# INVESTING IN GIRLS' EDUCATION: EMPIRICAL APPLICATIONS IN ZIMBABWE

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## Abstract

Recently the social sector has exhibited a push towards “social” investments, which attempt to induce investors to back projects with the promise of a potential return based on achieving a specific objective, paid by public savings or donor funds. In order to quantify this return, it may benefit implementers to monetize the social benefit associated with an intervention. This paper evaluates the indicators used by education interventions based on their feasibility, impact, and monetizability. Certain indicators are monetized for the IGATE Zimbabwe project, an ongoing intervention which aims to improve girls’ education in rural Zimbabwe. This empirical application of the project results in immediate cost savings of $670,659.24 USD as a result of lower repetition rates. Additionally, the project would result in an increase in future annual earnings of $50,916.21 USD for treated individuals as a whole, as a result of additional years of schooling conditional on the absence of labour market barriers to girls. However, since girls are likely to face significant labour market barriers in Zimbabwe, I find that this may highlight the need for interventions focusing on combatting harmful gender norms.

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# 1. Introduction

Women in developing countries typically spend more time on non-labour market activities and are less likely to obtain higher education (Duflo, 2012). While girls tend to benefit from gender-neutral interventions, there may be justification for more direct targeting. This is due to the fact that girls tend to face a myriad of unique barriers to education. For instance, social norms, life expectancy and labour market outcomes may result in parents investing less in the education of girls (Duflo, 2012; Jensen 2010b). Furthermore, there exist harmful cultural practices such as early marriage and pregnancy, which can negatively impact a girl's educational attainment. Finally, in certain cases, merely attending school can be a dangerous endeavor for girls where they risk being attacked or sexually harassed (Herz and Sperling, 2004).

While helping facilitate girls' education by circumventing the aforementioned barriers may be reason enough, there are other factors which may be of interest to policy makers. Specifically, girls exhibit higher marginal returns in earnings to education (Patrinos and Montenegro, 2014; Psacharopoulos and Patrinos, 2004). Additionally, increasing female labour force participation can increase the tax base (Schultz, 2002).

Recently, the social sector has been experimenting with creating investments to induce investors to fund projects with the potential for a return on their investment based on a Payment by Results (PbR) framework. Under this framework, an implementer is payed based on public sector savings (social impact bonds) or funds allocated to achieving a certain result (development impact bonds) (Center for Global Development, 2013; Warner, 2013). The implementer can then distribute the return to investors according to their agreement. The purpose of this initiative is to tap into additional financial resources to increase the amount and/or scale of projects. Given this, it is of interest to implementers to properly measure the impact that can be attributed to an intervention. This process is challenged by the difficulty of reliably collecting data, how well the indicators represent their desired impact, and how easily the resulting benefits can be measured in monetary value.

This paper contributes to existing literature by evaluating the indicators used by education interventions based on their feasibility, impact on cognitive skills, and monetizability. This paper then proceeds to measure and monetize the impacts of an ongoing project. The project is IGATE Zimbabwe, which is an intervention aimed to improve girls' education in rural Zimbabwe using a mixed approach. This mixed approach is a combination of resources (village based savings and lending funds, bicycles) as well as training community members to facilitate community based activities which promote gender equality.

I find that the current treatment provided by IGATE Zimbabwe results in immediate cost savings of $670,659.24 USD to the schools of treated individuals as a result of lowered repetition rates. Using years of schooling and the Mincerian earnings function I find that the intervention could result in increased earnings of $50,916.21 USD annually for the 48,733 treated individuals as a whole, under the assumption that there are no significant labour market deficiencies discriminating against girls.

The rest of the paper is organized as follows. Section 2 contains a brief literature review that summarizes previous attempts to improve girls' education. Section 3 provides an evaluation of indicators used to measure educational outcomes. Section 4 details the methods used to monetize certain outcomes. Section 5 describes IGATE Zimbabwe's approach and beneficiaries. Section 6 contains IGATE Zimbabwe's impact on certain derived indicators. I then proceed to monetize these derived indicators in Section 7. Finally, I present my conclusions in Section 8.

## 2. Literature Review

Interventions targeting girls' education can be categorized into three groups: resources and infrastructure, policy and institutions, and norms and inclusion (Unterhalter et al., 2014).

Interventions targeting girls' education by providing resources have been successful, but may warrant some caution. Cash transfers have been found to improve girls' access, retention and progression in school (Kremer et al., 2009; Behrman et al., 2011; Fiszbein et al., 2009). However, how these transfers are implemented is of key importance. Evidence suggests that low income populations and grade levels with the highest dropout rates should be targeted (Unterhalter et al., 2014). Otherwise, when employed improperly, resources can be wasted or these transfers can contribute to social tension (Chapman and Mushlin, 2008). Interventions which waive school fees have been found to drastically increase enrollment, especially for girls (İşcan et al., 2015). However, care should be taken, since drastically increasing enrollment has been found to significantly lower school quality due to the resulting higher-pupil teacher ratio (İşcan et al., 2015). While surveys indicate that girls often report missing school due to their menses, findings suggest that providing menstrual supplies had no impact on attendance (Oster and Thornton, 2011).

Regarding infrastructure, construction of village based schools in Afghanistan was found to disproportionately benefit girls' enrollment and test scores (Burde and Linden, 2013). Investigating these results, Burde and Linden (2013) finds that distance effects girls greater than boys, likely due to the unique risks girls face to their safety and chastity to and from school. Thus, interventions aimed to improve access to education via the construction of additional schools may be of great benefit to girls.

Interventions using the policies and institutions approach typically aim to improve the schooling of girls by implementing reforms at a large (national and regional education system) and/or small scale (local school and classroom). Hiring more female teachers has been a popular initiative, however results have been mixed. In some cases, hiring female teachers was found to increase literacy scores but not affect math scores, while in others it was found to have no effect on literacy scores and a negative effect on math scores (Antecol et al., 2015; Chudgar and Sankar, 2008). On the note of teachers, studies suggest that teacher's attitudes towards girls may impact their success. Lloyd et al. (2000) find that schools where teachers expressed less supportive attitudes towards girls exhibited higher dropout rates for girls. Thus, interventions which aim to alter these attitudes at the institutional level may be beneficial.

Interventions focusing on norms and inclusion typically focus on changing harmful attitudes and practices towards girls at personal and/or interpersonal levels. Examples include the provision of learning spaces and clubs for girls, sex education, and working with faith communities. Theoretically, addressing these barriers should facilitate a better learning environment for girls. However, to date there has been little empirical evidence of these interventions having a direct impact on educational outcomes, since these approaches have been under-researched and under-funded (Unterhalter, 2014).

Mixing these approaches has been met with success. The construction of "Girl friendly schools" in Burkina Faso led to an increase of enrollment of all children aged 5-12 by 19% and test scores by 0.41 standard deviations (Kazianga et al., 2013). This intervention provided new schools which also dispensed take-home rations, textbooks, and other resources. Faculty were also taught to promote a gender inclusive environment.

## 3. Selecting Indicators for Assessment and Investment

The outcomes of education interventions can be measured in many different ways, which typically fall into two categories of indicators. The first being indicators measuring the consumption of education: years of schooling completed, educational attainment, enrollment, and a multitude of rates (attendance, repetition, dropout). The second are indicators measuring cognitive performance as a result of consumption, which is typically measured by standardized test scores. Ultimately, these indicators proxy for the gain in cognitive skills associated with an improved education.

Under the assumption that schooling institutions are efficient and can improve the cognitive skills of students, consumption should lead to this result. However, across the world the quality of schooling institutions varies considerably: the benefit of a year of schooling in a highly developed country tends to be quite different from that of a developing one (Hanushek and Woessmann, 2010). As a result, mere increases in consumption may not lead to sufficient improvements in cognitive skills if schooling institutions are of poor quality. A better indicator for this matter would be standardized test scores, which are found to be the best available measure of cognitive skills (Hanushek, 2013). Given this, it would seem that implementers should only care about test scores. However, interventions typically face various constraints such as time and resources. For example, an intervention may not have the resources to administer and collect standardized test score data at a large scale. Additionally, interventions may have stakeholders who would prefer to measure results in monetary terms in a cost-benefit analysis framework. Therefore, if the goal is to induce investors by monetizing results, how can one monetize the value of a standard deviation increase in test scores? Even when proper indicators are used, how can one ensure investors that their money is being put to good use if the results would take decades to properly monetize? Thus, in practice we find that different indicators have different advantages and disadvantages in different contexts, so implementers and evaluators should decide which sole indicator or mix is best suited given their objectives and constraints. To aid this process, I evaluate the advantages and disadvantages for each indicator with regard to their measurement, impact, monetizability and possible perverse incentives under a PbR framework.

**Years of Schooling**

Years of schooling is measured as the number of years of schooling an individual has completed, meaning that any years spent repeating grades are not included (UNESCO, 2013). From an intervention's perspective, measurement is easy. An intervention simply has to observe how many of the enrolled students in a grade have completed said grade; having met the requirements to progress to the next grade or graduate. The period of measurement is relatively short, as the name suggests, it simply requires one academic school year.

A drawback of years of schooling is that, as previously stated, this measurement is not easily comparable. The difficulty in comparison lies in the benefit attributed to this measure being dependent on the quality of the delivering school. School quality is defined as how much learning can be imparted to individuals, which can vary greatly between schools, regions, and countries (Hanushek, 2013). As a result, the benefit to a year of schooling can vary greatly as well. Education interventions in developing countries typically target schools of poor quality. Thus, the value added of an additional year of schooling may not be much.

As a PbR indicator, years of schooling is convenient in that it requires a short time horizon to measure; suitable given the project spans at least a school year. It is easy to put a monetary value on years of schooling as well, using the Mincerian earnings function method (refer to Section 4). However, as discussed above, years of schooling is not a strong measure for the impact on cognitive skills. Thus, there exists a trade-off between measurability and impact that an intervention must consider.

**Standardized Test Scores**

Standardized test scores are measured as an individual's performance on a standardized test. From an interventions perspective, measurement may be difficult, specifically because testing on a large scale requires a lot of resources to administer and collect results in a reliable manner. The required period of measurement is dependent on the expected period required for individuals to realize benefit. As a result, it is quite flexible and can be used in interventions with a shorter time horizon.

As previously mentioned, standardized test scores are considered to be the best available indicator for cognitive skills. To elaborate, Hanushek (2013) finds that when cognitive skills are measured as achievement on international assessments of mathematics and science and incorporated into empirical growth models, school attainment has no independent impact on economic growth. It should be no surprise then that a large amount of interventions have used standardized test scores as an outcome measure (Miguel and Kremer, 2004; Duflo, 2000; Banerjee et al., 2010; Duflo et al., 2011)

Gains in standardized test scores are very difficult to monetize. Specifically, there are very few commonly agreed upon monetary values for increases in test scores (Dhaliwal et al., 2013). As a result, most individuals stick to cost-effectiveness analysis when evaluating an intervention that uses test scores as an outcome (Banerjee et al., 2005; Kazianga et al., 2013; Kremer et al., 2009).

Gains in standardized test scores are a suitable PbR indicator since they are a strong measure of impact. However, it is difficult to monetize them unless sufficient data is available to show the cost of achieving similar gains elsewhere. Thus, it may benefit an intervention to also include an indicator which is easily monetized. Furthermore, it is important to consider potential perverse incentives which may arise when using test scores as a PbR indicator, such as cheating and teaching to the test.

**Educational Attainment**

Educational attainment is measured as a level of schooling completed (ex. Primary education, secondary education, tertiary education), which is very easy to measure. However, from the perspective of an intervention, this measure requires a long period of time to be meaningful, typically longer than the lifespan of an intervention. This period would be the amount of years required for a treated cohort to complete a level of education. In terms of impact, educational attainment is similar to years of schooling in that it does not control for quality.

The benefit to educational attainment can be monetized by either using the Mincerian earnings function or the age-earnings profile method (refer to Section 4). Using this measure is advantageous, in that the returns to education have been calculated for a wide variety of countries using educational attainment (Psacharopoulos and Patrinos, 2004; Montenegro and Patrinos, 2014). Thus, monetization is simple if there are returns to education already calculated for a country of interest in a relevant period.

The major constraint that educational attainment suffers from is requiring a long time horizon to be a meaningful measure, this alone makes it typically not suitable as a PbR indicator.

**Repetition Rates**

Repetition rates are calculated as the average number of attempts students take to complete a certain grade. Ideally, lower repetition rates imply that the schooling system becomes more efficient at educating students, so that they require fewer attempts to complete a grade. However, this measure does not control for quality of education received, and as a result is not the best measure of impact. Even when quality is assumed to be maintained or improved, repetition rates can still be misleading. For instance, lower repetition rates can be the result of increased dropout rates. A benefit to the measurement of repetition rates is that they can easily be monetized using the cost savings method (refer to Section 4).

From a PbR perspective, this indicator is enticing since the monetary benefit is realized far sooner than with other indicators. This is due to schools saving the unit cost of providing a year of school whenever an individual does not have to repeat a year. However, there are some significant shortfalls. Specifically, it is not a strong measure of impact and can create perverse incentives; such as encouraging weaker students to drop out.

**Enrollment**

Enrollment is the number of students who have registered to attend a school or grade, which is very easy to measure. An intervention simply has to keep track of how many individuals are enrolled in a school over a period of time. Enrollment is the pre-requisite to consumption, it measures whether an individual is registered to participate in schooling. As a result, all other indicators require the measurement of enrollment. Given this relationship, enrollment has an indirect relationship with benefit, mainly as a facilitator to consumption.

When measuring enrollment, one should be sure to take into account school transfers which can bias results. Specifically, when enrollments arise due to displacement from other schools, this measure can overestimate the resulting benefit. Thus, when viewing changes in enrollment one should focus on individuals who were previously not enrolled at any school. One way to ensure this is to compare relevant population enrollment rates pre and post intervention.

Children who are currently not enrolled in school tend to be from families of lower income status (Deolalikar, 1997). This may be the case since parents in lower income levels often under estimate the returns to education (Jensen, 2010a). Thus, an intervention which promotes enrollment may be targeting the poorest of individuals, which is often an objective of implementers.

A great majority of countries exhibit a positive return to education, especially at lower levels (Psacharopoulos and Patrinos, 2004; Montenegro and Patrinos, 2014). Thus, allowing more individuals to access schooling should lead to an increase in the aggregate amount of benefit received, ceteris paribus. However, when enrollment is the objective, special care should be given to ensure the quality of education is maintained at a desired degree. This is because enrollment is positively related to the pupil teacher ratio, which is in turn inversely related to student learning (Glewwe and Muralidharan, 2015). Thus, implementers should decide how much average benefit they are willing to sacrifice to possibly increase aggregate benefit, this can be done by setting an adequate pupil-teacher ratio.

Given that increases in enrollment can increase the aggregate benefit of consumption, then the additional consumption due to new enrollees can be attributed to the increased enrollment. This additional benefit can then be monetized through a measure such as additional years of schooling.

Enrollment can be a suitable PbR indicator, since it is a pre-requisite which facilitates individuals to access the benefits of schooling. However, it’s credibility as a PbR indicator is contingent on the aforementioned precautions being heeded. Enrollment affects the aggregate benefit associated with other measures, which makes its monetization contingent on the other indicators used and their monetizability. Thus, enrollment should be combined with another indicator which can be easily monetized.

**Attendance Rates**

Attendance rates are the frequency in which enrolled individuals attend school. They are typically challenging to measure, since they require an individual to reliably track the attendance of each student on a regular basis. Attendance measures how many schooling days an individual consumes. Ideally, higher attendance rates should imply that students are more likely to progress to the next grade or perform better on test scores.

Monetization should be done through related measures such as additional years of schooling, educational attainment, or repetition rates. As a PbR indicator, attendance rates benefit from being a strong measure of consumption. However, given the difficulty in tracking, it may prove costly for an intervention to do so reliably.

**Dropout Rates**

Dropout rates are the rate in which individuals un-enroll from school. This is easy to measure; it relies on the changes in enrollment rates over the course of a year. Interventions typically want to reduce dropout rates to ensure that individuals maintain their access to schooling. Interventions may want to target this measure since low-income individuals are likely to have higher dropout rates.

Monetizing lower dropout rates is typically done by converting them into additional years of schooling (Patrinos and Velez, 2009). This can be done using equation (1), where the additional years of schooling from treatment ($S_T$) is calculated as the difference between the dropout rates for control ($d_C$) and treatment ($d_T$) multiplied by the number of individuals in the treatment group ($N_T$).

$$(1) \quad S_T = (d_C - d_T)N_T$$

However, this method assumes that individuals that do not drop out in fact complete the grade, thus does not account for repeaters. Given this, it is more reasonable to simply use years of schooling initially instead of making this conversion.

As a PbR outcome, dropout rates may be suitable if an intervention cares substantially about keeping individuals enrolled. However, it is not the most suitable measure of impact and its monetization relies on a stronger measure of impact (years of schooling completed).

## 4. Methods to Monetize Outcomes

Economic cost-benefit analysis requires the estimation of the value of all benefits and costs associated with an intervention in monetary terms. In education interventions, the benefit is typically associated with increases in expected labour market outcomes (Hanushek, 2013). These expected labour market outcomes can be estimated using the discounted future earnings method as well as the Mincerian earnings function. It is also possible to monetize outcomes using the cost savings that result from increased school efficiency. It is important to note that expected labour market outcomes and cost savings are complementary methods of measuring impact, meaning that their values can be simultaneously added towards the total impact of a project. Thus, it may benefit projects to include a mix of indicators which are able to capture both expected labour market outcomes and cost savings, such as tracking both years of schooling and repetition rates.

**Discounted Future Earnings Method**

The discounted future earnings method is calculated by comparing the discounted future benefits and costs associated with higher levels of education to a base level. This method is typically calculated using age-earnings profiles, which are the average wages of individuals with a given educational level at each age. The goal of this method is to calculate the private return to obtaining a higher educational level.

The private return of attending university is calculated using equation (2). The first term in the equation represents private benefits which is subtracted by the second term; private costs. The private benefit is the discounted future sum of the wage differential between having a university degree ($W_{u,t}$) or a secondary education ($W_{s,t}$) in period t over the amount of periods an individual is expected to work ($\theta$). Private costs are the fees and direct costs of attending university ($C_{u,t}$) as well the opportunity cost of forgone earnings (expressed as wages with a secondary education) over the time required to complete a university education ($\delta$).

$$(2) \quad NPV_U = \sum_{t=\delta}^{\theta} \frac{W_{u,t} - W_{s,t}}{(1+r)^t} - \sum_{t=1}^{\delta} \left(W_{s,t} + C_{u,t}\right)(1+r)^t$$

This method is applicable to any level of education; however lower level returns are relatively asymmetric since in developed countries children do not forgo any earnings. However, in developing countries this is not always the case. In developing countries children at the primary level may be forgoing helping their family in agricultural labour or even participating in other child labour activities (Jimenez and Patrinos, 2008). Thus, these opportunity costs should be considered when applying this method in developing countries.

Discounted future earnings using age-earnings profiles is the gold standard when it comes to monetizing returns to education (Jimenez and Patrinos, 2008). However, this method has large data requirements, in that it requires data with a large number of observations for each age-earnings profile for each level of education. In the context of developing countries, the required labour market data is either non-existent, difficult to access, or of poor quality.

**Mincerian Earnings Function**

The Mincerian earnings function was invented by Jacob Mincer (1974). It calculates log-wages ($\log(W_i)$) as a function of years of schooling ($S_i$) and labour market experience ($E_i$), shown below. Labour market experience is calculated as the individual's age subtracted by years of schooling and the age they entered school.

$$(3) \quad \log(W_i) = \alpha + \beta S_i + \lambda_1 E_i + \lambda_2 E_i^2 + \epsilon_i$$

The Mincerian earnings function can also be calculated using educational attainment, by using dummy variables for each level of schooling:

$$(4) \quad \log(W_i) = \alpha + \beta_p D_p + \beta_s D_s + \beta_t D_t + \epsilon_i$$

The main drawback of the Mincerian, which makes it slightly inferior to the discounted future earnings method, is that it assumes flat age-earnings profiles for different levels of education. This means that the returns to a level of education is constant at all ages. Another problem is that when using years of schooling, the Mincerian assumes that each year of schooling is equal in impact. That being said, the Mincerian earnings function does have advantages. Firstly, it requires a dataset with far fewer observations than that required to construct the proper age-earnings profiles necessary for the discounted future earnings method. Secondly, the Mincerian is a popular method and calculated by many studies. Good resources are Psacharopoulos and Patrinos (2004) and Monetenegro and Patrinos (2014), which have a catalogue of Mincerian earning function results for many countries and periods. Thus, if the calculation is done for a desired country and relevant period, monetization becomes very easy, since all that is then needed is the data for gains in years of schooling or educational attainment.

**Cost Savings**

Cost savings to governments, institutions or individuals can be used to quantify the impact of an intervention. These savings can occur due to the resulting efficiency gains of an improved education. One way to approach this, is to estimate the cost savings which result from lowered repetition rates (Cuadra and Fredriksen, 1992; Patrinos and Velez, 2009). Lower repetition rates imply that the school requires less resources to provide for a cohort of students. Repetition cost savings ($S$) can be calculated using equation (5), where $r_a$ and $r_b$ are repetition rates for after and before treatment respectively, $N$ is the number of treated students and $UC$ is the unit cost of providing a year of schooling to a student.

$$(5) \quad S = (r_b - r_a) N \cdot UC$$

This calculation could also be used in the context of a randomized control trial, as shown in equation (6). In this case, repetition rates for the control ($r_c$) and trial ($r_t$) are multiplied by their respective unit cost of providing a year of schooling to a student and then differenced and multiplied by the number of treated individuals ($N_T$).

$$(6) \quad S_{RCT} = N_T(r_c UC_c - r_t UC_T)$$

This method as a monetization tool benefits from its low data requirement. Specifically, repetition rates are easy to calculate or obtain and only need to be collected either before and after the treatment or simply after the treatment when a control exists. This method also has immediate and tangible implications: these are savings which the school realizes immediately, as opposed to labour market outcomes which may take years to realize.

## 5. IGATE Zimbabwe

### Background

Improving Girls' Access through Transforming Education (IGATE) is an intervention focused on improving the education of girls in rural Zimbabwe. The intervention was implemented in late 2013 and is active until late 2016. It was implemented in ten districts: Beitbridge, Binga, Chivi, Gokwe North, Gokwe South, Insiza, Lupane, Mangwe, Mberengegwa, and Nkayi.

The intervention is estimated to treat 48,733 girls in 467 schools. To evaluate this intervention, the implementers use a Randomized Control Trial (RCT) approach at the school level. The sample consist of 1,927 girls: 1,200 girls in 53 treatment schools and 727 girls in 33 control schools. Three surveys are conducted, the first being prior to implementation (baseline), then another the subsequent school year (midline), and the final survey being the last school year of operation (endline). Data available at our disposal includes a baseline dataset and a midline report.

IGATE's intervention uses a mixed approach, combatting both resource scarcity and negative cultural norms. The intervention consists of nine components listed and described in Table 1. The intervention's composition is two resources, three policy and institution, and four norms and inclusion interventions. While only interventions one to six were initially planned, the remaining three were added during implementation.

Given the complexity of this intervention, only the following models were operational at the time of implementation: Village Savings and Lending (VS&L) fund, Power Within Girl Clubs and Mothers' Groups. While three models were operational, multiple communities have not been exposed to all three of these, or were for less than six months. The implementers thus use two different classifications of the treatment. The first is full treatment (FT), observing only those communities which received all three interventions for over 6 months. The second is intent-to-treat (ITT), which observed all communities, regardless of how much, if any, treatment was received. Arguably the intent-to-treat specification may be most suitable, given that unobserved school characteristics, such as operational efficiency, may be correlated to both ease of implementation and education outcomes such as test scores.

The IGATE project measures improvements in girls' education by the following indicators: standardized test scores (literacy and numeracy), retention rates, and attendance rates. Retention rates are defined as the percentage of a cohort of individuals enrolled in the first grade at baseline who are expected to reach a given grade. The calculation of this outcome is outlined in UNESCO (2009).

While retention and attendance rates do not have specific targets, the project has aimed to improve standardized test scores in both numeracy and literacy by 0.4 standard deviations. In order to incentivize this target, the project sets standard deviations of test scores as a PbR indicator. The PbR payment is provided by the donor and handled by a financial intermediary. The payment is delivered to the implementers based on the target standard deviation increase in test scores achieved over the control. Specifically, the implementers receive a payment equal to the fraction of the achieved over target increase in standard deviation of test scores (capped at 175 percent) multiplied by available funds. The available funds for the PbR indicator is set as ten percent of the intervention's budget, which is also provided by the donor.

**Results**

Midline assessment has found that treatment under the ITT framework had no significant impact on both retention and attendance, however had a significant effect on both literacy and numeracy test scores. Specifically, treatment resulted in an increase in literacy test scores by 0.049 SD and numeracy test scores by 0.136 SD.

The PbR benchmark for midline was set at a 0.2 standard deviation (half of the total goal attempted to be achieved by the program at endline) increase in both literarcy and numeracy test scores. The payment was set at $1,234,923 USD, with half of the payment eligible for both numeracy and test scores. Thus, the IGATE project received $150,167 USD for their increase in literacy scores and $420,183 USD for their increase in numeracy scores, for a total of $570,350.

## 6. Quantifying the Impact of IGATE

While IGATE's measure of retention rates itself is not of particular interest in terms of monetization, it's required data can be used to calculate indicators which are. Specifically, the calculation of retention rates requires two consecutive periods of enrollment and repeater data. This data allows for the calculation of progression, repetition, and dropout rates. Thus, we can use the data which the IGATE midline report has provided on the number of enrolled individuals in a specific grade at both baseline and midline as well as the number of individuals from the baseline who have to repeat a given grade during the midline to calculate the aforementioned rates.

**Progression Rates**

Progression rates are the percentage of baseline enrollment that has progressed to the next grade by the midline. Grade specific progression rates are denoted as $p_{g,i}^{b}$, where $g$ denotes the group (treatment or control), $i$ the grade, and $b$ denotes baseline. They are calculated as the difference between the number of enrolled individuals in the next grade at the midline ($E_{g,i+1}^{m}$) and the number of individuals repeating the next grade at the midline ($R_{g,i+1}^{m}$), divided by the number of enrolled individuals in the current grade at baseline ($E_{g,i}^{b}$).

$$(7) \quad p_{g,i}^{b} = \frac{E_{g,i+1}^{m} - R_{g,i+1}^{m}}{E_{g,i}^{b}}$$

The average progression rate for a group ($\bar{p}_g$) is calculated as the sum of the respective grade specific progression rates divided by the total number of grades ($I$).

$$(8) \quad \bar{p}_g = \left(\sum_{i=1}^{I} p_{g,i}^{b}\right) \Big/ I$$

For this calculation we have to use the first 9 grades since the report does not provide a measurement for the number of individuals graduating from the 10th grade. Thus, while we do have the number of repeaters at midline for the 10th grade, it is not possible to distinguish if the remainder are dropouts or graduates. Nonetheless, we compare the average progression rates between both treatment and control for the 9 grades and find that the treatment group has a higher progression rate by 7.6 percentage points (pp) (refer to Table 3).

**Repetition Rates**

Repetition rates are the fraction of baseline enrollment which have to repeat the same grade at the time of midline. Grade specific repetition rates are denoted $r_{g,i}^{b}$ and are calculated by dividing the number of repeaters of a grade at midline ($R_{g,i}^{m}$) by the number of individuals enrolled in that grade at baseline ($E_{g,i}^{b}$).

$$(9) \quad r_{g,i}^{b} = \frac{R_{g,i}^{m}}{E_{g,i}^{b}}$$

Average repetition rates ($\bar{r}_g$) are calculated using the grade specific repetition rates similarly to average progression rates detailed above, except all 10 grades can be used. Comparing average repetition rates between both treatment and control we find that the treatment group has a lower repetition rate by 15.33 pp.

**Dropout Rates**

Dropout rates are the percentage of baseline enrollment that has dropped out by the midline. Grade specific dropout rates are denoted $d_{g,i}^{b}$ and are calculated by subtracting 1 by both the grade specific progression and repetition rate.

$$(10) \quad d_{g,i}^{b} = 1 - p_{g,i}^{b} - r_{g,i}^{b}$$

Observing Table 3 it appears that some grade specific dropout rates have negative values. If monitoring was at the school level, this could be the result of new individuals entering the cohort in larger numbers than those dropping out. However, since tracking is at the individual level where the data provided only includes girls who were identified both at baseline and midline this should not be the case. Instead, using some algebra, we find that misclassification between enrollment and repeaters can lead to this result (see Appendix). Specifically, for the dropout rate to be negative it is likely the case that current grade enrollees ($E_{g,i}^b$) were misclassified as repeaters ($R_{g,i}^m$) or subsequent grade repeaters ($R_{g,i+1}^m$) were misclassified as enrollees ($E_{g,i+1}^m$). Unfortunately, given that there are two pathways for this result, it is difficult to narrow down which error is taking place specifically. Assuming this error is random, it should not bias our results terribly, but should be taken into consideration.

Average dropout rate is denoted $\bar{d}_g$ and calculated for the first 9 grades since grade specific dropout rates rely on grade specific progression rates. Comparing average dropout rates between both treatment and control we find that the treatment group has a higher dropout rate by 4.68 pp.

**Years of Schooling**

Years of schooling, occasionally referred to as schooling, is the amount of schooling an individual completes within a given period. Schooling completed by grade is denoted as $S_{g,i}^b$ and is calculated by multiplying the progression rate ($p_{g,i}^b$) by the number of individuals enrolled at baseline ($E_{g,i}^b$).

$$(11) \quad S_{g,i}^b = p_{g,i}^b \cdot E_{g,i}^b$$

$$(12) \quad \bar{S}_T = \left( \sum_{i=1}^{I} S_{g,i}^b \right) \Big/ I$$

The control and treatment group differ in both total and specific grade enrollment, thus in order to compare the two we must calculate schooling for the control group using the treatment number of enrollment for each grade. Additionally, we must do so for only grades 1-9 since we are using progression rates.

Thus, to compare the two in practice we calculate:

$$(13) \qquad \sum_{i=1}^{9} E_{T,i}^{b}\left(P_{T,i}^{b} - P_{C,i}^{b}\right) \Big/ \sum_{i=1}^{9} E_{T,i}^{b}$$

This equation yields the difference in schooling as a result of the treatment. We find that treatment increases the average years of schooling obtained by an individual by 0.07. Given this method of calculation, this result is likely an underrepresentation of the average years of schooling gained. This is due to our calculation not including individuals who completed a grade and decided not to progress to the next.

**Discussion**

Through this analysis, we have found that treatment results in higher progression rates (7.6 pp) and dropout rates (4.68 pp) as well as lower repetition rates (15.33 pp). Additionally, treatment increases schooling by 0.07 years. Upon first glance, it appears that the project is successful. Higher progression rates, years of schooling and lower repetition rates are all positive measures. However, the higher dropout rate deserves some consideration. As previously noted in section 3, repetition rates can be inversely related to dropout rates. Given that the IGATE project benefits treated individuals with more resources and optional after school programs, it’s hard to imagine how this would result in a higher dropout rate.

To investigate the higher dropout rate, we reference Table 3 to find that in the 9$^{th}$ grade there is a very large difference in dropout rates. Specifically, the treatment dropout rate (53.85%) is much larger than the control (-4.55%). When the 9$^{th}$ grade is omitted, the treatment in fact has a lower average dropout rate than the control by 1.8 pp. Thus, it may benefit the implementers to try and figure out what caused this abnormally high dropout rate for the treatment group in the 9th grade.

Going forward, both years of schooling and lower repetition rates can be used to monetize the benefits of this project.

## 7. Monetizing the Impact of IGATE

### Cost Savings

We can estimate the cost savings to schooling institutions by using data from Zimbabwe's Education Public Expenditure Review conducted by the Ministry of Primary and Secondary Education and The World Bank in 2016. The average cost of providing a year of primary and secondary education to a student in Zimbabwe is $88 and $436 USD, respectively. However, these estimate are inflated by the two metropolitan provinces (Bulawayo and Harare), where primary unit costs are $184 and $319 respectively and secondary unit costs are $841 and $806 respectively. Thus, country wide average estimates may not provide an accurate representation of costs. When we restrict our data to provinces in which IGATE operates we find that the weighted average primary and secondary unit costs are much lower: $53.34 and $427.62 respectively.

Table 4 shows a breakdown of the cost of providing a year of schooling based on level of education and the province in which IGATE operates. Given that secondary costs are much higher than primary, and both vary significantly by province, it would benefit our estimate to disaggregate the 48,733 treated individuals by these categories. Unfortunately, this exact information is currently unavailable. However, we can estimate this using the composition of our sample at baseline (Table 5). The process involves finding the percentage of the sample which belongs in each education level and province category and simply applying those proportions to the population (48,733 individuals). The result, our estimated values of the population composition, is shown in Table 6.

Given that we are estimating cost savings by level of education and province, we can fine tune our calculations by finding the effect of treatment on repetition rates by education level.

Making this adjustment, we find that treatment lowers repetition rates for primary and secondary students by 6.78 and 35.26 percent, respectively.

We estimate that the IGATE treatment immediately creates cost savings of $670,659.24 to the schools of treated individuals (Table 7). It is worth noting that treatment effects may continue to persist resulting in individuals being less likely to repeat future grades. Thus, treatment could result in additional cost savings for schools in future years.

**Future Earnings**

Returns to educational attainment in Zimbabwe have been calculated for 1987, 1995, and 2003. Unfortunately, previous labour market survey data is difficult to obtain, and there have since been no known surveys containing earnings or wage data. Thus, we must rely on existing estimates. Estimates for 2003 are calculated by Kwenda and Ntuli (2014), they find that the return to primary and secondary schooling (O-level) is a 24.7 and 61.6 percent increase in hourly wages, respectively. Assuming that the returns to each year of schooling within an education level is constant, we could find the return to a year of primary schooling by dividing the estimate for educational attainment by its number of years required to obtain[1]. In Zimbabwe, obtaining a primary education takes 7 years and obtaining a secondary (O-level) education requires an additional 4. Thus, the return to a year of primary and secondary schooling is a 3.1 and 9.23 percent increase in hourly wages.

Going forward, two points must be made clear. The first is that these estimates are for Zimbabwe in 2003 and the Zimbabwe of 2016 may be very different. GDP per capita has almost doubled since, however, unemployment rose as well (World Bank, 2015a). The second is that

[1] This assumption may result in a lower estimate if returns are concave or a higher estimate if returns exhibit a sheepskin effect. (Lemieux, 2006)

Kwenda and Ntuli (2014) exclude female data from their analysis. They do so because of labour-market participation issues, finding that the majority of women in their data were engaged in unpaid family work or were home makers. As of 2012, the percentage of females employed in Zimbabwe is 24.1 percent, which is roughly the same as in 2002 (23.1 percent) (World Bank, 2012). Thus, it is possible, and likely, that the same barriers for females to access the labour market still exist. Education may not be a sufficient condition to grant girls access to the labour market (Unterhalter et al., 2014). This observation may suggest the need for interventions which focus on combatting social norms in order to better access labour market outcomes. Regardless, we will proceed to estimate the returns to education in order to provide a counterfactual of what would be the case in the absence of these barriers.

The constant term in a Mincerian earnings function provides an estimate for log earnings for individuals who have no education or experience. Thus, we can transform the constant into a non-logarithmic value in 1995 Zimbabwean dollars (ZWD) shown in row F in Table 8. Given that this value is in 1995 ZWD, a currency that has been abandoned as of 2006, we convert this value into 1995 USD and then 2016 USD (row G). We can then and multiply it by the percentage increase in earnings due to a year of schooling to find the respective monetary benefit. Thus, we obtain the hourly monetary benefit associated with an additional year of primary and secondary (O-level) (row H and I). We then multiply this value by the average number of hours worked in a year (2080) to obtain yearly benefit for an additional year (row J and K).

Disaggregating the projects impact on years of schooling by education level, we find that the project results in an increase in years of schooling of 0.09 and 0.02 for primary and secondary (O-level) students respectively. These outcomes can then be multiplied by the yearly benefit of an additional year of schooling to calculate the additional yearly income incurred by treated individuals.

Thus, we find that the additional years of schooling as a result of IGATE Zimbabwe can be monetized to represent additional yearly earnings of $50,916.21 amongst treated individuals as whole. Finally, the net present value of all future earnings produced by IGATE is $436,808.00.[2]

[2] This calculation assumes individuals work for 43 periods, a USD inflation rate of 1 percent (World Bank, 2015) and a discount rate of 12 percent.

## 8. Conclusion

This paper contributes to existing literature by evaluating the alternative approaches for measuring the outcomes of education interventions based on their feasibility, impact on cognitive skills, and monetizability. Findings show that there are often a trade-offs between these indicators based on the aforementioned criteria. Ideally, interventions may want a mix which includes a strong indicator of impact as well as indicators which can easily be monetized to capture both increased earnings as well as cost savings from school efficiency. An example of such a bundle may be standardized test scores, years of schooling as well as repetition rates.

This paper then derives outcomes for IGATE Zimbabwe to find that the current treatment provided by IGATE Zimbabwe results in immediate cost savings of $670,659.24 USD to the schools of treated individuals as a result of lowered repetition rates. Additionally, the 48,733 treated girls could gain additional future earnings of $50,916.21 annually as a whole, under the assumption that there do not exist significant labour market deficiencies. However, this is unlikely the case, and may justify the use of other types of interventions, such as those focusing on remedying harmful cultural norms to help girls access the labour market.

The above estimated monetary benefits for schools and treated individuals can be used to price the outcomes for PbR frameworks such as social and development impact bonds. Additionally, these monetary benefits can be compared with program costs to assess the social viability of the program.

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# Tables

**Table 1: IGATE Interventions**

| Intervention | Category | Summary | Operational at ML |
|---|---|---|---|
| 1. Power Within Girls Clubs | Norms and Inclusion | Train local women to operate after school programs for girls designed to teach them about their rights, the importance of completing primary school, and leadership skills. | Yes |
| 2. Mother/Family Groups | Norms and Inclusion | Train local women on the importance of girls' education and how they can mentor, guide, and counsel girls and other parents on matters such as education, hygiene, and gender-based violence. | Yes |
| 3. Village, Savings and Lending (VS&L) | Resources and Infrastructure | Train local men and women on group savings, generating capital for small businesses and creating a safety net for participants. The purpose is to increase total household funds and raise funds specifically for girls' school fees and related costs (uniforms, books, etc.) | Yes |
| 4. School Development Committee (SDC) and Gender Focused WASH Training | Policy and Institutions | Train school officials involved in the SDC on business and management skills, and on how to create and foster gender-friendly environments. SDC members also receive Water, Sanitation and Hygiene (WASH) training, including training for Mother Groups on how to make reusable menstrual pads. | No |
| 5. Channels of Hope | Norms and Inclusion | Working with community faith leaders to reduce negative practices such as polygamy and early marriage/pregnancy. | No |
| 6. Communities Supporting Girls' Education | Policy and Institutions | Train communities on how to score their school against mandated standards for educational provision, how to develop an action plan based on their results, and how to lobby the government for improved service provision | No |
| 7. Male Champion Training | Norms and Inclusion | Training local men to lead the process of bringing about gender-based, community-level changes to support girls' education | No |
| 8. BEEP | Resources and Infrastructure | Establishes and supports community-based programs to provide bicycles to students living long distances from school | No |
| 9. Reading Clubs | Policy and Institutions | Train teachers to develop students' reading skills through a tailored plan that includes used books provided by the organization "Happy Readers". | No |

Information retrieved from the 2016 IGATE Midline Report

**Table 2: Enrollment and Repetition**

| Variable | Group | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Baseline Enrollment | Treatment | 119 | 127 | 144 | 121 | 142 | 45 | 27 | 22 | 13 | 7 |
| | Control | 67 | 77 | 62 | 86 | 86 | 27 | 16 | 26 | 22 | 1 |
| Midline Enrollment | Treatment | 44 | 120 | 134 | 132 | 131 | 140 | 23 | 30 | 8 | 4 |
| | Control | 22 | 80 | 77 | 56 | 85 | 84 | 15 | 27 | 22 | 2 |
| Repeaters | Treatment | 38 | 36 | 41 | 30 | 40 | 39 | 22 | 20 | 6 | 4 |
| | Control | 20 | 30 | 25 | 23 | 27 | 26 | 15 | 26 | 22 | 1 |

Data is retrieved from the 2016 IGATE Midline Report

**Table 3: Education Rates**

| Variable | Group | Average | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Progression Rates | Treatment | 45.48% | 70.59% | 73.23% | 70.83% | 75.21% | 71.13% | 2.22% | 37.04% | 9.09% | 0.00% | |
| | Control | 37.90% | 74.63% | 67.53% | 53.23% | 67.44% | 67.44% | 0.00% | 6.25% | 0.00% | 4.55% | |
| | Difference | 7.59 pp | -4.04 pp | 5.70 pp | 17.61 pp | 7.76 pp | 3.68 pp | 2.22 pp | 30.79 pp | 9.09 pp | -4.55 pp | |
| Repetition Rates | Treatment | 50.41% | 31.93% | 28.35% | 28.47% | 24.79% | 28.17% | 86.67% | 81.48% | 90.91% | 46.15% | 57.14% |
| | Control | 65.73% | 29.85% | 38.96% | 40.32% | 26.74% | 31.40% | 96.30% | 93.75% | 100.00% | 100.00% | 100.00% |
| | Difference | -15.33 pp | 2.08 pp | -10.61 pp | -11.85 pp | -1.95 pp | -3.23 pp | -9.63 pp | -12.27 pp | -9.09 pp | -53.85 pp | -42.86 pp |
| Dropout Rates | Treatment | 4.86% | -2.52% | -1.57% | 0.69% | 0.00% | 0.70% | 11.11% | -18.52% | 0.00% | 53.85% | |
| | Control | 0.18% | -4.48% | -6.49% | 6.45% | 5.81% | 1.16% | 3.70% | 0.00% | 0.00% | -4.55% | |
| | Difference | 4.68 pp | 1.96 pp | 4.92 pp | -5.76 pp | -5.81 pp | -0.46 pp | 7.41 pp | -18.52 pp | 0.00 pp | 58.39 pp | |

**Table 4: Cost of providing a year of schooling in Zimbabwe**

| | Matabeleland North | Matabeleland South | Midlands | Masvingo |
|---|---|---|---|---|
| Primary | $35 | $54 | $55 | $61 |
| Secondary | $803 | $422 | $336 | $365 |

**Table 5: IGATE Baseline Sample Composition**

| | Matabeleland North | Matabeleland South | Midlands | Masvingo | Total |
|---|---|---|---|---|---|
| Primary | 400 | 479 | 588 | 266 | 1,733 |
| | 23% | 28% | 34% | 15% | 92% |
| Secondary | 1 | 25 | 38 | 89 | 153 |
| | 1% | 16% | 25% | 58% | 8% |
| Total | 401 | 504 | 626 | 355 | 1,886 |

Obtained from the IGATE Baseline Dataset

**Table 6: Estimated Population Composition**

| | Matabeleland North | Matabeleland South | Midlands | Masvingo | Total |
|---|---|---|---|---|---|
| Primary | 10,336 | 12,377 | 15,194 | 6,873 | 44,780 |
| | 23% | 28% | 34% | 15% | 92% |
| Secondary | 26 | 646 | 982 | 2,300 | 3,953 |
| | 1% | 16% | 25% | 58% | 8% |
| Total | 10,362 | 13,023 | 16,175 | 9,173 | 48,733 |

**Table 7: Cost Savings from Lowered Repetition Rates**

| | Matabeleland North | Matabeleland South | Midlands | Masvingo | Total |
|---|---|---|---|---|---|
| Primary | $24,526.70 | $45,314.84 | $56,656.69 | $28,426.45 | $154,924.68 |
| Secondary | $7,316.09 | $96,120.55 | $116,328.64 | $295,969.28 | $515,734.56 |
| Total | $31,842.80 | $141,435.38 | $172,985.32 | $324,395.73 | $670,659.24 |

**Table 8: IGATE's Impact on Future Earnings**

| | | |
|---|---|---|
| | **Exchange Rates** | |
| | 1995 USD/ZWD Exchange Rate[1] | 8.38 ZWD (1995) |
| A | 1995 ZWD/USD Exchange Rate | 0.12 USD (1995) |
| B | 1995 USD to 2016 USD | 1.58 USD (2016) |
| C = A*B | 1995 ZWD to 2016 USD | 0.19 USD (2016) |
| | **Mincerian Returns** | |
| D | Return to a year of primary education | 3.44% |
| E | Return to a year of secondary (O-Level) education | 15.40% |
| | **Wages** | |
| F | Average uneducated wage in ZWD 1995 (Mincerian Cons.)[2] | 0.83 ZWD (1995) |
| G= C*F | Average uneducated wage in USD 2016 (Mincerian Cons.) | 0.16 USD (2016) |
| | **Hourly Benefit** | |
| H= D*G | Hourly benefit to an additional year of primary | 0.01 USD (2016) |
| I = E*G | Hourly benefit to an additional year of secondary (O-level) | 0.02 USD (2016) |
| | **Yearly Benefit** | |
| J | Yearly benefit to an additional year of primary | 11.37 USD (2016) |
| K | Yearly benefit to an additional year of secondary (O-level) | 50.86 USD (2016) |
| | **IGATE Beneficiaries** | |
| L | Number of primary girls | 44,780 |
| M | Number of secondary girls | 3,953 |
| | **IGATE Benefit** | |
| N | Additional primary years of schooling | 0.09 |
| O | Additional secondary (O-level) years of schooling | 0.02 |
| P = J*L*N | Annual Benefit to Primary Girls earnings from IGATE | 46, 347.30 USD (2016) |
| Q = K*M*O | Annual Benefit to Secondary Girls earnings from IGATE | 4,568.92 USD (2016) |
| R = P+Q | Total Annual Benefit | 50,916.22 USD (2016) |

1. Makochekanwa (2007)
2. Kwenda and Ntuli (2014)

## Appendix

### Proof: Relationship between enrollees/repeaters and the dropout rate

Below we have the dropout rate:

$$1 - p_{g,i}^{b} - r_{g,i}^{b}$$

By substituting in the progression and repetition rate and some manipulation we have:

$$1 - \frac{E_{g,i+1}^{m} - R_{g,i+1}^{m}}{E_{g,i}^{b}} - \frac{R_{g,i}^{m}}{E_{g,i}^{b}}$$

$$\frac{E_{g,i}^{b} - E_{g,i+1}^{m} + R_{g,i+1}^{m} - R_{g,i}^{m}}{E_{g,i}^{b}}$$

Observing the numerator to determine the sign of the equation:

$$E_{g,i}^{b} - E_{g,i+1}^{m} + R_{g,i+1}^{m} - R_{g,i}^{m}$$

We see there exists an inverse relationship between each period's enrollment and repeaters. Thus, this term can be negative when new enrollee in a grade is misclassified as a repeater or when a repeater in the subsequent grade is misclassified as an enrollee. For example, if the above terms are replaced with the following values respectively.

$$110 - 120 + 30 - 20 = 0$$

We have that dropout rates equal zero, which is as low as dropouts can naturally go with adequate matching across periods.

However if we misclassify someone in the current grade who is a new entrant ($E_{g,i}^{b}$) as a repeater ($R_{g,i}^{m}$) then the above becomes:

$$109 - 120 + 30 - 21 = -2$$

Or if we are to misclassify someone in the subsequent grade who is a repeater $R_{g,i+1}^{m}$ as an enrollee $E_{g,i+1}^{m}$ then we have:

$$110 - 121 + 29 - 20 = -2$$

Thus, given that we find negative dropout rates, it is likely the case that there exists some misclassification between enrollees and repeaters are the grade level. Unfortunately, given that there are two pathways for this result, it is difficult to narrow down which error is taking place specifically.