which the large expenses in tertiary education have been a success via the metric we use. As we will discuss in our concluding remarks, imaginative thinking about these computations could therefore in principle result in ways of increasing the exceptionally low tertiary enrollment rates in many African countries.

The chapter begins by setting out a simple model of the role of education in improving incomes of individuals. We focus on tertiary education, as this is the most pertinent for the brain drain from Africa to many countries. It is the loss of the skilled that attracts the greatest amount of attention in the media and in policy debates. At the heart of the exercise is a net present value (NPV) computation, similar to that used in the economics of education literature. In particular, we will study the question of the spending by governments on higher education, focusing on sub-Saharan Africa. The principal pecuniary costs and benefits of spending on higher education are collected. These include costs of the education itself and the benefits of the education among those who stay in the local economy. The analysis explicitly takes into account the fact that many leave—that is, there is a brain drain. Further, and in particular, those who are outside the country also bring in remittances. In addition, many of those who leave return with higher skill levels.

We discuss the costs and benefits of the brain drain from different perspectives. We begin by discussing this in the context of a nation or a "village." Under this perspective we think of the village as paying for the tuition, but also receiving the benefits of the increased remittances.

There is also another perspective that is often forgotten in the analysis. That is the perspective of the individual himself or herself. People migrate to seek better lives. If successful, then this should be included in the calculus of the pluses and minuses of the brain drain. Under this perspective we again see that there are positive net benefits to the brain drain. Indeed, this resolves a paradox in the literature on the economics of education that has found very low internal rates of return to tertiary education in many African countries. This is a paradox because it is contrary to what would initially be expected in countries with very low human capital levels seeking rapid economic transformation. In our computations, allowing for the probability of draining and therefore earning large incomes abroad, we obtain relatively large rates of return. This suggests that it is the probability of being a part of the brain drain that results in evident high interest of many to invest their time in tertiary education.

This chapter provides the detailed data analyses and empirical implementations of ideas in Easterly and Nyarko (2009) and earlier. As will be described later, some computations have been made in Bollard, McKenzie, and Morten (2010) that are related but different from those of the current chapter, using survey data for Ghana. We are not aware of any other papers that explicitly model the costs and benefits of spending on education taking into account the brain drain in Africa. As we shall point out in each

of the subsections, there has been a voluminous amount of research work done on the various elements that go into our computations—remittances, brain drain migration statistics, the value of diaspora both when they are abroad (trading networks) and when they return. Clemens and Pettersson (2008) and Clemens (2007) have also documented positive aspects of the brain drain.

10.2 The Simplest Village Economy

To fix ideas, we now describe a stylized small African village. We imagine the local leaders or the village chief or voters deciding on how much to spend on tertiary education at the university in their village, which has recently been created. We imagine a village economy with small numbers of educated beyond the primary level, modest secondary schooling, and with an extremely limited tertiary-educated stock. The economy also has extremely limited industrial capacity or a tertiary sector.

The decision makers need to decide how much to spend on higher education. Those who have finished secondary school level may be able to enter the university system. Since there are so few spots at the tertiary or university level relative to the possible entrants with secondary schooling, the numbers that enter the university level is constrained only by the village government spending. Hence, the total number of seats at the university level is determined by the total spending of the village governments on tertiary education. In particular, at this stage we ignore private schools and tuition paid at government tertiary institutions, each being negligible for many sub-Saharan nations for the period of interest. We will let c denote the cost per year for educating an individual. It takes T_c years to complete the university education; typically, $T_c = 4$ but can run from three to five years. It is presumed that the costs are raised from general taxes of the villagers. (Our robustness section will deal further with this assumption and myriad other issues.)

Of the tertiary educated, a fraction will be drained off to foreign villages or countries, with the residual fraction remaining in the home village. Those who remain in the local economy earn wages and contribute to the economy. Those who are abroad are assumed to send back home remittances to family members each year they are abroad.

The villagers obtain "utility" from having educated people locally around them. In particular, their valuation of educated people is precisely equal to the wage rate they earn, conditional on their being in the village. Let $\left\{w_t^{(i)}\right\}_{t=0}^{\infty}$ denote the expected wages of individuals of education level i in the local economy. We shall use $i = 0,1,2,3$ to denote the education levels of categories "uneducated," "primary," "secondary," and "tertiary," so that the two designations that will be important here will be $i = 2$ (secondary) and $i = 3$ (tertiary). As our emphasis is on the tertiary educated, we shall suppose that it is only the tertiary educated who drain.

The village chiefs also value the remittances of those who leave the village.

These remittances are of the form of transfers to other members of village, construction of houses in the village, and so forth. Let $\{R_t\}_{t=0}^{\infty}$ denote the sequence of expected remittances of an individual, which only happen when outside of the village; in particular, we may think of $R_t = 0$ when the individual is within the economy. In particular, the village chiefs do not assign a value to the wages received in foreign countries by those who leave for those foreign countries—they care only about their remittances.

The village chiefs do not care who gets the remittances just as they do not care who gets to talk to or be serviced by the educated within the local village economy. In particular, distributional issues do not worry them. Incomes (and costs) in the future are discounted by a discount factor. Let r_0 denote the rate of interest for those computations, with an implied discount factor of

$$\delta_0 \equiv \frac{1}{1+r_0}.$$

Let C and $W^{(i)}$ denote the discounted costs and wages:

$$C \equiv \sum_{t=0}^{\infty} \delta^t c_t \text{ and } W^{(i)} \equiv \sum_{t=0}^{\infty} \delta^t w_t^{(i)} \text{ for all } i,$$

and

$$R \equiv \sum_{t=0}^{\infty} \delta^t R_t.$$

The village elders seek to maximize the expected discounted present value of the streams of incomes, $W + R$ of the different types of agents less costs of educating them at the tertiary level, C.

At the optimum, the village chiefs will compare the costs of educating the marginal student, from secondary level to tertiary level, to the expected discounted benefit accrued from that marginal student.

In this village, drainage occurs right after schooling. There is a probability d that our representative individual will leave the village. If the individual does not leave but instead stays in the village, the individual will stay in the village forever. If the individual leaves (or drains), there is a probability χ that the individual will return to the village economy, and a probability $1 - \chi$ that the individual never returns. As mentioned earlier, the chiefs of the village receive satisfaction from knowing that their young ones are either employed locally at high wages or are sending remittances to other members of the village.

The village chiefs think of there being two possibilities or types of the tertiary-educated representative individual. With probability $(1 - d)$ the individual will not drain and will stay in the local economy. We refer to these types as the locally resident educated (or LRE). The net additional return of the chiefs from such individuals, over and above having them be secondary educated is:

$$NPV^{LRE} = W^{(3)} - W^{(2)} - C.$$

Next, with probability d the individual will drain. Conditional on draining, there is a probability of $(1 - \chi)$ that the individual will drain and never return to work in the village. The chiefs get no wage satisfaction in that state in any period, but will be receive satisfaction from the remittances in that state. If we let R^{NR} denote the net present value of the expected remittances in this state, then the net satisfaction of the chiefs, NPV^{NR} equals the expectation of these remittances less costs of education and relative to their expected contributions (wages) if they did not get tertiary educated:

$$NPV^{NR} = R^{NR} - W^{(2)} - C.$$

Finally, conditional on draining, with probability χ the individual will leave the village but eventually come back. Let

$$W^{ret} \equiv E\sum_{t=0}^{\infty}\delta^t w_t^{ret}$$

denote the expected net present value of this sequence of wages in the local economy, with an analogous definition for R^{ret}, the remittances they send when they are outside of the country and which we set to zero in any period t when they are within the village. The net contribution to the chiefs of these eventual returnees is therefore given by:

$$NPV^{ret} = R^{ret} + W^{ret} - W^{(2)} - C.$$

Hence, the expected return of the "Drainers" to the chiefs, including both those who never return as well as those who return, will be

$$NPV^{D} = (1-\chi)NPV^{NR} + \chi NPV^{ret}.$$

The return to the chiefs, taking into account the net contribution of the two types of tertiary educated, those who are local and those who drain, is therefore:

(1) $$NPV = (1-d)NPV^{LRE} + dNPV^{D}.$$

To see this even more clearly, write the expected utility of the educated in equation (1) above as follows. First, recall we defined W^{ret} to be the expected discounted wages of the eventual returnee individual in the periods when returned to the village. Then

$$W^{not\_ret} \equiv W^{(3)} - W^{ret}$$

is the expected sum of discounted wages that were not received because the individual was abroad. These are the wages that could have been received if the individual was in the home country as opposed to being abroad. A simple rearrangement of equation (1) shows that

$$NPV = NPV_{\text{village}} + \Delta NPV_{\text{abroad}} \text{ where}$$
$$NPV_{\text{village}} = \left\{W^{(3)} - W^{(2)} - C\right\}, \text{ and}$$
$$\Delta NPV_{\text{abroad}} = d(1-\chi)\left\{R^{NR} - W^{(3)}\right\} + d\chi\left\{R^{ret} - W^{not\_ret}\right\}.$$

In particular, the NPV can be broken into two parts. The first part, NPV_{village}, is the expected net present value of the increment if there was absolutely no brain drain, and the second, $\Delta NPV_{\text{abroad}}$, representing the expected discounted increment of the remittances over local village wages in each of the periods that the individual is abroad. The first term, NPV_{village}, is the NPV that would be obtained if there was absolutely no brain drain. We expect this to be positive, although the internal rates of return obtained both here and in the literature are low. The expression $\Delta NPV_{\text{abroad}}$ represents the impact of the brain drain. To the extent that remittances exceed incomes locally, this expression will be positive. In the exposition below we shall frequently talk about the returns to education without the brain drain and mean the expression NPV_{village} and refer to the incremental effect of the brain drain as the term $\Delta NPV_{\text{abroad}}$.

10.3 Results for the Village Economy

In the subsequent sections we will be discussing our simple model in great detail, and we will further discuss our data in some detail. In our robustness section we will stress test our model with different parameter value assumptions. In this section we quickly state our main conclusions under some stylized parameter values for Ghana. We will follow some standard procedures in the literature on the economics of education and compute some internal rates of return.

We will proceed by providing a quick list of some of the data and parameter values we use.

1. We use the cost data for tertiary education from the United Nations (UN) data sets.

2. We obtain data on the brain drain probabilities, d, from the Docquier and Marfouk (2005) data sets.

3. We obtain the value of χ from survey data that suggests a value $\chi = 0.5$ as the probability of return and with this taking place at year seven being reasonable assumptions to use.

4. We use the Ghana Livings Survey data (GLSS V) to get the wages,[1] $W^{(3)}$ and $W^{(2)}$.

5. We use data on remittances given by the UN International Fund for Agricultural Development (IFAD) surveys, which imply a per migrant re-

1. See http://www.statsghana.gov.gh/docfiles/glss5_report.pdf.

Table 10.1 **Internal rates of return and net present values**

	IRR		NPV at $r = 0.08$	
Remittances data	UN IFAD (%)	R = US$3,600 (%)	UN IFAD ($)	R = US$3,600 ($)
Locally res.	14	14	17,229	17,229
Never ret.	42	33	57,714	33,026
Returnees	41	32	37,271	29,368
Drainers	42	32	47,492	31,197
Educated	29	23	32,361	24,213

mittance value of US$5,260 for Ghana, as well as the lower value of $3,600 per person, per year.

The first pass of our results can be summarized in table 10.1. We report both the internal rate of return[2] (IRR) as well as the net present value at an interest rate of 5 percent. We do this for each of the different types of tertiary-educated types mentioned earlier: locally resident (LRE), never returns (NR), returnees (ret.), the drainers (D), and the tertiary educated as a class (E).

We obtain positive and large internal rates of return and net present values. Using the IFAD remittances data we obtain for the tertiary educated as a whole, an internal rate of return of 29 percent and a net present value at $r = 5$ percent of $32,361. The values are lower, but still large, when we use the lower value of $3,600.

What is driving the results should be clear: the remittances of those who leave compensate for the loss from being at home locally. In our robustness section we stress test our model with even lower values of the remittances than the two illustrated above.

10.4 Do *W* and *R* Capture True Costs and Benefits?

One big question in this entire analysis is whether the wages and the remittances truly capture the benefits of tertiary education and the value (or losses) associated with those who drain. What are the arguments for and against using W and R as measures of the value of the tertiary educated?

We begin by noting that we have included the costs of tertiary education in our computations, noting in our robustness section the obvious issues

2. The internal rate of return is defined as the interest rate at which the net present value is equal to zero. This is often used as a measure of the profitability of an activity or enterprise yielding costs and incomes over time. Although it has many faults, its use is standard in the economics of education literature.

surrounding its use and how sensitive our conclusions are possible errors in the estimates. So here we take out costs in our discussion.

So, our first and somewhat feeble defense in the use of wages as the value of the tertiary educated is that it is what is used in most of the returns to education literature. The question we seek to ask is not the moral or philosophical one of what is the value of a human being. Instead, it is the narrow economic question of whether resources used in educating an individual from secondary to tertiary education is worth the resources used for that tertiary education. The question then becomes one of evaluating the benefits of that additional education against its costs. At a first pass, the additional wages that the tertiary-educated person will earn is a proxy for that additional benefit from the schooling. For the village elders in the village economy who are expending resources, the additional resources of their village sons and daughters and the remittances they bring back to the parents in the village will feature heavily in their calculus of the pluses and minuses of the spending. Remittances often end up with members of the village, often the poorest members. This is a plus to the village elders. In our individual calculations, one would presume that wages would be a huge part of one particular person's cost and benefit analyses of education. Yes, there may be other motivating factors like quality of life, prestige, and so forth. But these are often correlated with wages, and, raw cash itself has to be important too.

Let us pursue this question further though. What are other measures that should be used? How else could we objectively measure the value of the tertiary education? Or, to say this in a different way, what are the other possible aspects of the tertiary educated that could be contributory factors in assessing the pluses and minuses? Well, there are a number of possible ways. There are valid factors to include in our analysis, but it is not clear whether these factors help our hurt our general conclusions. In particular, the relative importance of tertiary education and also the brain drain could actually be increased by adding these other factors. We leave these questions for later sections (and later papers). We will, however, mention one of them now.

One issue that comes to us continually in the discussion of the brain drain is the issue of having enough critical mass in the home countries. The argument is usually made that if more of the talented Ghanaians, say, would stay in Ghana, they would exert pressure locally to result in change at home. There are, of course, many responses to this argument. First, there is quite a large amount of unemployment among the tertiary educated. It is not at all clear that being in their home countries and dependent on the government for jobs that the tertiary educated would form the effective pressure group often dreamed about in the media. Indeed, having a large diaspora community exerting a fearless independent voice may be much better. Those who have been part of the brain drain and have returned to their home country may have outside options and hence be less afraid of criticizing the local

leaders. These are potential pluses of the brain drain, and, when appropriately measured could strengthen our basic argument.

10.5 The Individual-Decision Problem

Above we have treated the costs and benefits from the point of view of the village collectively. The villagers tax themselves to pay for the education of their children, and perceive rewards according to the local wages the children receive when they are locally resident, or the remittances they bring when they are abroad.

We can now think of the individual or family perspective. As a first pass at the individual perspective, we can simply follow the existing literature on internal rates of return as follows: In this first pass, suppose the tertiary-educated benefits are, as before, the incremental wages over and above secondary educated, and that those tertiary-educated wages equal either the local wages if the individual is locally resident or foreign wages when the person is abroad. In particular, notice that this is exactly the same as the exposition for the village economy, but where the remittances are replaced by foreign wages.

Let us continue by assuming that the costs are precisely the costs of education as above, which is described in detail, as will be the data on foreign wages. We are computing the social returns to tertiary education so we use the same costs as in the village economy. By replacing remittances by foreign wages, we are getting to the individual-decision problem and individual costs and benefits. This provides a useful comparison with the existing literature: what happens to the rates of return when we add the benefits of the brain drain—we know that for some countries 50 percent or more of the tertiary educated are outside their home countries, so omitting the brain drain is potentially omitting an important factor in the returns to education calculus.

The returns we compute would be genuine private returns if individuals pay for their education, which they do not in practice. However, we perform our computations as if they did, and we include as costs the costs of the education.

So, what do the net present values (NPVs) and the internal rates of return (IRR) look like? Well, to continue with our computations we require the wages of the typical tertiary-trained individual when abroad. We have data on incomes of Ghanaians in the United States from the US census data. We also have data on Africans in Europe from various Organisation for Economic Co-operation and Development (OECD) databases. These are all described in detail later.

In terms of our computations, note that all we have to do is to replace the figure for remittances in the village economy computations with that of wages for the individual computations. The village chiefs have an optimization problem similar to the individual private returns computation except

that when the tertiary educated migrate, the chiefs value them for their remittances while the individual values himself or herself via the foreign wages. Clearly, since we obtained positive net present values (NPV) and internal rates of return (IRR) with the lower remittances values, we expect much higher NPVs and IRR when we perform the individual computations.

We will perform our computations under two scenarios. The first is with the parameters we used in the baseline case. The second multiplies the local Ghanaian wages of the tertiary educated and the local costs of tertiary education by a factor of 2. We intend for this to capture any possible miscalculations in those variables. Further, since we are here comparing wages earned while a resident abroad to wages earned while a resident locally, there is an argument for scaling the wages of the tertiary educated up to account for purchasing power parity (PPP) as is standard in, for example, gross national income (GNI) computations.[3] We seek to correct for biases that may cause us to underestimate wages and costs of the tertiary educated. In particular, we are not also increasing the base wages of the secondary educated. All types of the tertiary educated, which we focus on here, use the secondary educated as the base in computing net present values, so changes to the secondary wages would affect each group equivalently.

For the Ghana data, our results can be summarized in table 10.2, where we have listed the internal rates of return (IRR) as well as the net present values at an interest rate of $r = 5$ percent (NPV5). We see that both are high for the individual, both under the standard parameters (multiplier = 1 in the table) as well as when we double both the local wages and local costs (multiplier = 2 in the table). For the tertiary educated as a whole, the internal rate of return is 67 percent for the standard parameters and 49 percent when we double the wage and cost parameters. Each of these numbers is very high relative to what is normally presented in the literature. The net present values NPV5 are $126,244 and $149,522, respectively.

When we double the costs and wages there is an increase in the IRR and the NPV5 for the locally resident, the IRR goes from 14 percent to 18 percent while the NPV5 goes from $17,229 to $51,192. In this case the benefits to lifetime increases in wages outweigh the effect of the increase in costs (relative to the wages of secondary educated).[4] There is a decrease in the values

3. We can obtain the purchasing power parity (PPP) factor from the World Bank World Development Indicators (WDI) by looking at the gross national income and dividing the value in PPP terms by that in current US $. For a variety of reasons, the PPP factor moves quite a bit from year to year. From the World Bank WDI data sets at http://data.worldbank.org/indicator as of Jan 12, 2011, for the years 2005–2009, the GNI those years in current USD billion was 10.0, 13.3, 18.4, 26.8, and 28.4; while in PPP international USD billion was 25.8, 28.5, 31.4, 34.7, and 36.6, resulting in what we call PPP ratios of 2.5, 2.1, 1.7, 1.2, and 1.3. Ratios for prior years also exhibit similar variability around the value of 2.

4. We remind the reader that we are not also doubling the wages of the secondary school educated—if we did then there would be no change in the IRR and NPV5 of the locally educated as all relevant variables would then have been doubled.

Table 10.2 Internal rates of return (IRR) and net present value (NPV) comparisons

	IRR comparisons		NPV comparisons ($r = 0.05$)	
Multiplier on cost and wage	1 (%)	2 (%)	1 ($)	2 ($)
Locally res.	14	18	17,229	51,192
Never ret.	90	68	342,188	338,409
Returnees	90	67	128,329	157,294
Drainers	90	67	235,258	247,851
Educated	67	49	126,244	149,522

for those who never return, as they are affected by the increase in costs of education but do not get any of the benefits of the increase in wages—the IRR goes from 90 percent to 68 percent, while the NPV5 goes from $342,188 to $338,409.

We stress here that what we are computing are actually "social" rates of return, as we have included the costs of education in the computation of the pluses and minuses. If we excluded the costs of education we would obtain even higher values of the IRR and NPV5. Given the large percentage who travel abroad, and the higher wages abroad relative to within the local economy, the higher returns of the drainers pushes up dramatically the ex ante expected returns to tertiary education as a whole—that is, among the collective group of tertiary-educated drainers and nondrainers.

We obtain figures far higher than those in the literature. See, for example, the survey paper Psacharopoulos and Patrinos (2004). The figures in the literature for rates of return to tertiary education in sub-Saharan Africa are of the magnitude of what we obtain in our above tables for the locally resident tertiary educated, as they should be. They are the same measures, except that different authors use different data sets and slightly different methods of estimation. We believe that since there is such a high incidence of brain drain in the countries we are interested in, it is important to include the brain drain in the compuations of the returns to education. When we do include these measures, we obtain extremely high rates of return.

This may resolve a certain paradox. Despite the low returns obtained in the literature, many Africans continually clamor for governments to invest in higher education. The media and popular presses all insist on the importance of investments in tertiary education. Students also clamor for the limited slots in the tertiary institutions. This would be paradoxical given the literature's stated low rates of return to higher education. A possible resolution to the paradox involves people taking into consideration the fact that they may get a change to drain abroad to obtain higher salaries. Our figures show that when these are taken into account, the rates of return to tertiary education as a whole become relatively large numbers.

We now turn to a detailed description of the data in the next few sections. Following that we will deal with some robustness issues—stress testing our model conclusions with different parameter values.

10.6 Cost of Tertiary Education, C

The cost to the government per year for the typical tertiary-educated person is obtained from the United Nations Educational, Scientific and Cultural Organization (UNESCO) data sets. The data on annual costs is often presented in a form that is (after normalizing by or dividing by) that year's nominal gross domestic product (GDP) per capita. This enables some comparability across nations, albeit imperfect. For all African nations for which we have data, the per student annual tertiary costs have been decreasing over time. For Ghana the costs have gone from 14.8 in 1970 to 2.09 in 2005. Given the recent extremely rapid increases in student numbers in Ghana, our expectation is that per unit costs today for Ghana have dropped significantly below this number. In Burkina Faso, it has gone from a large 29.39 in 1980 to 1.93 in 2005.

For example, for Ghana the cost today is about 2 times GDP per capita. For the countries for which there is reasonably current data, the per unit annual costs hover around this number or less. The questions about the costs and how they move over time will be important in our robustness section. For this reason we re-produce below the most current data we have for African nations as well as the year of the data, ordered from the smallest to the highest costs. (See tables 10.3 and 10.4).

10.6.1 Cost Recovery via Loans, Tuition, and Others

There are a number of issues that may distort the calculations above and give us potentially an incorrect view of the costs of the provision of tertiary education. On the one hand, there are various cost recovery and tuition policies by universities. To the extent that there is cost recovery, this would imply an overestimation of costs and an underestimation of the benefits of education in our own computations in the village economy above. We list

Table 10.3 **Per unit annual costs of tertiary education**

Country	Early cost	Year	Later cost	Year
Botswana	6.98	1975	3.72	1985
Burkina Faso	29.39	1980	1.93	2005
Ethiopia	9.51	1995	5.74	1993
Ghana	14.82	1970	2.09	2005
Mauritius	3.56	1980	0.30	2006
Rwanda	14.46	1970	4.04	2005
Senegal	4.32	1980	2.35	2005
Zambia	13.27	1970	1.68	2000

Table 10.4 **Most current cost data**

Countries	Cost	Years
Libyan Arab Jamahiriya	0.24	1999
Mauritius	0.30	2006
Mauritania	0.41	2005
South Africa	0.45	2004
Somalia	0.50	1970
Egypt	0.54	1980
Tunisia	0.56	2005
Cameroon	0.60	1999
Zimbabwe	0.64	1985
Angola	0.65	2005
Morocco	0.67	1996
Cape Verde	0.74	2005
Togo	0.87	1970
Namibia	0.93	2002
Benin	1.14	2002
Swaziland	1.40	1980
Zambia	1.68	2000
Madagascar	1.75	2005
Guinea	1.89	2005
Uganda	1.89	2004
Burkina Faso	1.93	2005
Ivory Coast	1.94	1994
Kenya	2.05	2000
Ghana	2.09	2005
Sierra Leone	2.31	1985
Chad	2.35	1996
Senegal	2.35	2005
Gambia	2.38	2004
Congo	2.46	2002
Liberia	2.58	1975
Mali	2.65	1999
Central African Republic	2.91	2006
Burundi	3.49	2005
Botswana	3.72	1985
Niger	3.96	2006
Rwanda	4.04	2005
Eritrea	4.27	2002
Lesotho	5.05	1994
Mozambique	5.32	2004
Ethiopia	5.74	1993
Nigeria	10.15	1970
Malawi	11.77	1992

these below, but argue that they are very small and would not appreciably change our main conclusions. Further, it is unclear whether the costs of education effectively take into account (a) the school capital construction costs and (b) the possibly distortionary effects of the method in which the government raises money to pay for the costs of higher education. We will

revisit these issues in our robustness section, but first we list some of the possible cost-recovery schemes. Again, we will argue that under plausible assumptions our main assumptions still hold.

Before we provide the list of these schemes, it may be important to discuss in the context of our model whether and how cost recovery should be treated in the basic optimization problem. There are two ways of viewing the interpretation of costs and, indeed, the entire optimization exercise in entering our village economy above. One interpretation is that the village elders think of "taxing" themselves to pay for the costs of the tertiary education for which they receive as benefits both remittances and the benefit of the services of the educated youth, and that those services are measured by the wages the educated receive. For example, the value of the services of a doctor is higher than the services of a clerical worker, the value of each is measured by their respective wages. Under this interpretation of cost recovery is a net benefit to the village chiefs; they receive the same services at lower net cost. (In this hypothetical exercise we suppose remittances would not be affected by cost recovery.)

However, there is another interpretation of the village economy. Suppose that the chiefs have primarily altruistic motivations and caring mostly about the youth, and in particular the net wages the youth receive upon graduation (as well as the remittances). If the students have to pay back to the chiefs a part of the cost, then this should be equivalent to a negative wage for the youth while going to school, and therefore a negative in the altruistic chiefs net present value computation. In particular, for these altruistic chiefs the cost recovery reduces chiefs' costs and also reduces one for one their perceived benefits. Cost recovery, therefore, would not affect the net present value computation of these altruistic chiefs.[5] As mentioned earlier, cost recovery is very small for many sub-Saharan African nations, so the above mentioned arguments are somewhat moot.

We now list some possible cost-recovery mechanisms practiced.

Tuition and Private Universities

If universities charge students tuition, then the government costs are much lower than those computed above. Indeed, one could imagine situations where the government cost of providing education is zero. Indeed, in some private for-profit universities the tuition may even exceed costs, so that there is a surplus for the investors or shareholders of the private university. During the period we have most of our data (up to 2000), the numbers of private universities in Ghana and many other African countries has been small. It is only in the past decade and less that private universities have taken off.

5. I thank David Weil for bringing this point up.

Student Loans

As with student payment of tuition and enrollment in private universities, student loans could be used as a form of cost recovery. This, however, is not widely used in Africa and even in situations where it is used, it is not clear how much of costs are really recovered (given the low or negative real interest rates, administrative costs, and loan defaults). (See Albrecht and Ziderman 1993).

National Service

An alternate form of cost recovery is national service. This scheme requires those in universities to work before, during, or after their schooling. The salary is often lower than government civil service salaries, so in principle this could be a form of cost recovery. As noted by Albrecht and Ziderman (1995), however, the cost-recovery benefits of national service are very low. Further, in areas where there is an excess supply of the tertiary educated and therefore unemployment in those ranks, the national service could be considered a benefit to the student and potentially a cost to the government, as the jobs are effectively being guaranteed.

Partnerships with Industry

Partnerships with industry are often touted as being possible ways of generating income for universities. At this time, however, even for Europe the estimates of the contribution to total costs of universities is low (6.5 percent was the estimate for Germany by Albrecht and Ziderman [1995]), and given their lower industrial bases, this would be expected to have almost negligible contribution to costs for African countries.

10.7 Young Locally Educated Who Stay

Estimates of incremental wages of those with tertiary education will be obtained from living standards surveys. As described earlier, the time series of wages of secondary educated, tertiary educated, and returnees are all needed in making our net expected returns computations. We have explicit data from the Ghanaian data sets, which we proceed to describe.

10.7.1 The GLSS Data Sets

We describe the Ghanaian data set below. The Ghana Living Surveys were taken at three different years: versions 3, 4, and 5 taken, respectively, in years 1991, 1998, and 2005. The surveys asked respondents a series of questions including education levels, age, and wages, among very many others. In the computations presented here we focus on the GLSS 5 data sets, the most recent. The GLSS5 was conducted in 2005–2006, and covered the entire country with a sample size of 8,687 households. In figure 10.1, we summarize

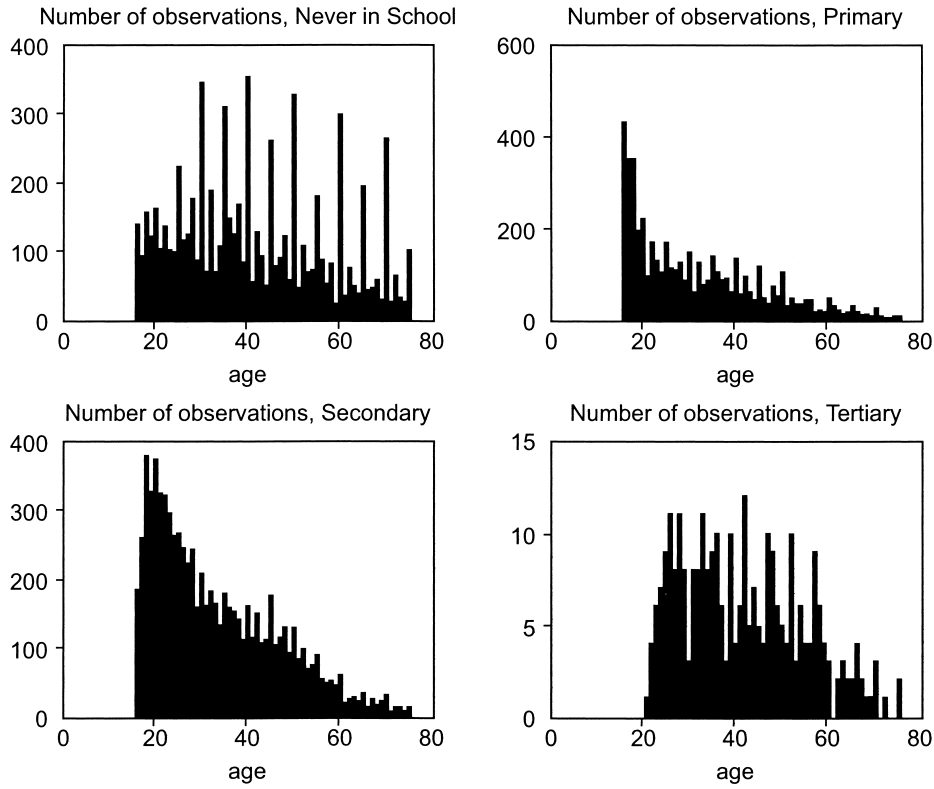

Fig. 10.1 Number of data points in GLSS survey data

the number of data points—broken down by education level and age level. We will, of course, be most concerned about the secondary- and tertiary-education levels in our computations.

Next, for our computations we need to compute the wage rate for each education level at each age. The first and direct method is, of course, to take the average wage for each education level and age combination. These averages will give us the wage sequences $\left\{w_t^{(i)}\right\}_{t=0}^{\infty}$ used earlier and shown in figure 10.2.

We note here that the average wages of the tertiary educated in figure 10.2 may seem low to the casual observer. We did some back-of-the-envelope checks of this data. After university education Ghanaians are required to do national service, considered by some as guaranteed employment for such students, many who may otherwise be unemployed. Those wages were, in the relevant years, around $600 per year. In contrast, public service workers were around $300–$500 per year, with higher amounts in the private sector. There was also anecdotal evidence of a decent amount of unemployment

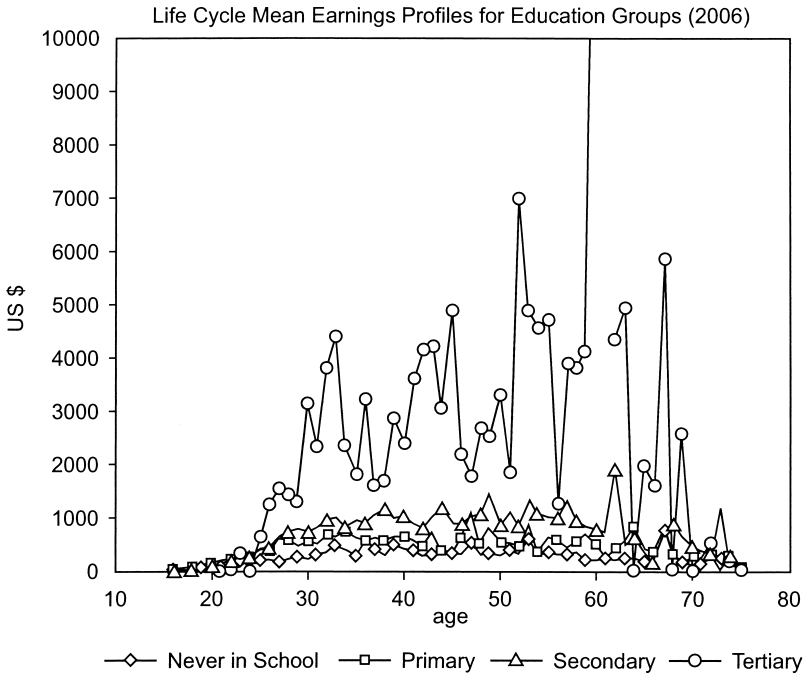

Fig. 10.2 Earnings of each educational group as a function of age

among the tertiary educated. These facts seem to corroborate the data from the GLSS survey for the tertiary educated.[6]

One other issue we have to address is whether to include or exclude the wages of those coded in the data as having income of zero. Most, although probably not all, of these are presumably unemployed. In our computations we average wages including those of all the zeros (although we exclude all those with income "N/A" or not available). In table 10.5, we note the ratios of incomes including and excluding the zero incomes. We do this for the three different waves of the GLSS data sets. We compute for each the income ratio between tertiary and secondary educated (as these are the cohorts of interest to us). In particular, columns (2) and (3) of table 10.5 provide the ratio $\overline{w}_3 / \overline{w}_2$ of the average wage of the tertiary educated, $\overline{w}_3$, and the secondary educated, $\overline{w}_2$, with and without the zero income earners. The second column shows the ratio of the average of the tertiary educated to the average of the secondary educated in the GLSS samples, including those with zero income. These range between 2.30 and 2.66, indicating a slight increase in

6. The GLSS 5 Report (September 2008) summarizes the findings of the GLSS 5 survey. Section 9.8 covers household income. Table 9.18 shows mean annual per capita income for all Ghana at GHC397 or about US$433 in prevailing exchange rates. The stated mean annual per capita income for the highest quintile is GHC688 (or about US$750).

Table 10.5 **Income ratios (tertiary over secondary) and Mincer regression coefficients**

GLSS version	Income ratio with all incomes included	Income ratio with only positive incomes	Ratio of log-incomes with all incomes	Ratio of log-incomes with only positive incomes	Mincer regression coefficient
3	2.30	2.29	1.07	1.06	0.69
4	2.33	2.18	1.06	1.05	0.81
5	2.66	2.37	1.06	1.05	0.82

the ratio over the different waves—the tertiary educated are out earning the secondary educated by larger fractions over time. The third column shows the ratio of average wages when we exclude those with zero incomes (presumably due to unemployment). We see then that there is a small decrease in ratio from Wave 3 to 4, then an increase from 4 to 5. We look at respondents who are of age eighteen and older in computing our average wages. Columns (4) and (5) report the ratios of the logs of average incomes, $\log(\overline{w}_3)/\log(\overline{w}_2)$. Given our purposes and the results presented here, we therefore do not believe that the issues of the zeros and nonzeros will significantly change our results.

10.7.2 Smoothing Data via the Mincer Regressions

As an alternate to using the raw average wages, one could consider smoothing the wages using the Mincer regressions, as is popular in the economics of education literature. In particular, let w denote income, let AGE be the age of the individual, and let SCHOOL be the dummy that is equal to 1 if tertiary educated, and zero otherwise. As is common in this literature, we use age as a proxy for experience. The Mincer regression we run is then given by

$$\ln w = \alpha + \beta_0.\mathrm{AGE} + \beta_1.\mathrm{AGE}^2 + \gamma.\mathrm{SCHOOL} + \varepsilon.$$

The Mincer regression we report is, γ, the coefficient on the tertiary schooling dummy variable. Some standard theory, or the interpretations of the theory, in the economics of education literature considers the parameter γ to be the returns to schooling and the internal rate of return of that schooling (the interest rate at which the net present value of the incremental return to schooling is zero).

We can apply the Mincer regressions to get an estimate of the wage rate as a function of age or experience. We then assume that an individual currently beginning the schooling process will follow that trajectory of wage rates into the future. We then set the wage of an individual of age t and education level i to be equal to the value predicted by the Mincer regression, at those given values of t and i. Figure 10.3 shows the Mincer equation smoothing of the raw income data.

First, we note that we obtain very little difference in our results upon using

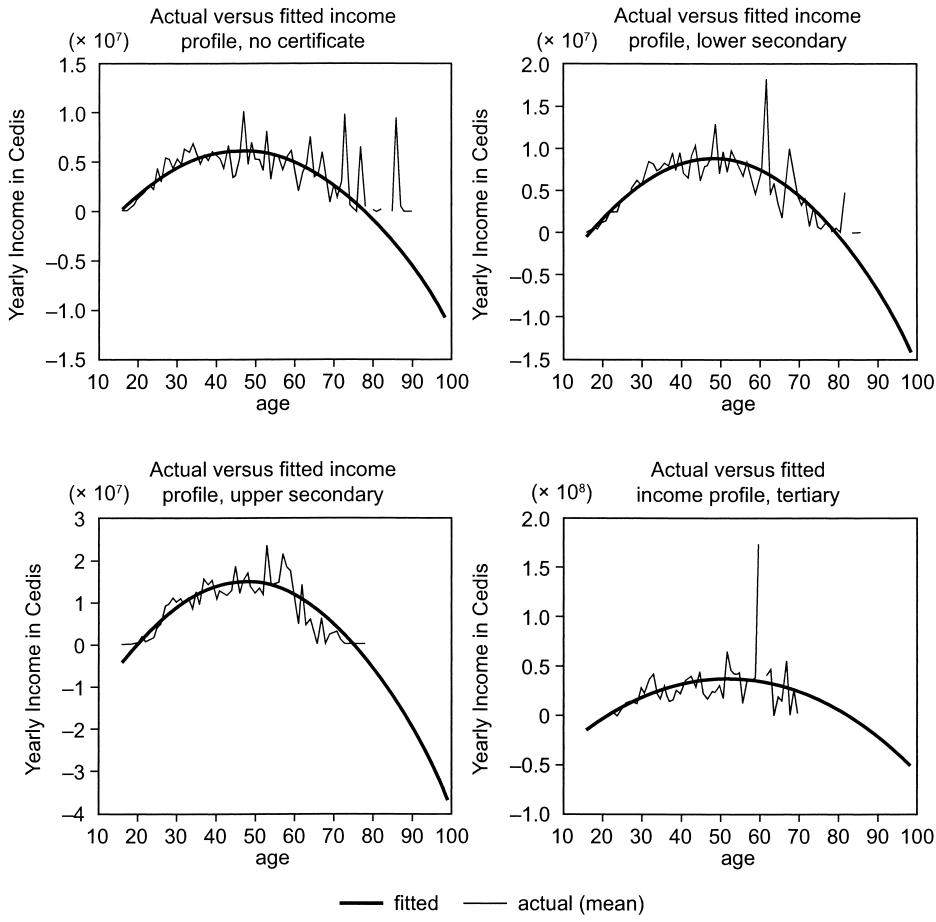

Fig. 10.3 Mincer regression smoothing of incomes

the method with raw averages versus those with the Mincer regressions. We have therefore chosen to report the former. We also note in passing that the issues of inclusion or exclusion of the unemployed arises, just as with the raw nonsmoothed averages. Again, since it does not seriously affect our results, we report only the values with the zero incomes included.

Our results are, of course, consistent with standard results in the economics of education literature, when remittances and the brain drain are excluded. Without the latter, the returns to tertiary education in Africa are surprisingly low, as is well documented in the literature. Bloom, Canning, and Chan (2006) and references cited there are a good source for a review of the literature.

10.7.3 Panels and Pseudopanels

Note that we have used a fixed year (2005) cross-section of individuals and used this as a proxy for the evolution of incomes across time. This use of a fixed-time data set to measure life-cycle earnings, although common in the economics of education literature, is still not one would wish for. There are, however, surprisingly few panel data sets that track individuals over time to enable us to seriously answer this defect. One option, which we have not chosen here, is to create a pseudopanel with some individuals from each of the three waves of the GLSS data sets at different ages to mimic the evolution of individuals across time. In particular, earlier data sets are used for younger cohorts while later data sets are used for the older cohorts. We would be piecing together different people at different times to construct a fictitious panel. Given the somewhat stark nature of our net present value results, we doubt that this would have made a significant difference to our conclusions.

Again, we concede there are many issues with the use of the data sets in computing the wage profiles. The possible weak arguments in our defense are, first, that it is the best data we have, and second, that it is currently the norm in the literature we seek to contribute to.

10.8 The Rate of Drainage, *d*, and the Rate of Return χ

In the description of the village economy above, we made a number of simplifying assumptions on when there is the first exit out of the local economy, the drain, and when there is a return to the local economy of those who do indeed return. In the more general version of the simple village economy, there is potentially a complicated stochastic process explaining the emigration and return decisions. In this general model, what we need to do is to set a sequence of probabilities $\{d_t\}_t$ of draining in each period t. Then, conditional on draining in period T, we need to specify in addition the probability of return in each subsequent period, $\{\chi_t\}_{t=T}^{\infty}$. Since there is a chance the representative individual never returns, we let χ_∞. represent this probability. In particular, we need to set probabilities $\{\chi_t\}_{t=T}^{\infty}$ and χ_∞ such that $\chi_\infty + \sum_{t=T}^{\infty} \chi_t = 1$. Further, in the general case, there could also be remigrations after the first return, and later returns after later migrations.

Instead, we shall impose very severe assumptions in our initial computations. The motivation for these come from surveys and casual observations. Recall that our primary focus is with emigration to OECD countries. Many who leave make one important emigration decision and then stay abroad for a while. When they decide to return, it is usually for good. (We are, of course, excluding short tourist visits). The survey by Black, King, and Litchfield (2003) finds that the overwhelming majority of respondents who have returned (83 percent) state that their return is permanent, with only 11 percent stating that they intend to reemigrate. We therefore model our repre-

sentative agent as making a decision to migrate one time, then after going abroad staying there until a one-time and irreversible decision to return.

We further calibrate our model as follows. First, we suppose that migration takes place almost immediately after completion of tertiary education. In particular, in our first cut we assume that the drainage occurs right after schooling. In particular, we suppose that tertiary education ends at age $t = 22$, then using the notation mentioned above, $d_{22} = d > 0$ and $d_t = 0$ for all other periods t.

We then use as a flow probability, d, the average rate of migration of tertiary-educated migrants obtained from the work of Docquier and Marfouk (2005). The data are obtained from censuses in OECD countries, and is available for the year 2000, as well as from national enrollment data. We will use the year 2000 rates of migration of skilled or tertiary educated in our computations. If one believes that emigration has been increasing over time, then these average migration rates will underestimate the true migration rates. As will be shown later, this would strengthen our basic conclusions.

When does our representative agent return? In particular, using the notation above, what are the return probabilities χ_∞ and $\{\chi_t\}_{t=T}^{\infty}$? Of those who decide to return, we shall approximate this by assigning all of the probability χ on a return date at year seven. There are two reasons for this. First, this is suggested by the survey of Black, King, and Litchfield (2003) and Pires, Kassimir, and Brhane (1999). Second, it is our hunch that a lot of the tertiary educated go to the OECD for further education (graduate degrees), which take about five or six years, and then spend a year or two doing practical training (if they are on F1 visas) or if they want to get a quick job to ready themselves for return.

Again, in our robustness section we shall discuss alternative formulations of the return probabilities and analyze the impacts on our results, spreading this probability over several years. It is fairly easy to see the impact of these changes in the date of return. We mention a few more surveys from the return migration literature in the subsection below.

10.8.1 Review of Some of the Return Migration Literature

- Gundel and Peters (2008) use data from the German Socio-Economic Panel (GSOP) to examine return migration among immigrants to Germany. They find that highly skilled individuals are more likely to leave Germany than low-skilled migrants. However, return migration is found to be lower for migrants from non-EU countries.
- Borjas and Bratsberg (1996) and Docquier and Rapoport (2007) also study the return of migrants. The latter refers to work showing that the return rate rose from less than one-fifth to about two-thirds for the return of Taiwanese PhDs who graduated from US universities in the fields of science and engineering from the 1970s to the 1990s. Very low rates of return are quoted from some studies of China and India, while

some other Indian software industry surveys "showed strong evidence of brain circulation, with 30–40 percent of the higher-level employees having relevant work experience in a developed country (Commander et al. 2004, 3)."
- The survey by Lowell and Findlay (2002) shows that some 50 percent of skilled workers return to their countries of origin, usually after about five years.

10.9 The Premium of the Returnees

When those who have been abroad return to their home countries, how much do they earn? Well, there are several parts to this, only one of which we will be able to meaningfully capture at this time. First, the returned come back with better skills. Second, they may earn a premium relative to their skill level because of the fact that they have had experiences abroad. On the other hand, because of lost social networks the returnees may face diminished wages. For our initial cut on the net present value computations, we shall assume for now no premium on returned migrants. In later work, and with better data, we will provide estimates of what we think are the net positives from the returned superior skills of migrants.

10.9.1 Literature and Data on Returnee Premia

Regarding data on the premium of the returned, we have identified a number of surveys that we list below.

1. Gibson and McKenzie (2010) find that migrants who return home do not tend to earn higher incomes than nonmigrants. However, they do tend to return with higher levels of human capital. Levels of repatriated savings appear to be similar in level to annual remittances, and there is some evidence that return migrants are more likely to be investing in business start-ups and sharing knowledge than nonmigrants.

2. A recent household survey on urban population (De Vreyer, Gubert, and Robilliard 2008) studied the impact of return international migration in seven major countries in Africa (Benin, Burkina Faso, Cote d'Ivoire, Mali, Niger, Senegal, and Togo). The surveys took place from 2001 to 2002. The sample consists of 58,459 individuals ages fifteeen years and older; 52,267 individuals in the sample never left the country where they were born and interviewed. The return migrants from OECD countries are 390 in number, and they constitute 0.6 percent of the sample. Average individual earnings of return migrants are 227.1 and nonmigrants are 55.9 (in 1,000 FCFA PPP; only active individuals). The average years of education of OECD return migrants is 11.1, compared to 5.6 for the nonmigrants.

In Benin and Togo, conditioning on education individuals who have been abroad earn 28 percent and 21 percent more than those who have not, and

the effect is statistically significant. In the other five countries the outcomes are mixed (negative in Cote d'Ivoire, Mali, and Senegal and positive in Burkina Faso and Nigher) but the coefficients are not significantly different from zero.

3. Wahba (2007) examines the labor market performance of return migrants to Egypt, and finds that on average, return migrants earn about 38 percent more than similar nonmigrants. The wage premium is lower for highly educated migrants: university graduates earn on average 19 percent more than their nonmigrant counterparts.

4. Barrett and Goggin (2010) estimate the wage premium for Irish migrants using a 2006 survey of Irish firms. After controlling for other factors likely to affect earnings, they find a 7 percent wage premium associated with return migrants. Estimated wage premiums differ by education level and migration destination. The premium for migrants with a postgraduate qualification was estimated to be 10 percent. Moreover, migrants that moved to far away countries (United States, Australia) were found to benefit from a higher premium than migrants that stayed in the United Kingdom or Europe. Finally, they find that the premium diminishes at a rate of about 1 percent per year.

10.10 Remittances

10.10.1 How Big Are the Remittances?

By one estimate, African workers send home around US$40 billion to the region (see table below). The value of remittances in sub-Saharan Africa (excluding North) are small by world standards, but high relative to GDP in Africa. The highest value of the remittances to GDP ratio is Nigeria, at 10.9 percent, with an additional four countries at ratios of 9 percent or higher (see table 10.6, as well as Barajas et al. [2010]).

The data on remittances come from a number of sources. None of them is really completely satisfactory. We shall discuss the different sources of data and note the limitations of each. One difficulty with the official statistics is that so much of the flows of remittances take place through informal

Table 10.6 **Estimates of remittances/GDP ratios, top five African countries**

	Country	Year	Remittances/GDP (%)
1	Nigeria	2007	10.9
2	Sierra Leone	2007	9.7
3	Togo	2007	9.6
4	Guinea-Bissau	2004	9.4
5	Senegal	2007	9.4

Source: From IMF Balance of Payments data as reported in Barajas et al. (2010).

channels—friends and family cash transfers, or the hawala system. In our empirical exercise, we shall specify the possible biases that could result from the use of different data sets on remittances.

1. Balance of Payments Data—Broad Definition. The official statistics for remittances are obtained from the Balance of Payments (BOP) data collected by the International Monetary Fund (IMF). The broad category used is that listed under "Workers Remittances, Compensation of Employees, and Migrant Transfers," made up of three constituent parts: (a) Workers' Remittances, defined as "current private transfers from migrant workers resident in the host country for more than a year, irrespective of their immigration status, to recipients in their country of origin"; (b) Compensation of Employees, defined as "wages, salaries, and other benefits paid to individuals who work in a country other than where they legally reside, for example, seasonal workers"; and (c) Migrants' Transfers, defined as "the net worth of migrants who are expected to remain in the host country for more than one year that is transferred from one country to another at the time of migration." Migrants' transfers are reported as "capital transfers" in the capital account of the balance of payments accounts.

The data are published by the World Bank Development Indicators (WDI), which relies on the IMF's Balance of Payments Yearbook (item codes 2391, 2310, and 2431, respectively). Data are available from 1970 onward. This source is very often used in the literature on remittances. As has been pointed out by Chami, Fullenkamp, and Gapen (2008), this is on the one hand too broad of a definition, as it adds "wages, salaries, and other benefits paid to individuals who work in a country other than where they legally reside, for example, seasonal workers." On the other hand and as mentioned earlier, it is also widely believed that a huge part of the remittance flows of individuals from host to home countries does not pass through the official channels at all, so would not be picked up in the BOP data. Freund and Spatafora (2008), based on market survey reports, indicated that the informal transfers may lie in the of 50 to 250 percent of recorded flows, depending on the country. Authors may use the more expansive BOP definition to compensate for the fact that informal transfers are excluded, but are important. This definition is used by Kapur (2004), who explains further the pluses and minuses of its use.

2. Balance of Payments Data—Narrow Definition. This uses only the entry "Workers' Remittances Receipts" in the Balance of Payments. In particular, it applies the correction to (1) advocated by Chami, Fullenkamp, and Gapen (2008). The problem with using this narrower definition is that there are fewer observations as, presumably, for many countries the aggregate of the three portions of (1) are listed, without a disaggregation into component parts. For example, countries like South Africa, Kenya, and Ivory Coast appear not to have entries for the narrower definition.

3. The United Nations IFAD Data.[7] In an attempt to capture informal flows of remittances, the IFAD (International Fund for Agricultural Development) has developed and reported data based on sources like population censuses in destination countries, household surveys, central banks and other official government sources, money transfer companies, international organizations, and academic institutions. Sample estimates are obtained from which extrapolations are made.

4. National Central Banks. Individual countries, especially the central banks, also gather local data on remittances. For (2003) in Ghana, the Bank of Ghana estimates that the remittances equaled US$1,017.2 (Addison 2004), which is an order of magnitude higher than the US$65 million estimate of the World Bank in the same year. Even this amount may be an underestimate. Mazzucato, van den Boom, and Nsowah-Nuamah (2004) suggest that unregistered remittances flowing into Ghana is around 65 percent of the total, meaning that the true remittances are around three times the value of the Bank of Ghana numbers. Based on this, the (2003) remittances of Ghana equal $3 billion. Informal quotes by the then-Ghanaian president John Kuffour put the 2006 number at US$4 billion, while that of the minister of tourism and diasporan affairs put the number at US$4.3 billion in 2007 (see Voices of the South on Globalization, 2007). Note that this would make remittances a sizable percentage of GDP.

Irving, Mohapatra, and Ratha (2010) reports on the findings of a 2008–2009 World Bank survey of 114 central banks worldwide (thirty-three in Africa). Approximately 43 percent of respondents in remittance-receiving countries collected information on remittances transferred through informal channels. Of these respondents, 42 percent base these estimates on information and data gathered in household and/or overseas migrant surveys. The report notes that there can be very large discrepancies between what central banks report to the IMF and what was reported to the World Bank in the survey: For example, for Ghana, remittances reported to the IMF totaled $105 million in 2007, while remittances reported in the survey were $1.8 billion.

5. Other Studies. Bollard et al. (2009) describe and analyze a new data set on remittances. The database is a compilation of microlevel immigration data from fourteen surveys in eleven OECD destination countries. According to the authors, these countries were the destination for 79 percent of

7. From their web page, http://www.ifad.org: "The International Fund for Agricultural Development (IFAD), a specialized agency of the United Nations, was established as an international financial institution in 1977 as one of the major outcomes of the 1974 World Food Conference. The Conference was organized in response to the food crises of the early 1970s that primarily affected the Sahelian countries of Africa. The conference resolved that 'an International Fund for Agricultural Development should be established immediately to finance agricultural development projects primarily for food production in the developing countries.'"

all global migrants to OECD countries in 2000. The surveys cover 33,000 immigrations, including 12,000 African migrants to nine OECD countries (Bollard et al. 2009, 9; Bollard, McKenzie, and Morten 2010, 4).

Table 10.7 provides the data on remittances for African countries from various sources, with WDI-broad and WDI-narrow representing the broad and narrow definitions of remittances mentioned above, and in current US $ millions, 2006.[8]

As argued above, the numbers from the balance of payments data probably do not capture what we need when we speak of remittances. In our baseline "simplest model" scenario, we use the higher UN IFAD numbers in computing remittances. The UN IFAD numbers are much more in accordance with central bank figures we have obtained from local African nations. This results in a per migrant remittance value of US$5,260 for Ghana (total of US$851 million from 16,1800 migrants). In our baseline figures above we also indicated the internal rates of return and net present values at a per migrant remittance of US$3,600 (or $300 per month). Our robustness section discusses even lower values of the remittances.

The numbers that we use will be average remittances over all classes, and we believe that this captures more fully the remittances of the tertiary educated. We now proceed to the question of remittances from different educational classes.

10.10.2 Decomposition of Remittances from Different Educational Classes

In our computations we will be using average remittances of nationals abroad when determining returns to tertiary education. One potential problem that needs to be addressed is the possibility that different educational groups send different levels of remittances. In particular, if it turns out that the tertiary educated remit much less than the average, then our use of the average remittances would bias upward the positive effects of the brain drain of the skilled.

Although one would a priori think that the higher skilled, being better educated, are more likely to remit more, some (e.g., Faini 2007) think that the skilled are more likely to bring their families with them to their host country, and therefore remit less. The basic finding is confirmed by Niimi, Ozden, and Schiff (2008), who suggest that a 1 percent increase in the proportion of university-educated migrants will lead to a 2.8 percent decline in total remittances.

Bollard et al. (2009) on the other hand, show the opposite. The authors focus on the relationship between remittances and educational attainment of migrants (all source countries). They look at both the likelihood of remitting and the level of remittances. They find that migrants with a university

8. World Bank World Development Indicators (WDI) downloaded June 2010.

Table 10.7 Remittances per year, in current US $ millions, 2006

Country	IFAD estimates	WDI-broad	WDI-narrow
Algeria	5,399	2,527	n/a
Angola	969	n/a	n/a
Benin	263	173	n/a
Botswana	n/a	117	79
Burkina Faso	507	50	n/a
Burundi	184	0	0
Cameroon	267	103	n/a
Cape Verde	391	137	136
Central African Republic	73	n/a	n/a
Chad	137	n/a	n/a
Comoros	85	12	n/a
Congo	423	11	n/a
Congo, Democratic Republic of	636	n/a	n/a
Côte d'Ivoire	282	167	2
Djibouti	n/a	28	4
Egypt	3,637	5,330	5,330
Equatorial Guinea	77	n/a	n/a
Eritrea	411	n/a	n/a
Ethiopia	591	172	169
Gabon	60	7	n/a
Gambia	87	64	63
Ghana	851	105	105
Guinea	286	42	42
Guinea-Bissau	n/a	28	n/a
Kenya	796	1,128	570
Lesotho	355	361	4
Liberia	163	685	685
Libyan Arab Jamahiriya	134	16	6
Madagascar	316	11	n/a
Malawi	102	1	n/a
Mali	739	212	193
Mauritania	103	2	n/a
Mauritius	356	215	n/a
Morocco	6,116	5,454	5,454
Mozambique	565	80	16
Namibia	n/a	17	7
Niger	205	66	n/a
Nigeria	5,397	3,329	n/a
Rwanda	149	21	17
São Tomé and Principe	n/a	2	2
Senegal	667	633	n/a
Seychelles	n/a	5	14
Sierra Leone	168	33	30
Somalia	790	n/a	n/a
South Africa	1,489	424	n/a
Sudan	769	1,156	1,155
Swaziland	89	99	1
Togo	142	193	n/a
Tunisia	1,559	1,510	1,510
Uganda	642	665	665
United Republic of Tan	313	15	8
Zambia	201	58	58
Zimbabwe	361	n/a	n/a

degree are less likely to remit than migrants without a degree (27 percent versus 32 percent). However, the average level of remittances is higher for migrants with a university degree. The authors find that remittance behavior is primarily accounted for by income effects—that is, more educated migrants earn more money abroad and are thus able to send more home.

Next, we note that there are many studies that find no impact of education on remittances per migrant (e.g., Naufal [2007] for Nicaragua, and Rodriguez and Horton [1994] for the Philippines).

10.10.3 When Do Remitters Remit?

One could also ask: When do remitters remit? We model in our baseline scenario remittances to be independent of time of return. Bollard, McKenzie, and Morten (2010) show that future returnees remit more. Gundel and Peters (2008) find that individuals that send remittances home are more likely to remigrate.

10.10.4 Data on Wages Abroad Used for the Individual Problem

We proceed by providing a few snapshots on the data, each producing slightly different estimates of the average wage rate of tertiary-educated Ghanaians moving abroad. We will use these snapshots in explaining how we arrive at a figure we will use in our computations. We have, we believe, used very conservative numbers (i.e., low foreign-wage rates).

1. From the Docquier and Marfouk (2005) data sets, we know that approximately 44 percent of the Ghanaian migrants to the United States have tertiary education. The US census data states that 31 percent of their sample of people born in Ghana and resident in the United States has tertiary education. This is not a perfect measure of incomes, but it should come close. It is imperfect because, of course, many of those who migrated to the United States with less than tertiary education could later become tertiary educated in the United States. Since we are interested in wage data, we use the US census data that also asks individuals for wages and we compute the average income of the top 31 percent of Ghanaians in the United States. This gives us a mean household US income of between $74,000 and $104,000 (the high and lows of the US 2000 census income buckets), or $89,000 with the midpoint value. Assuming a two-income household gives us an income level of $45,000 per person.

2. The average individual income of all Ghanaians in the United States among full-time, year-round workers is, according to the US 2000 census, US$32,262 for men and $26,235 for women. We know from the Docquier et al. data sets that a majority of the migrants are men. A simple average of the two would give us $29,242.50.

3. Although a large percentage of migrants from Ghana move to the United States, a significant percentage also go to other Western European countries. We, however, use the same US figure for them. We do not cur-

rently have precise data for the United Kingdom, but we doubt that this will significantly throw off our IRR computations.

4. We of course need to exclude taxes from income statements. Or do we? Taxes after all are, for the most part, returned as benefits to the individual in terms of services, unemployment benefits, and so forth. Further, we did not take out taxes from the Ghana data. At the income levels we are using in the United States, the average federal tax rate was 16.6 percent in the year 2000. Even if we assume Ghanaian taxes are zero (they are not), addition of the taxes did not measurably change the very large IRR values.

In our first pass at the individual problem, we will use the after-tax average annual US income values. That is, the wage figure in (2) above less US federal income taxes of 16.6 percent. We obtain an annual after-tax wage of $24,388. As argued above, we believe this to be an underestimate of the wages.

10.11 Robustness

We will begin by discussing the effect of changes in various parameters used in the model. We hope that this will enable us to test the basic assumptions of our model. Our baseline parameters are those used in the implementation of the village economy presented earlier. The values of our parameters involve estimates from different sources. In this robustness section, we will vary some of the parameters across a range obtained from the literature or that seem reasonable as ranges. We will look at the impact of changes in these parameters on two types of results we could be interested in:

1. The first is on how the return to education as a whole is affected—this is the ex ante definition of education taking into account those who stay and those who leave. This is measured by the NPV of the educated (NPV^E)—again, this includes both the locally resident and the drainers.
2. The other question is the effect on the comparison between the return of the locally resident educated versus the drainers. This is measured by NPV^{LRE}) and NPV^D), and their internal rates of return.

As described in the introduction, the second question gets most of the attention in the media and in the press, but it is the first that should be the most relevant for policymakers in many developing African nations. As we argue here, the returns to education are large, even allowing for the brain drain. An increase in education would therefore help to raise incomes. In this robustness section, however, we will discuss the implications on both questions as we change our baseline parameters.

We proceed in the next section by discussing the effect on our two questions in (1) and (2) above, of changes in the costs of education, C, of the wage profile of the tertiary educated, of the level of remittances, and of the drainage probabilities. We will measure the effect of these changes by looking at

the changes in the internal rates of return (IRR) and the net present values at baseline rates of interest of $r = 5$ percent (which we denote by NPV5) for the relevant quantities required in answering questions (1) and (2).

10.11.1 Cost of Education

Suppose we have underestimated the average cost of tertiary education. Suppose that the costs are higher than what we have from official statistics. Suppose further, that following Feldstein (1995), that the true cost of each $1 of spending is actually say $2 because of the distortionary effects of the taxation required to raise that $1. How will this affect our conclusions on the brain drain?

In our baseline village economy, all the tertiary educated have the same cost C of education, whether they stay in the local economy or eventually leave. Changes in C therefore affect the locally educated exactly the same as the drainers. In situations where the NPV of drainers is higher than that of the locally resident, as was in our baseline model, if the drainers become "unprofitable" in an NPV sense (i.e., NPV less than zero) because of increases in the cost C, then so too would the local nondrainers, since the latter have lower NPVs. Indeed, the locals will become unprofitable before the drainers in this case—that is, at a lower level of cost. So, how much of a difference in the cost of education do we need to overturn our results? Well, keep the wage profile at our baseline, as obtained from the livings survey data, and maintain the remittance level at our (lower) baseline of $3,600 for Ghana. Define the "cost multiplier" to be the corrective multiplicative factor to costs—so that a cost multiplier equal to 1 is the baseline cost data as reported by official statistics and, for example, a cost multiplier equal to 2 denotes doubling the costs of tertiary education—as perhaps recommended by Feldstein (1995).

Table 10.8 shows the decrease in the internal rate of return (IRR) and in the value of the net present value (NPV) at the baseline interest rate of $r = 5$ percent, NPV5, caused by the increase in costs from our baseline values to twice the baseline value. The internal rates of return still drop, but remain

Table 10.8 **Effect of changes in costs C**

	IRR comparisons		NPV comparisons ($r = 0.05$)	
Cost multiplier	1 (%)	2 (%)	1 ($)	2 ($)
Locally res.	14	10	17,229	13,450
Never ret.	33	21	33,026	29,247
Returnees	32	19	29,368	25,589
Drainers	32	20	31,197	27,418
Educated	23	14	24,213	20,434

positive and large for education as a whole (from 23 percent to 14 percent) and particularly for the drainers (32 percent to 20 percent). Similarly, the NPV5 computations all remain positive.

One could ask how high costs have to be to begin to overturn the positive NPV5 numbers. It turns out that we would need costs 5.6 times the baseline cost values for the returns to begin to be negative. The negative returns begin with the lowest values—the NPV5 of the locally resident educated. At that level the other NPVs still remain positive, and it takes a cost factor of 7.4 for the NPV5 of the educated (which includes both resident and drainers) to become zero.

Again, we note that the changes in the robustness exercise here are changes in costs only, keeping all other relevant parameters at their baseline village economy levels mentioned in the earlier section.

10.11.2 Are There Quality Issues and Capacity Constraints on Production of Tertiary Educated?

We presented in tables 10.3 and 10.4 the cost data across Africa, as these values are critical for our computations and the entire NPV exercise. We will not pursue here, in any detail, the very interesting question of the changing production function of tertiary education in Africa as capacity rises. We do explore the effects of increasing output in tertiary education in Africa. If there are capacity constraints and the costs figures rise significantly as enrollments rise, contrary to the impression given by tables 10.3 and 10.4 above with everything else remaining the same, then our policy recommendations may no longer be valid. We have a number of responses to this concern: (a) It is our own view that economies of scale will work as a check on rapid rises in the costs of tertiary education. We have seen declines over time in the per person costs of tertiary education since the independence of many African countries, and although it is unlikely to fall much further in the future, it is also unlikely, in our opinion, to rise that steeply; (b) the capacity constraints of real significance are related to the shortage of professors for the universities—other costs, like housing and infrastructure, one would expect to have major economies of scale. The shortage of professors is probably related to the existence of better opportunities in the local economy for both the professors and the graduates themselves. However, if wages of graduates are rising, then the entire net present value exercise needs to be redone, as this could increase the baseline returns to tertiary education without the brain drain (what we called NPV_{village} earlier). That is, the factors that cause an increase in costs (shortage of professors) could also increase the wage of locals. The negative effect of increased costs of professors is mitigated by the increased wages of graduates in our NPV computations.

In summary, if the production of tertiary education is supply constrained and costs go up, there is the potential for our policy recommendations to be made invalid. At this time we do not believe that the changes in costs will

change that rapidly, due to economies of scale, and further as it changes there are other parts of the calculus that will also move around, which will result in small net effects.

Quality Issues. There is a second and related issue concerning the possibly declining quality of the tertiary-educated graduates in local African universities, as there is a massive push in enrollments. Here it is important to distinguish two parts of this question—that related to past graduates and our computations above, and those related to future graduates and our policy recommendations. Regarding the computations in the village economy earlier and those using current data, we have already incorporated quality issues into the computations. Presumably, the wage rates locally and remittances (which should be related to wages abroad) are all a function of the quality of the tertiary educated. They have therefore already been accounted for.

The bigger issue is with the policy prescriptions for the future. If tertiary enrollments are expanded and quality falls, how would this affect our basic argument? Well, first there is the question of the returns to tertiary education itself, even without taking into account the brain drain; that is, the term NPV_{village}. The reduced quality will presumably reduce the local wages and perhaps lead to increased unemployment of the tertiary educated. How do these reduced wages compare to the new reduced costs of education? It is the comparison of these two that will determine the net effect.

How about the effect of the reduced quality of graduates on the incremental returns to brain drain, $\Delta NPV_{\text{abroad}}$? Well, the main channel will be via remittances. Since remittances are a small proportion of total wages abroad, it is possible that these remittances will stay relatively robust, even as there are reductions in wages abroad due to reduced quality of those graduates.

Our position on the quality issues is related to that of costs and supply constraints mentioned earlier. Since the NPVs of education are generally positive, and since there are returns to scale in the provision of tertiary education as evidenced by past cost data, we believe that there are opportunities for increasing the quantity of education without major impacts on the quality.

10.11.3 Wages of Nondraining Locals

Suppose we have underestimated the level of wages of the locally resident educated. Suppose this is either because of poor data or nonrepresentative samples. Alternatively, this could be because we are incorrectly measuring the value of the tertiary educated by their wages. How would an upward revision in the wages of the locally resident affect our results?

It should be repeated here, however, that given the high unemployment of the tertiary educated, it is not obvious that the existing wages are an underestimate in our village economy model. However, we perform this robustness check anyway.

An increase in the imputed wage rate of the tertiary educated with no

change in that of the secondary educated will of course increase the NPVs and internal rates of return to educated of the locally resident. Further, to the extent that some of the drainers return, the higher local tertiary wages will also increase the NPVs and IRR of the drainers. In particular, a revision upward in the wage sequence of the tertiary educated will increase all NPVs and IRRs.

How about the comparison between the locals and the drainers? Well, an increase in the level of the wage sequence will obviously have a bigger effect on the locally resident than the drainers. So, how much of a difference in the wages of locals do we need to overturn our result that the expected NPVs of the drainers exceed those of the locally resident? Again, note that we keep all other parameters equal to our baseline levels: costs are those from the UNESCO data sets and we maintain the remittance level at our baseline of $3,600 for Ghana. Let the wage multiplier denote the corrective multiplicative factor to the sequence of local wages—so that a wage multiplier equal to 1 is the baseline wage sequence and, for example, a wage multiplier equal to 2 denotes doubling the local wages at each and every date. Table 10.9 shows the increase in the internal rate of return (IRR) and in the value of the net present value at the baseline interest rate of $r = 5$ percent (NPV5) caused by the increase in local wages. The internal rates of return rise from 14 percent to 24 percent for locally resident tertiary educated and from 32 percent to 33 percent for drainers, and from 23 percent to 29 percent for the tertiary educated as a whole. The NPVs at 5 percent interest rates rise from $17,229 to $54,971 for the locally resident tertiary educated, from $31,197 to $47,596 for the drainers, and from $24,213 to $51,270 for the tertiary educated as a whole.

We also note that the wage multiplier of 1.65 is needed for the expected NPV at $r = 0.05$ of locals to exceed that of the drainers (where again we should stress that we believe the comparison of NPV5 of locals to that of drainers is actually not the appropriate question to be asking). It should be mentioned that part of the reason for the exercise in this section is that the data we have indicates what some may consider to be low domestic-wage rates. Part of the issue is that we have correctly included wages of

Table 10.9 Effect of changes in local wage sequence

	IRR comparisons ($r = 0.05$)		NPV comparisons	
Wage multiplier	1 (%)	2 (%)	1 ($)	2 ($)
Locally res.	14	24	17,229	54,971
Never ret.	33	33	33,026	33,026
Returnees	32	34	29,368	62,112
Drainers	32	33	31,197	47,569
Educated	23	29	24,213	51,270

unemployed as zero. It should be stressed that the main conclusions do not change much when we omit the unemployed. The average wages will rise, but definitely not as much as the twofold rise modeled in this robustness section.

10.11.4 The Effect of Errors in Measurement of Remittances

The earlier section explained the effect of changes in local wages. The effect of changes in remittances is almost the exact opposite. An increase in remittances affects the relative importance of drainers in comparison to locally resident in only those periods an individual is away, just like the effect of wages. A $1 increase in the remittances has the same positive relative effect (i.e., on NPV of drainers minus NPV of locally resident) as a $1 decrease in the local wage rate.

We now ask what happens if we suppose that our estimates of the remittances are too high relative to our baseline (of $3,600). We should mention here we actually believe that our remittance levels are too low, and do not include all the informal remittances and investments of people who are abroad. Nonetheless, we provide the robustness checks here.

In particular, we look at remittance multipliers: a remittance multiplier of 1 is the baseline level, and a multiplier of 0.5, say, means that we use remittances equal to one-half of our baseline level.

A decrease in the imputed remittances of the tertiary-educated drainers with no change of other parameters will, of course, decrease the NPVs and internal rates of return to the drainers, and will not affect the locally resident. In particular, a revision downward in the remittances of the drainers will decrease all NPVs and IRRs except those of the locally resident.

Table 10.10 below shows the decrease in the internal rate of return (IRR) and in the value of the net present value at the baseline interest rate of r = 5 percent, NPV5, caused by the decrease in remittances from our baseline to half its value. The internal rates of return all remain positive. The biggest drop, as would be expected, is among the drainers who never return—the NPV5 figure goes down from $33,026 to $6,256.

Table 10.10 Effect of changes in the assumed level of remittances

	IRR comparisons		NPV comparisons (r = 0.05)	
Remittances multiplier	1 (%)	0.5 (%)	1 ($)	0.5 ($)
Locally res.	14	14	17,229	17,229
Never ret.	33	15	33,026	6,256
Returnees	32	19	29,368	20,799
Drainers	32	18	31,197	13,528
Educated	23	16	24,213	15,378

We also note that the remittance multiplier of 0.6 is needed for the expected NPV5 of locals to exceed that of the drainers. (Again, we stress that the comparison between locals and drainers is not the right question; it is the NPV of the educated as a whole taking into account the drainers—in the table it remains positive even with a halving of our baseline remittance numbers.)

10.11.5 The Drainage Probabilities

The net present value of the educated, NPV^E, is a weighted average of the NPVs of the locally resident educated NPV^{LRE}, and the drainers, NPV^D. The larger is the probability of drainage, d, the more the weights move the NPV^E toward NPV^D and away from NPV^{LRE}.

So, suppose we have miscalculated the drainage probability and that instead it is a larger number. Since for most of our computations NPV^D exceeds NPV^{LRE}, the increase in the drainage probability d will increase the NPV of education. It will actually strengthen the main conclusions of this chapter. It is indeed possible that our drainage probabilities, being the average drainage rates (nationals abroad divided by total nationals for the tertiary educated) may underestimate the marginal drainage probabilities (those in the most recent years) if the drainage probabilities have been rising over time.

10.11.6 Timing of Return

We have adopted a very stylized model of the timing of return of those who drain and come back. We have assumed all who drain leave immediately after school and those who return do so in seven years.[9] The more general case involves a complex model of the tertiary educated leaving at all different dates and returning at different dates, with a complicated model of return probabilities and random durations of stay.

Our feeling at this time, based on the various surveys we have seen, is that we have probably underestimated the duration of stay abroad. Given the relative values of the remittance term and the local wage rates, this would imply that in a more general model we should have larger returns to tertiary education more generally, and to those who drain more specifically. A more general model, given the other parameters in the model, will most probably strengthen our general conclusions.

9. One may be concerned that a return date of seven years means that the returnees are not important. This is not correct. First, a return date of seven years means that at a 5 percent interest rate, since $1/(1.05)^7 = 0.71$,we see that after seven years approximately 71 percent of the value is retained with 29 percent discounted relative to the present value. Further, we are comparing income streams, so both returnees and nonreturnees incomes are both discounted and at the same rate.

10.11.7 Post-2000–2005 Data Issues

We have worked with a lot of data from around the years 2000–2005. This has been constrained by the data sources we have—the data on stocks of migrants are usually obtained from census figures, many of which were last taken around the year 2000. There are a number of post-2000 developments that should be discussed. In Ghana there has been a tremendous increase in enrollments at the tertiary level over the past five to ten years. As the enrollment levels have increased, so too, presumably, has been the per person costs of education. Many have remarked that this has been associated with the reduced quality of education. We discussed issues of costs and quality in our robustness section above. The big open question is the extent of the brain drain currently, as the total stock of the tertiary educated has increased so rapidly. Rather than speculate, we await the census figures that should be in within the next couple of years in Ghana and in many other countries.

10.12 Items Omitted from Discussion

10.12.1 Skills of the Returnees

Due to a lack of data, we have modeled the returnees as having no extra education after their time spent abroad. We know, however, that many come back with superior skills, which could be extra formal education or skills in more advanced economies working in sectors for which there would be few opportunities for advancement in their home countries. There has been quite a bit of attention put on the importance of returnees to India in the information communication technologies (ICTs) industries there. If these benefits of the returnees are added, they will of course increase the already high returns to those who drain out of the country. In much earlier work (see Easterly and Nyarko 2009), we have commented on the skills of the returnees. We reserve for subsequent work the study of the improved skills of those who return. We merely remark here that if these skills were added into the computations our results would be stronger, and we believe considerably so. In that sense, the fact that we have obtained strong returns to education and the brain drain without including these factors may be a reflection of the power of our results.

10.12.2 Internal African Migration

The focus of much of our work has been on the brain drain outside of Africa. There has been quite a bit of brain circulation within Africa. Adepoju (2002, 2006) have observed that highly skilled African professionals have increasingly found South Africa and Botswana to be "attractive alternatives" to Europe, the United States, and the Gulf States. At this time we do not have data indicating large transfers of the tertiary educated from one

sub-Saharan African country to the next. We leave the question of within-Africa brain drain or circulation to future work.

10.12.3 Labor Hoarding?

As the economy of Ghana and many other African countries improve, we are beginning to get anecdotal evidence of an increase in the return of the tertiary educated. This of course begs an obvious question. Could it be that it was a great idea to educate people and have them sent abroad when the economy was doing poorly, so that they could form a reserve pool of skilled labor ready to come back to the home country when the economy improved? Was there an invisible hand leading the central planner to educate people and to "hoard" them in foreign countries so that when the local economy could absorb them they are available to return? Our data can not directly test this hypothesis, of course, but the model we present could easily be tweaked at to get a handle at this. Again, we leave an in-depth discussion of this for future work.

10.12.4 Incentives

In other work (see Easterly and Nyarko 2009) we have discussed the very important literature on the question of the role of incentives to invest in education in the presence of the brain drain. The basic idea is that in the presence of the brain drain, and the opportunity to receive very high wages in the future with some probability, individuals make bigger investments in their education (either in terms of money spent or effort in studying and attending university). This incentive effect could increase the supply of the tertiary educated so much that it more than compensates for those who leave. In particular, the final number of tertiary educated left in the home or source country after the brain drain exceeds the number who would be in the country if the incentive effect of the brain drain was not there (say by banning the drain by law or by making it extremely difficult for people to leave).

10.13 Conclusion

In this chapter we have discussed the brain drain in Ghana. We have performed some rates of return to education computations using various data sets. Our main conclusions are that when using wages and remittances in standard cost-benefit returns to education computations, we have found that there have been high rates of return to tertiary education in general, taking into account the brain drain. Both from a social or "village" point of view, as well as from the individual point of view, the rates of return are large.

Our results on the individual returns to education resolve a paradox in the returns to tertiary education literature, which often finds low or sluggish returns. This is paradoxical given the clamoring for tertiary education by leaders and the general public in many sub-Saharan African nations. It is

also paradoxical as one may expect a high rate of return to tertiary education in countries that have such low stocks of tertiary educated and where development is a priority.

In our robustness checks we have stress tested the model, and the main conclusions seem to withstand these tests. Various variables we have omitted from our analyses may strengthen the conclusions we have.

There are several issues we wish to highlight in our concluding remarks. First, we point out that in most of the conversations on the brain drain in Africa, it is almost universally considered something that is bad and to be avoided. The arguments in the media and in policy circles often use a cost-benefit argument. It is often stated that "the government has wasted money" if people trained at the tertiary level then drain out. Our numbers show that these statements must be made carefully, and indeed that the opposite may be true. There are also arguments of the form "if only the highly skilled would stay" the local economies would do much better. Our results at least cast a little doubt on such assertions.

More importantly though, our results indicate that there is room for creative thinking around the question of tertiary education provision. We have found high internal rates of return to tertiary education. This suggests that creative thinking around the provision of higher education could possibly be both self-financing (or even return a profit) and lead the education of large numbers of people. At currently levels of local incomes, however, this may involve some leaving the home country, at least for a while. In particular, rather than thinking of the brain drain as a curse upon the economies of sub-Saharan African countries it could instead be a part of the instrument to use for expanding the number of tertiary educated who are in the local economies. If it is known that one out of every two tertiary-educated people leave the country, then the logical implication is that there is the need to train twice as many to get the desired number locally. Our numbers show that this may indeed be feasible financially for the sponsoring entity (the government or non-governmental organization [NGO]). Our numbers also suggest that the individuals would also be able and willing to pay for loans incurred in this process. Our computations suggest interesting possibilities with financing schemes for tertiary education that (a) explicitly take into account the possibility that some will drain out of the country, and (b) that asks those who are out of the country, and presumably earning more money, to pay higher amounts to reimburse the government for their education. The analysis also suggests that the payments by those who leave could in principle form the bulk of the income, which in later years will finance the massive expansion of tertiary education in the local economies.

For emphasis, we should note all the beneficiaries of schemes as described above. First, since this is potentially self-financing, the local economies will benefit from expanded numbers of educated. Second, by introducing a new financing system for higher education, those who are initially credit con-

strained may be able to attain an education that otherwise would have been denied them. Finally, it should be remarked that those who end up being part of the brain drain should be counted in the welfare computations. In the discussions and the rhetoric on the brain drain, it is often presumed that once Ghanaians leave their country they cease being Ghanaians and so their welfare no longer matters. Should the goal of development not be the development of Ghanaians as opposed to those who happen to reside in Ghana? If a large number of people are educated who otherwise would not be, and a large fraction of those get improved incomes and livelihoods abroad who otherwise would not or would be unemployed in Ghana, is that not a positive to be included in evaluating policy?

In this chapter we have evaluated the costs and benefits of the tertiary-education system including the calculus of all Ghanaians, those abroad and those in the home country. Our data show that continued investments in tertiary education may yield significantly large net present values and internal rates of return, and further, that higher-education financing schemes could therefore be ultimately self-financing.

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