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Hoyt Bleakley, University of Michigan
Bhanu Gupta, Ashoka University

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Mind the Gap: Schooling, Informality and Fiscal Externalities in Nepal*

Hoyt Bleakley† Bhanu Gupta‡

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Abstract

While increasing average years of school has been a development priority for decades, the associated fiscal costs and benefits have been less studied, in part because of the lack of appropriate data. Recently UNESCO organized a project measuring the extent of subsidies, by level of schooling, from all levels of government, in eight developing countries. One of these countries was Nepal, which also has a household budget survey that permits us to estimate the degree of formality, tax payment, and benefit receipt as a function of years of schooling. Using a simple Mincer-like model, we estimate the fiscal externality associated with an additional year of school. In contrast to previous literature on social returns and assumptions underlying multilateral development goals, we find that within primary school, fiscal benefits and costs, on the margin, are quite balanced, with subsidies closest to the present value of future taxes minus benefits. At higher levels of schooling, however, marginal fiscal benefits exceed costs by 5 percent of per-capita consumption.

Keywords: Taxation, Subsidies, Schooling Decision, Nepal
JEL codes: I2, J2, H3

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†Department of Economics and Population Research Center, University of Michigan. Email: hoytb@umich.edu.

‡Department of Economics, Ashoka University. Email: bhanu.gupta@ashoka.edu.in

1 Introduction

Raising levels of education has been a development priority for over a half-century. Around the world, governments subsidize education in part to encourage school attendance. Numerous studies (c.f., Psacharopoulos and Patrinos (2018)) show that children who get more years of schooling earn more as adults. Therefore the government's education spending might be thought of as an investment in expanding the future tax base. This combination describes a fiscal externality: 'fiscal' because the government's taxes and spending are involved, and 'externality' because the student (plus his family) do not pay the full cost of additional schooling nor receive the full benefit. Is there a gap between these benefits and costs, and, if so, how large is it?

The challenge in quantifying this gap has been the incomplete measurement of the extent of education subsidies in less developed countries. Recently, however, UNESCO organized a pilot project for "National Education Accounts" (NEA) in eight countries. The NEA reports measure public educational spending from all levels of government and decompose by all levels of schooling. Two of the eight countries (Nepal and Uganda) also had contemporaneous household budget surveys, which permit comparison of public and private spending.

We complement the subsidy data with estimated tax payments, made from a Nepalese budget survey. In these data, more educated workers have higher purchasing power, consistent with the literature. To this, we add a less-documented result: workers with more education also have substantially higher probabilities of being in the formal sector. Of workers with zero to two years of schooling, the percentage in the formal sector is in the low single digits. The fraction of formality rises to approximately half of workers with post-secondary education. Thus, more educated workers contribute more to the government's coffers because they spend more (higher VAT) and because their earnings are higher and more likely to be in the formal sector (higher income taxes). (Section 2 describes these data sets and summary statistics.)

We develop an empirical model in the spirit of Mincer (1958) to compare fiscal costs and benefits of an additional year of school. In the model, the student receives a marginal benefit in the form of higher future earnings, but pays contemporary marginal costs in the form of direct costs (tuition, books, transport, etc.) and of opportunity costs (foregone earnings). The government's problem is qualitatively similar, with higher future taxes (from

higher future wages) being the marginal benefit and subsidies plus foregone taxes on foregone earnings being the marginal costs. With both linear and quantile regressions, we estimate the relationship between tax payments and years of schooling. These estimates combine with the subsidy data and an interest-rate to form the estimated gap, or fiscal externality. (We describe the model in Section 3 and present results in Section 4.)

We find substantial fiscal costs and benefits associated with another year of schooling, although how the two balance varies by level. For finishing primary school, subsidies are close to the present value of future taxes, with a deficit of less than a few US$ per year, itself about 0.5% of household consumption per capita (among those with primary school only). For secondary school, the gap leans negative as well, especially at lower quantiles of distribution, although the mean effect is an even smaller fraction of household consumption than it is for primary school. For tertiary (university/higher) education, we see the opposite: positive gaps (benefits in excess of costs) for the mean and especially for the upper part of the distribution. This gap amounts to five percent of household consumption, a significant surplus. The difference by level makes intuitive sense. The lower levels of education are highly subsidized and most of the workers with such education have low labor-market formality; therefore, the government recoups its investment mainly through the 13% VAT. In contrast, higher education, while more costly, is less proportionately subsidized, and its graduate earn more in formal employment and thus subject to the income tax.

These results contrast with an earlier literature on the 'social rate of return' to schooling. Schultz (1988, page 547) summarizes this literature as finding that such returns were "insufficient to warrant further expansion of subsidized public higher education," but this was "rarely the case at the primary and secondary level." He notes that such comparisons accounted for subsidies, but rarely for taxes, which he states was justified if taxes were proportional to income. The patterns of formality by education in developing economies challenge this assumption; higher rates of formality among the more educated brings a higher tax rate too (Soares and Haanwinckel (2017) show this to be true for Latin America). Our results are therefore more similar to Johnson's (2006) argument that higher-education subsidies in the US are progressive if we consider that higher-income households both make greater use of higher education and pay higher taxes.

We subject this result to sensitivity analysis in Section 5. We show that this result is not sensitive to alternative definitions of subsidies, taxes or

household. The result is also robust to the effects of emigration. While we use three percent as the default interest rate, it would have to be drastically lower to convert all of the estimated gaps to positive. (We present several additional robustness checks in the Appendix.)

While increasing schooling generates various pecuniary and non-pecuniary externalities for an individual, we focus on measuring fiscal externality of an additional year of schooling over different baseline years of completed schooling. Our estimates are useful in not only conducting a cost-benefit analysis of spending government monies across various levels of education but also in comparing the welfare impact of spending public funds on education versus other competing welfare programs (Hendren and Sprung-Keyser (2020)).

Finally, we offer conclusions in Section 6.

2 Data and Descriptive Statistics

To estimate the fiscal externalities, we require data on household-level tax payments, education level and non-household expenditure on schooling. Information on the later is not readily available, especially for developing countries, as aggregating data across multiple stakeholders involved in education financing has been a challenge. The National Education Accounts, piloted by UNESCO, address this challenge. We combine these with a nationally-representative household survey data and the Nepalese tax schedule to conduct our empirical analysis.

2.1 Education Subsidies

The National Education Accounts (NEA) of Nepal has information on expenditure by all the financial stakeholders –household and non-household– at different levels of education[1] This information has been complied by UNESCO Institute for Statistics (UIS), International Institute for Educational Planning (IIEP) and Global Partnership for Education (GPE), not just for Nepal but for seven other developing countries (IIEP, UIS and IIEP Pôle de Dakar (2016*a*); IIEP, UIS and IIEP Pôle de Dakar (2016*b*)).[2]

[1]These data are complied in UNESCO (2016).

[2]The seven other countries are Côte d'Ivoire, Guinée, Lao PDR, Senegal, Uganda, Vietnam and Zimbabwe. Only Nepal and Uganda data distinguishes the per student government expenditure between public and private schools and also includes household

Nepal's NEA data capture education expenditure per student across 7 levels of education. These are pre-primary, primary (1-5 grade), lower secondary (5-8), secondary (8-10), higher secondary(10-12), technical education, and higher education (college education). The main providers of educational resources are governments (central, state and local); households; NGOs; and schools. The expenditure per student depends on whether the student is in a public or private school. In our main analysis, we use the total non-household education expenditure, be it from the government, NGOs or the school.

Figure 1, Panel A, shows the ratio of annual non-household expenditure to total expenditure by level. For public schools, this ratio is high. At the primary level, the non-household expenditure is NPR 7,209 per student, which is 84% of the total expenditure. The government subsidy accounts for 95% of the total subsidy. At higher education level, the subsidy rate declines to 52%, although it increases in levels to NPR 30,385. This pattern is markedly different for private schools, with households accounting for the bulk of the expenditure. Accordingly, at the primary level, the non-household expenditure is NPR 1,106, which is 6% of the total expenditure. For the higher-level private institutions, the non-household expenditure is NPR 14,337 per student, or 17% of the total expenditure.

2.2 Household data

We use the third round of nationally-representative Nepal Living Standards Measurement Survey (LSMS), which was conducted in 2010-11 by the Central Bureau of Statistics of Nepal (CBS) and the World Bank to capture the demographic and consumption details of 5,988 households (28,760 individuals). It contains individual-level information on education, business and job characteristics, benefits received and migration status of the household members.(CBS (2011))[3]. Our final sample consists of 5,886 households whose heads are aged between 20 and 80 years and education details are not missing.

We use the total household consumption to impute the tax payments as

expenditure. We choose the setting of the analysis to be Nepal over Uganda because the data from Uganda do not permit certain robustness checks.

[3]We do not use the Nepal Labor Force Surveys because they don't contain information on total consumption, the type of school attended by the individual or benefits received from the government. The national Census (2011) is also not appropriate becuase it doesn't record consumption or income.

described in the next sub-section. There is a positive consumption gradient with education. The median per capita annual consumption of households whose head has finished primary education is around NPR 27,000, and this increases to NPR 65,000 if the household head has finished bachelors degree (Table 1).

Our main independent variable is the years of education completed by the household head. The household heads with bachelors and masters degree are coded as having completed 15 and 17 years of education because the duration of these programs in Nepal is of three and two years respectively. Table 1 shows that around 65% of the household heads have highest education grade that lies within the primary education category, 18% have secondary education and the rest have higher education. We construct two measures to capture the educational level of the household members besides the household head – total years of education of all the remaining members; and the maximum educational grade achieved by a member excluding the household head. We use these measures as controls in the regression analysis.

2.3 Taxes, Formality, and Benefits

We now briefly describe the calculation of household tax payments, after adjusting for formality. There are two primary taxes : income tax and value added tax (VAT). We impute the income tax payments of the household heads engaged in the formal sector by, first, constructing a tax table that delineates the income tax payments for each level of income according to the income tax schedule. Then, the household's consumption, c, equals $f(s) - T(s)$, where $f(s)$ is the taxable income by years of schooling s, and $T(s)$ is the income tax. Next, we merge the income tax table with the LSMS data by matching the imputed consumption from the tax table to the reported consumption in the survey data. Thus, we can assign the taxable income and tax payment to each household in the survey data using the tax table. We calculate income tax payments only for household heads that are employed in the formal sector because those in the informal sector, in practice, do not pay income tax.[4]

To define tax-formality, we rely on the result that wage earners whose income is subject to third-party reporting are more likely to pay taxes (Kleven

[4]Appendix A.3 provides a detailed explanation of the methodology and a description of Nepal's income tax schedule.

et al. (2011), Slemrod (2007)). Therefore, anyone whose income is reported to the government by the employer or who benefits from social security is considered to be in the formal sector (Azuara and Marinescu (2013); Camacho, Conover and Hoyos (2014)). According to our preferred definition, a wage earner is in the formal sector if any job that she does displays at least one of the following features - tax is deducted by the employer, employee contributes to the provident fund, pension on retirement, or subsidized medical care. As the self-employed are less likely to pay taxes, we consider only registered businesses as tax-payers. (In an alternate definition, even these businesses are considered to be in the informal sector. Refer to Appendix A.2.) All other economic activity, in particular agriculture, forms the informal sector. In our sample, around 16% of 5,886 household heads are in the formal sector.[5] No matter which definition of formality we use, the rate of formality increases with years of schooling (see Appendix Figure 1). For example, about 4% of people without school education are employed in the formal sector, while 62% of people with a masters degree are engaged in the formal sector (Panel B of Figure 1).

The value added tax (VAT) rate in Nepal is 13%, although some commodities like essential food items are zero-rated. In the main specification, we assume that the VAT is paid on the entire household consumption, although we exclude food consumption from the VAT tax base in the sensitivity analysis.

The total tax contribution of the households is the summation of Income tax and VAT[6]. Panel B of Figure 1 shows a steep positive gradient of total taxes with education. The positive slope comes from the increase in the tax base and in formality levels. People with higher education tend to be in the formal sector and thus, pay both income and value-added tax to the exchequer. Conversely, those with low education are mostly engaged in the informal sector and end up paying only VAT. For instance, people with no

[5]Of the 16%, 11.6% of the household heads have an income that is subject to non-trivial marginal income tax rate. (Unlike most countries, the marginal tax rate of lowest income bracket in Nepal is non-zero and equal to 1%.) By comparison, registered taxpayers in Nepal are an estimated 10% of total households (Inland Revenue Department Report (2015) and CBS (2012)).

[6]Contributory deductions from income under programs, such as provident fund, are not included in the total tax payments of an individual because the taxpayer should receive the return on these deductions over his lifetime. Thus, such contributions are not a fiscal externality over the long term.

education on average pay NPR 18,757 in total taxes of which the VAT represents 95%. In contrast, people with higher education pay NPR 68,607 as taxes, of which VAT is only 60%.

We also consider the government's expenditure on various welfare programs. We expect that more education leads to lower take-up of the welfare schemes. LSMS survey documents the payments received by the households under seven major cash-transfer programs. The magnitude of benefits is much lower than the taxes remitted (Panel B, Figure 1). Hence, we include the benefits only in the sensitivity analysis.

3 Model

In this section, we analyze the choice of years of schooling in a stylized model based on the seminal work of Jacob Mincer (1958). We include taxes and subsidies and derive the fiscal externality (the gap) associated with an additional year of school. An individual starts school at $t = 0$ and faces an interest rate of r. The direct cost of schooling in year t is $c(t)$, which includes tuition, transport, uniforms, books, etc. The government contributes a subsidy of $\gamma(t)$, so the student only sees the net cost. The student leaves school at time s, which also represents the total years of schooling accumulated. At that time, the person starts earning $f(s)$, for $f'(s) > 0$. (Primes denote first derivatives.) The wages per worker grow at a rate of g per annum. Once working, the person has to pay a tax of $\tau(s)$. (Taxes are functions of earnings that depend on years of schooling.)

The person's lifetime income, net of taxes and direct costs, is

$$\int_s^\infty e^{-(r-g)t} \left[f(s) - \tau(s) \right] dt - \int_0^s e^{-(r-g)t} \left[c(t) - \gamma(t) \right] dt$$

where we assume an infinite horizon for simplicity. From the individual's perspective, this object is the present value of his/her human capital. Let $\tilde{r} \equiv r - g$, which is the required rate of return, adjusted for wage growth.

What choice of years of school maximizes the individual's human capital? If we take the derivative with respect to s, we attain the following first-order condition (FOC) for optimality:

$$(f' - \tau') / \tilde{r} = (f - \tau) + (c - \gamma) \tag{1}$$

The left-hand side is the marginal benefit associated with additional time in school. This includes the increase in labor productivity (f'), but also the

change in taxes (τ'). These changes apply to future flows, and the interest rate accounts for the accumulation of these flows over time. The marginal costs are found on the right-hand side of the equation and are grouped into two concepts. The first is the opportunity cost. While a person is in school, he is not working, but neither does he pay taxes on income that he does not earn. The second is the direct cost, net of the subsidy. This equation has an intuitive interpretation.

If dollar's worth of time invested today yields a future flow of payments greater than $\tilde{r}$, then the student should continue in school. When the flow payment per dollar drops below $\tilde{r}$, the student should leave school.

Government policies shift the choice of schooling, although some combinations of taxes and subsidies that deliver the socially optimal decision. If taxes and subsidies are both zero, the FOC reduces to

$$f^{'}/\tilde{r} = (f + c) \tag{2}$$

which defines the undistorted optimum for s. But other, nonzero combinations also leave this choice undistorted. If

$$\tau'/\tilde{r} = \tau + \gamma \tag{3}$$

then these terms drop out of equation 1, which leaves the choice undistorted locally. A global example would be a proportional income tax and a school subsidy of the same proportion.

In general, however, there is a gap between the government's marginal benefits and costs. This represents a fiscal externality: a person's choice of schooling spills over onto the government's budget. The marginal benefit for the government is $\tau'/\tilde{r}$, the taxes received per unit increase in schooling. But an additional year of education costs the government $\tau + \gamma$, the fiscal opportunity and direct-subsidy costs. If this gap is positive ($MB > MC$), then the government receives more revenue per marginal year of school than it incurs in costs. Policies that raise schooling, such as compulsory attendance or higher subsidies, might well relax the government's budget constraint and bring schooling closer to optimum. In contrast, a negative gap has the opposite implication.

To estimate the gap for various years of schooling, we need to calibrate the tax (τ) and subsidy (γ) functions. The NEA data gives information about subsidies for different levels of school, both public and private. We use data from the LSMS expenditure survey to compute taxes and then calibrate $\tau(s)$.

4 Empirical Model and Results

We use a quantile regression to examine the effect of education on tax payment at the median, as well as, at the 25th and 75th percentiles. We also use an ordinary least squares (OLS) regression to consider effects at the mean. These methods provide a convenient estimate of the level and (conditional) gradient of tax with respect to years of schooling for the various summary statistics. Let τ_h be the total tax payments of the household h. The primary dependent variable is the number of years spent in school, $Eduyear_{ih}$, by the household head i living in the household h. X_{ih} is a vector of other demographic characteristics of the head such as age. Z_h is a vector of household characteristics like the total years of education of other household members. Then, the θth quantile of the conditional distribution of τ_h, given the covariates, is a linear function,

$$Q_\theta(\tau_h|Eduyears_{ih}, X_{ih}, Z_h) = \alpha_{0\theta}+\beta_{1\theta}Eduyears_{ih}+\mathbf{X}'_{ih}\delta_{1\theta}+\mathbf{Z}'_h\delta_{2\theta}+u_{\theta ih} \quad (4)$$

Now, we can test how far is the fiscal gap in Nepal from the condition defined in equation 3 and hence, the undistorted optimal choice of schooling. The fiscal gap, defined as the difference between the marginal benefit and the marginal cost, is calculated by using the following formula:

$$\hat{\beta}_{1\theta} - \tilde{r}(\hat{\alpha}_{0\theta} + \hat{\beta}_{1\theta} * S + \bar{\mathbf{X}}'_{ih}\hat{\delta}_{1\theta} + \bar{\mathbf{Z}}'_h\hat{\delta_{2\theta}} + subsidy_{S\theta}), \quad (5)$$

where $\tilde{r}$ is the discount rate and S is the point at which the fiscal balance is calculated. $\hat{\beta}_{1\theta}$ represents the marginal benefit (τ'), while the term in the parenthesis represents the fiscal opportunity and direct-subsidy cost ($\tau+\gamma$).[7] While calculating the subsidy cost, we use the θth quantile of subsidy at grade S.

We estimate this model separately by education level: primary (0-5 grade), secondary (6-10 grade) and higher education (11-17 grade). For OLS regressions too, we use the same set of controls and estimate the mean fiscal gap.

In the analysis below, we use a 3% net discount rate ($\tilde{r} \equiv r - g$) as the default, but include results for higher and lower rates as robustness

[7]In our analysis, we demean the controls included in the vectors X_{ih} and Z_h, so that the term in the parenthesis reduces to $\hat{\alpha}_{0\theta} + \hat{\beta}_{1\theta} * S + subsidy_{S\theta}$, where $\hat{\alpha}_{0\theta} + \hat{\beta}_{1\theta} * S$ is the fiscal opportunity cost. In other words, the intercept $\hat{\alpha}_{0\theta}$ can be interpreted as θ_{th} quantile of tax payments of the household whose head has zero years of schooling and mean value of other observables.

checks. A natural benchmark for the interest-rate (r) would be the market yield on Nepal's sovereign debt, but Nepal did not issue sovereign bonds during the study period. Warusawitharana (2014) reports an implied r of around 5.1% on dollar-denominated sovereign bonds issued by select developing countries. Nepal likely faces a higher r insofar as the comparison countries have higher income per capita and more exportable natural resources. GDP per worker proxies the growth of wages (g). Combining information on labor force (World Bank (2020)) and GDP (International Monetary Fund (2020)), we calculate that real GDP per worker has grown at an average rate of 2.6% from 1994–2018. We take 3% as the approximate difference of the two rates. This measure, based on opportunity cost, is similar to numbers based on intergenerational equity, as estimated by Lopez (2008) for Latin America.

An additional year of school is associated with substantial government spending and revenue. For an interest rate of 3%, these fiscal costs and benefits are approximately balanced, though tilting negative, for primary and secondary school. For higher (tertiary) education, they instead tilt positive. For primary school, fiscal marginal benefits are generally less than fiscal marginal costs, although only by a small margin. The first column in Panel A of Table 2.1 shows the median outcomes. Another year of school is associated with a median tax payment that is higher by NPR 610 (US$8.47). This fiscal benefit is akin to a dividend that is paid continually in the future. But there are two upfront costs. One is the opportunity cost: tax payments that are foregone because the student is in school instead of working. We estimate these to be almost NPR 18,750, which is the model's prediction for tax remittances by someone with five years of schooling and the mean of the other observables. The other fiscal cost is the school subsidy itself, which we compute as NPR 7209. We multiply these two costs by the 3% discount rate and subtracted from the benefit to obtain a fiscal gap of NPR 169 (US$2.35). This is not significantly different from zero at conventional levels of confidence and equals 1/2 of a percent of household consumption per capita.

Given the simplicity of this calculation, we discuss the effect of a few small modifications. First, getting fiscal costs and benefits to exactly balance in this calculation would imply a break-even interest rate of 2.35%. This calculation is for an infinitely lived person, and therefore we require an even lower interest-rate to break-even, if mortality and retirement were taken into account. (Bleakley (2018), discusses incorporating mortality and retirement into return calculations for human capital. For modern life tables in devel-

oping countries, required rates of return would need to be higher by around 100 basis points.)

Another simple modification is to evaluate the fiscal gap for a student stopping at four rather than five years of school. By assumption, the marginal benefit and marginal subsidy cost would be the same, but the opportunity cost would be lower by NPR 610. This would only close the discounted gap, however, by NPR 18 (610 times .03), approximately a 10th of the total gap.

For other statistics of the distribution, fiscal gaps are also slightly negative. These are found in the remaining columns of Panel A, where we consider the 25th percentile, 75th percentile, and mean as outcomes. In all cases, years of schooling predict higher tax payments, with the larger effects being at the higher percentiles and for the mean. As before, however, this flow of future benefits is arrayed against substantial costs in the beginning.[8] For a 3% discount rate, the net fiscal balance remains negative, however it is closer to zero than it was at the median. These numbers also reflect relatively small gaps when compared to household consumption per capita. Indeed, at the mean, this gap is less than one part in one thousand of household consumption.

Next we consider secondary education, for which fiscal balances turn somewhat more negative. See Panel B of Table 2.1. Tax payments rise with education for all four of the statistics considered. Marginal fiscal gaps come in between NPR 1700 and NPR 2200 (US$23 and US$31). These gaps are over 1% of the value of household consumption per person, except at the mean.

Finally, we turn to higher (tertiary) education, which starts at grade 11 in Nepal. These results are found in Panel C. An additional year of education is associated with higher tax payments. This arises in part because of higher income, but what distinguishes this group from the others is the higher rate of formality (Figure 1). As a result, this group pays more in direct taxes on the margin as its income rises. The fiscal gaps are substantial. At the 75th percentile, the gap is almost NPR 3,737, which represents over 2.5% of household consumption per capita. At the mean, this is even larger: the gap is almost NPR 5,400 (US $75), or over 5% of consumption. This represents a fiscal benefit to encouraging higher education. (This contrasts with the results from primary and secondary education, where the net fiscal impact

[8]The subsidy level differs between private and public schools. As the majority of household heads with primary education attend public schools, the subsidy amount is same across the three quartiles. Because a small number did report attending private schools, the mean subsidy is slightly lower.

is likely negative, albeit often difficult to distinguish from zero.) Viewed in a different way, this represents a significant disincentive to attain higher education.

5 Sensitivity Analysis

The above results are qualitatively robust to alternate strategies for measurement and modeling. The main set of robustness checks are found in Table 2.2, where we report estimates of the gap between fiscal marginal benefits and costs.

The first check repeats the analysis from Table 2.1, but only with household heads who reported attending public schools. Further, we consider only the government's contribution to the public-school subsidy. This moves the fiscal balance associated with your school in a positive direction, with the exception of primary school, but only by a little bit. This is because non-government subsidies to schools are dwarfed by those from the government.

Next, we tweak our model for taxes. The VAT in Nepal excludes certain food items, although the survey did not provide enough information to separate non-covered expenditures. In row 2, we simply exclude all food expenditures from the VAT calculation. This makes essentially no difference to the results. The next row reports the fiscal gap using the self-reported expenditure on land, property, housing and income taxes, instead of imputed income taxes. The self-reported measure might be lower than actual tax payments made by the formal sector workers because they may not perceive tax payments, which are remitted by the employer, as expenditure. For instance, workers like government employees, whose income is subject to third-party reporting[9], report less than 1% of their consumption in tax payments, as opposed to 13% according to the tax schedule. The fiscal gap at the primary and secondary level remain unchanged because income tax is a small proportion of the total taxes at those levels. For higher education, the fiscal gap reduces because self-reported taxes are lower than imputed taxes.

Education should effect not just tax payments, but also benefit receipt, although this latter channel is comparatively small. Panel B of Figure 1 shows why. LSMS has information on benefits received under various social security programs, and thus we can measure net tax payments (taxes minus

[9]Kleven et al. (2011) shows that tax evasion rate is low for people whose income is subject to third-party reporting.

benefits). While the slope of taxes with respect to education is evident in the graph, the relationship between benefits and education is, in fact, quite small and sometimes not even sloping upwards.[10] Accordingly, when we use net taxes as the dependent variable, the results are hardly different from baseline. See Row 4.

Next, we test an assumption of our empirical strategy that the household consumption and tax payments are a function of only the household head's education. We modify our analysis by using instead the education level of a random working-age member of the household and control for the sum of education of the rest of members. Row 5 shows that the results remain statistically indistinguishable from the baseline .

We check for the sensitivity of the results to alternative discount rates in Rows 6 & 7. We drop the discount rate to 1% and expectedly, the fiscal gap improves. For tertiary, the fiscal gap is now positive and significant at all the moments of the distribution. For primary and secondary levels, the fiscal balance is quite balanced in the majority of specifications. Another possible discount rate is the pre-tax real return on private investment based on the assumption that public investment crowds out private investment. For Nepal, this is around 6.5%[11]. If we use such a high level of discount rate, then the marginal fiscal cost is higher than the marginal benefit except for the mean of the distribution at higher education level.

Next, we consider how migration would affect these calculations. (In the sample, around 32% of the households report having a member outside Nepal.) Migrants who leave Nepal after their school years take with them their (subsidized) human capital. Neither do they pay income taxes nor is there a fiscal opportunity cost if the migrants leave the country right after school. Nevertheless, those migrants might very well send back remittances, which expand the national tax base. We characterize the magnitude of these

[10] Almost flat gradient of benefits with education might be because of two countervailing effects. If education increases awareness about legal rights, then the take-up of benefits might increase with schooling. Only 16% of households receive money under any cash-transfer program, suggesting poor access. Conversely, if the program benefits are an insignificant proportion of consumption, then the take-up will fall as incomes rise with schooling. For instance, the average payments under old-age pension program are only 3% of the total consumption of the household where the head has finished higher education.

[11] The Asian Development Bank uses a discount rate of 9% in the cost-benefit analysis for infrastructure projects(Asian Development Bank (2017)) such as road construction (Asian Development Bank (2018)). We subtract the growth rate of GDP per worker (2.6%) to get an alternative measure of $\tilde{r}$.

effects by using information on migrant's education and remittances.

We calculate migration-adjusted tax payments for each household head. See Appendix Table 3. We assign a probability of migration, P, to each head based on years of schooling[12]. For example, if 7 out of 146 people in working-age group migrate out of Nepal, then the migration probability of household head with one year of education is 5%. In the case of migration, no income tax is paid. However, the government gets VAT equal to 13% of remittances (R) once they are consumed by the households. In the case of no migration, there are no changes to the tax payments. Thus, migration-adjusted tax payments (M) are calculated using the following formula:

$$M = (1 - P)\tau(s) + 0.13 \times PR,$$

Replacing $\tau(s)$ with M in the empirical specifications doesn't change the results qualitatively. The fiscal balance improves a little for both higher and secondary levels in most of the specifications, while it worsens a bit for the primary level.

We also discuss additional checks in the Appendix A.5. Among other things, they test for alternate levels of subsidies, conservative definition of formality, changes in household composition and alternate definitions of education levels. We also present results where we relax the assumption of infinite horizon and calculate the average present value of lifetime tax payments, using the non-linear tax schedule, where the working age is finite.

6 Conclusion

We analyze the government investment in education in terms of fiscal externalities. These externalities exist because the individual neither bears the full cost of education, because of subsidies, nor does he realize the full benefit of education, because of taxes. We consider the context of Nepal. On average, the fiscal distortions create a minimal gap between the benefits and costs at the primary and secondary level. However, at the tertiary level, the fiscal gap is positive and significant. This study provides a novel explanation for this: people with higher education are more likely to be in the formal

[12]In the LSMS data, the household head, by definition, cannot be away from the household for more than 6 months in the last year and hence, is not classified as a migrant (CBS (2011))

sector and hence, pay income taxes. We subject our findings to a variety of sensitivity analyses, including the effect of emigration, and show that the results remain robust.

The positive fiscal gap at the tertiary level implies that the government receives more revenue per marginal year of school than it incurs in costs, all else held fixed. In contrast, fiscal gaps are quite small for lower levels of schooling. Consequently, policies made to increase primary or secondary schooling cannot be justified based on these estimates of the fiscal externality, while policies to increase higher education might be. Characterizing the optimal distribution of schooling in the country, however, would require accounts of equity and general equilibrium, but the gap measured above represents a crucial yardstick for comparison.

Lastly, this study would not have been possible without access to information on aggregate government spending per student at different levels of education. To the best of our knowledge, disaggregated information on subsidies is not available for a majority of developing countries. This study demonstrates the usefulness of properly measuring education subsidies for calculating the fiscal returns to education, and we therefore recommend constructing such data for a wider range of countries.

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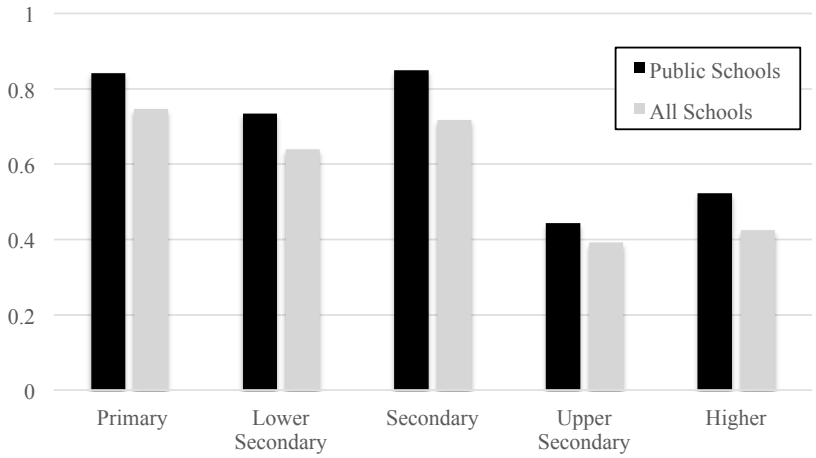
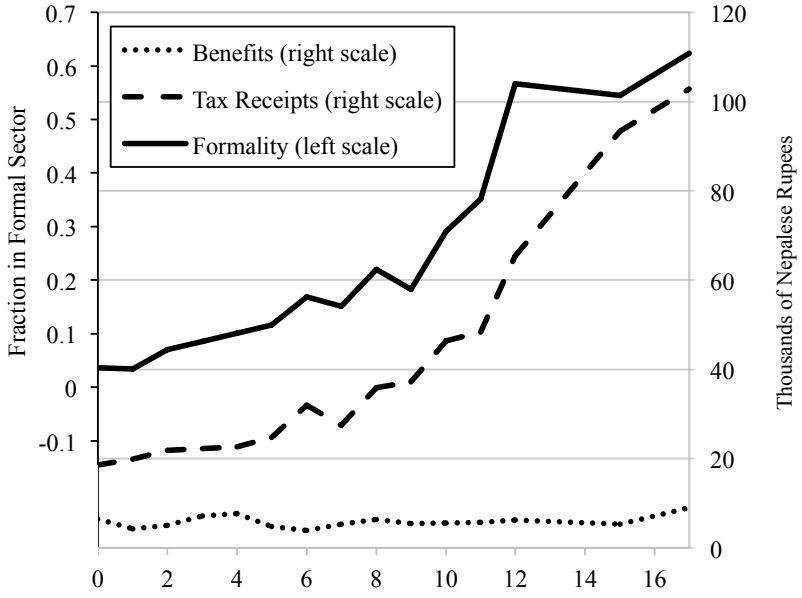
Figure 1: Education Subsidies, Formality, and Taxes, by Education Level

Panel A: Subsidy Rate, by Education Level



Panel B: Formality and Fiscal Impacts, by Highest Grade Completed



Note: In panel A, primary education level is from grades 1-5, lower secondary from 6-8, secondary from 9-10, upper secondary from 11-12 and higher education's duration is of three years. The left scale of Panel B shows the proportion of labor force in formal sector according to education level. For our analysis, formality is synonymous with being compliant with tax laws. A wage earner is in the formal sector if her income is reported to the government by the employer or if she receives benefits from the social security net. Additionally, businesses registered with the government are also included in the formal sector. Informal sector consists of rest of the workforce including workers engaged in agriculture. The right scale shows the mean of benefits received under various cash-transfer schemes and taxes paid, according to the education level.

Data Sources: For Panel A, data comes from the national education accounts compiled by UNESCO and can be accessed using the link http://uis.unesco.org/en/news/national-education-accounts. To construct Panel B, we use data from Nepal Living Standards Survey 2010.

Table 1: Summary Statistics

Statistic	Household consumption per capita (NPRs)	Direct tax (NPRs)	VAT (NPRs)	Subsidy at end point of the interval (NPRs)	Education of household head (years)	Household heads in formal sector (proportion)
Panel A: Primary Education (Grades 0-5)						
Count	3,787	3,787	3,787	353	3,787	3,787
Median	26,768	0	15,296	7,209	0	0
25th %ile	18,292	0	10,710	7,209	0	0
75th %ile	40,345	0	22,692	7,209	2	0
Mean	33,859	1,061	18,833	7,192	1.09	0.05
Std. dev.	26,132	9,187	14,267	325	1.78	0.22
Panel B: Secondary Education (Grades 6-10)						
Count	1,081	1,081	1,081	292	1,081	1,081
Median	38,760	0	22,877	30,510	8	0
25th %ile	25,950	0	15,331	30,510	7	0
75th %ile	59,864	0	33,747	30,510	10	0
Mean	49,303	7,766	28,653	29,816	8.16	0.21
Std. dev.	40,675	36,016	27,315	4,438	1.41	0.41
Panel C: Higher Education (Grade 11 to Bachelor's Degree)						
Count	893	893	893	222	893	893
Median	64,898	0	32,969	30,385	12	0
25th %ile	43,100	0	21,547	30,385	11	0
75th %ile	97,275	16,105	49,276	30,385	15	1
Mean	80,091	23,718	40,877	27,277	12.29	0.46
Std. dev.	58,555	61,512	30,782	6,356	1.62	0.50

Note: This table presents the summary statistics of the main variables used in the analysis. The rest of the variables are described in the appendix. The primary data source is Nepal Living Standards Survey - 2010. The subsidy data comes from National Education Accounts reports compiled by International Institute for Educational Planning (IIEP), UNESCO Institute for Statistics (UIS) and Global Partnership for Education [IIEP Reports 2016a 2016b]. This data can be accessed at http://uis.unesco.org/en/news/national-education-accounts

Table 2.1 : Estimated Fiscal Benefits and Costs for a Year of Education

Panel A: Primary Education (Grades 0-5), N=3787

	Median	*25th %ile*	*75th %ile*	*Mean*
Years of Schooling	610***	511***	836***	870***
	(92)	(74)	(176)	(188)
Opportunity Cost at Grade 5	18747***	14199***	26069***	23294***
	(392)	(315)	(751)	(841)
Subsidy at Grade 5	7209	7209	7209	7192
Gap, MB-MC	-169**	-131**	-163	-44
	(81)	(65)	(156)	(165)
Gap / Consumption	-0.005	-0.006	-0.003	-0.001

Panel B: Secondary Education (Grades 6-10), N=1081

Years of Schooling	547	220	1354	2221*
	(415)	(224)	(830)	(1172)
Opportunity Cost at Grade 10	26415***	18445***	41544***	40505***
	(959)	(516)	(1917)	(3023)
Subsidy at Grade 10	30510	30510	30510	29816
Gap, MB-MC	-1161***	-1249***	-808	111
	(393)	(211)	(785)	(1094)
Gap / Consumption	-0.026	-0.039	-0.012	0.002

Panel C: Higher Education (Grade 11 to Bachelor's Degree), N=893

Years of Schooling	3737***	2000***	7623***	8875***
	-941	(489)	(2398)	(1937)
Opportunity Cost at Grade 15	52675***	33080***	99141***	88647***
	(2945)	(1532)	(7508)	(6658)
Subsidy at Grade 15	30385	30385	30385	27277
Gap, MB-MC	1245	96	3737*	5398***
	(865)	(450)	(2206)	(1752)
Gap / Consumption	0.014	0.002	0.027	0.05

Note - This table calculates the difference between MB and MC (fiscal gap) at the end-point of each level of education. The dependent variable is total tax payments - income and consumption tax (VAT). We assume that only people in the formal sector pay income tax. Everyone pays VAT. Main coefficient of interest is "years of schooling" of the household-head which is equal to the MB. "Opportunity cost" is the tax forgone due to an additional year of schooling at the end-point of the interval. "Subsidy" is non-household expenditure per student which includes central and local government expenditure, international and local NGO, external loans and grants, off-budget assistance and internally generated funds by the schools. Other controls include quadratic terms of the age of the household-head and the sum of education level of all the other family members. We demean the controls so that the marginal cost is the discounted value of the sum of opportunity cost and subsidy. We use a discount rate of three percent. In the final row of each panel, we take the average per-capita consumption of households whose head has education level equal to the end-point of the interval, and use it to standardize the fiscal gap. In 2010-11, the year of the analysis, 1 USD was equal to 72 Nepalese rupees. The primary data source is Nepal Living Standards Survey - 2010. The subsidy data comes from National Education Accounts reports compiled by International Institute for Educational Planning (IIEP), UNESCO Institute for Statistics (UIS) and Global Partnership for Education [IIEP Reports 2016a 2016b]. This data can be accessed at http://uis.unesco.org/en/news/national-education-accounts. Standard errors are shown in parentheses. Three stars denotes signifigance at the 1% level; two stars, 5%; and one star, 10%.

Table 2.2. Alternate Estimates of the Gap

		Primary				Secondary				Higher			
		Median	25th %ile	75th %ile	Mean	Median	25th %ile	75th %ile	Mean	Median	25th %ile	75th %ile	Mean
1	Only public schools and only government subsidy	-483**	-211	-311	-259	-1091***	-1151***	-715	245	1275	206	4175*	5745***
		(206)	(177)	(456)	(350)	(419)	(206)	(783)	(1112)	(953)	(469)	(2339)	(2022)
2	VAT only on non-food consumption	-76*	-152***	171*	147	-684**	-646***	-506	429	977	232	4741**	5567***
		(43)	(22)	(91)	(145)	(268)	(141)	(730)	(1032)	(650)	(374)	(2175)	(1673)
3	Dependent variable is self-reported tax instead of imputed tax	-185**	-129**	-205	-215*	-1116***	-1272***	-871*	-464	86	-587*	1556**	1182**
		(80)	(65)	(138)	(112)	(336)	(207)	(495)	(525)	(428)	(323)	(611)	(582)
4	MB is equal to taxes net of benefits	-169***	-131***	-163***	4	-1161***	-1274***	-808***	-9	1245***	93**	3737***	5510***
		(12)	(9)	(23)	(25)	(29)	(15)	(58)	(91)	(88)	(46)	(225)	(200)
5	Using random working-age member instead of household head	-164*	-160**	-143	77	-849**	-970***	-657	186	853	289	2925*	5007***
		(88)	(68)	(174)	(208)	(406)	(257)	(679)	(676)	(597)	(387)	(1562)	(1710)
6	Discount rate of 1%	350***	297***	503***	565***	-23	-270	633	1518	2906***	1365***	6328***	7716***
		(88)	(71)	(169)	(180)	(408)	(219)	(815)	(1146)	(915)	(476)	(2333)	(1875)
7	Discount rate of 6.4% (r = 9%, g = 2.6%)	-1051***	-859***	-1294***	-1081***	-3097***	-2913***	-3258***	-2280**	-1579**	-2062***	-667	1456
		(70)	(56)	(133)	(138)	(368)	(198)	(736)	(1008)	(783)	(407)	(1997)	(1545)
8	Adjusted for migration and remittances	-381***	-224***	-503***	-443***	-866***	-869***	-700	31	1437**	23	4306**	5506***
		(74)	(61)	(135)	(141)	(301)	(162)	(612)	(850)	(699)	(379)	(1817)	(1506)

Note: This table presents estimates of the gap between fiscal marginal benefits and marginal costs of education under different assumptions. See notes from Table 2.1 for specifications. Standard errors are shown in parentheses. Three stars denotes significance at the 1% level; two stars, 5%; and one star, 10%.

Appendix Table 1: Summary Stats of variables not included in Table 1

	Age (in years)	Sum of education grades, in years, of other household members (excluding the head)	Highest grade of education, in years, within the household (excluding the head)	Household Size	Male Dummy for Household head	Benefit received (In NPRs)	Dummy for Benefits received	Dummy for In-Kind Transfers
Panel A: Primary Education (Grades 0-5)								
Count	3,787	3,787	3,635	3,787	3,787	3,787	3,787	3,787
Median	48	10	7	5	1	0	0	0
25th %ile	38	3	3	3	0	0	0	0
75th %ile	59	20	10	6	1	0	0	0
Mean	48.60	13	6.60	4.86	0.67	1,043	0.16	0.09
Std. dev.	13.74	12.83	4.36	2.37	0	2,940	0.37	0.28
Panel B: Secondary Education (Grades 6-10)								
Count	1,081	1,081	1,067	1,081	1,081	1,081	1,081	1,081
Median	40	14	9	5	1	0	0	0
25th %ile	32	8	5	3	1	0	0	0
75th %ile	50	25	12	6	1	0	0	0
Mean	41.37	18	8.29	4.94	0.82	784	0.14	0.06
Std. dev.	11.62	14.60	4.26	2.18	0	2,223	0.35	0.24
Panel C: Higher Education (Grade 11 to Bachelor's Degree)								
Count	893	893	862	893	893	893	893	893
Median	40	19	11	4	1	0	0	0
25th %ile	32	11	9	3	1	0	0	0
75th %ile	50	30	15	5	1	0	0	0
Mean	41.31	22	10.82	4.41	0.86	711	0.12	0.05
Std. dev.	12.20	16.92	4.23	2.19	0	2,293	0.33	0.22

Note : The primary data source is Nepal Living Standards Survey - 2010. The subsidy data comes from National Education Accounts reports compiled by International Institute for Educational Planning (IIEP), UNESCO Institute for Statistics (UIS) and Global Partnership for Education [IIEP Reports 2016a 2016b]. This data can be accessed at http://uis.unesco.org/en/news/national-education-accounts

Appendix Table 2. Alternate Estimates of the Gap

		Primary				Secondary				Higher			
		Median	25th %ile	75th %ile	Mean	Median	25th %ile	75th %ile	Mean	Median	25th %ile	75th %ile	Mean
1	Sample restricted to public schools	-492**	-220	-320	-269	-1182***	-1241***	-805	155	1215	147	4116*	5686***
		(206)	(177)	(456)	(350)	(419)	(206)	(783)	(1112)	(953)	(469)	(2339)	(2022)
2	Top higher ed. master instead of bachelor									429	-465	2705*	4327***
										(658)	(359)	(1577)	(1265)
3	Omit admin expenditure for secondary					-553	-641***	-200	705				
						(393)	(211)	(785)	(1094)				
4	Conservative definition of formality	-175**	-142**	-209	-79	-1102***	-1221***	-969	-48	738	-380	2074	3747**
		(81)	(65)	(153)	(161)	(368)	(207)	(718)	(1095)	(597)	(390)	(1749)	(1652)
5	Household heads who have completed schooling									2359**	881*	8236***	6943***
										(1025)	(503)	(2396)	(2122)
6	Male-headed households only	-309***	-310***	-265	-76	-1189**	-1213***	-1108	-20	1018	137	4864**	6076***
		(92)	(77)	(174)	(195)	(465)	(241)	(958)	(1332)	(932)	(491)	(2451)	(1897)
7	Use max of other household members' education instead of sum	-203**	-87	-172	21	-819**	-1140***	-965	624	2050**	47	7077***	5650***
		(85)	(63)	(164)	(172)	(357)	(253)	(780)	(1141)	(857)	(460)	(2174)	(2059)
8	Each level starts at endpoint of previous level					-882***	-1049***	-571	410	1444**	274	4281***	5224***
						(256)	(134)	(449)	(622)	(575)	(346)	(1558)	(1452)
9	Alternative definition of Grade 10					-499	-939***	-70	548	-115	-447	1106	2736
						(373)	(193)	(757)	(820)	(1872)	(784)	(3865)	(2747)
10	Tax payments adjusted for non-linear returns to work experience	-447***	-418***	-480***	-430***	-1567***	-1637***	-1416***	-1009***	843**	-823***	3231***	3243***
		(18)	(15)	(37)	(36)	(117)	(65)	(222)	(314)	(375)	(191)	(790)	(997)

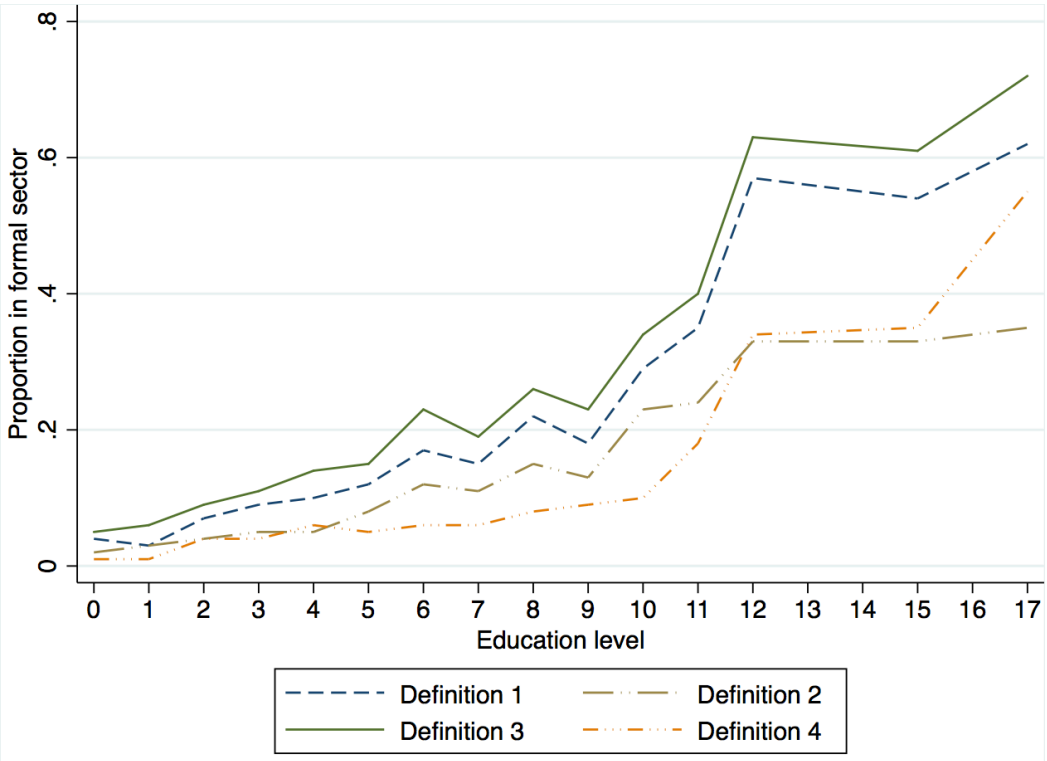
Note: This table presents estimates of the gap between fiscal marginal benefits and marginal costs of education under different assumptions. See notes from Table 2.1 for specifications. Standard errors are shown in parentheses. Three stars denotes significance at the 1% level; two stars, 5%; and one star, 10%.

Appendix Table 3: Migration, remittances, and taxes.

1	Education level of Household head	0	1	2	3	4	5	6	7	8	9	10	11	12	15
2	Probability of migration	0.04	0.05	0.13	0.12	0.16	0.22	0.21	0.21	0.24	0.27	0.23	0.24	0.18	0.13
3	Average income tax paid by the household (in NPR)	717	570	1864	1804	2235	1818	6684	3044	8008	6457	12862	13361	25840	40388
4	Average VAT paid by the household (in NPR)	17854	19365	19995	20390	20456	22883	25312	24490	27889	30717	33566	35058	39628	53032
5	Average net remittances sent by migrants who have years of schooling equal to the respective column (in NPR)	37752	64993	35546	42977	48176	83664	66230	69472	83358	88860	120688	104615	63537	62204
6	Average migration-adjusted taxes (in NPR) = [0.13*(5)*(2)] + [[(3)+(4)] * [1-(2)]]	18000	19352	19605	20274	20005	21677	27198	23700	29834	30335	39401	40178	55387	82754

Note: In this table, we adjust the tax paid by the household for the possibility of migration. The probability of migration is equal to the proportion of people who migrated conditional on school grade. If the household head migrates, then the household pays VAT on the remittances. These remittances, we assume, are equal to the average remittance sent by the migrants with similar years of schooling. If the household head doesn't migrate, then there is no change in the tax payemts. Thus, migration-adjusted taxes = [0.13 X Average net remittances X Prob. of migration] + [(Direct taxes + VAT) X (1-Prob. of Migration)]. The VAT rate is 13 percent. The data for this table comes from the Nepal Living Standards Survey - 2010.

Appendix Figure 1: Alternate Measures of Formality Rate, by Education Level



Note: This figure graphs the change in proportion of formal labor force according to education level. For our analysis, formality is synonymous with being compliant with tax laws. We use Definition 1 in the main analysis. Other definitions of formality change the job characteristics used to describe the formal sector. In one alternate definition, all the self-employed people are categorized as informal labor force. (Details of these alternate definitions are given in appendix A.2) This graph is based on calculations using the data from Nepal Living Standards Survey 2010.

A Appendix

A.1 Construction of variables used in the analysis.

1. **Identity and demographics of the household head** – We use the "household roster" of the LSMS survey to determine the identity of the household head. This section also has information on the age and gender of the family members. Additionally, we create a unique id for each respondent using the PSU id, household id and serial number of the respondent. This id is used to merge other relevant sections of the LSMS to the household roster.

2. **Education** – We use the "education" module of the LSMS questionnaire to construct this variable. For the grades 1 to 12, the years of education completed is equal to the education grade. Household members with bachelors and masters degree are coded as having completed 15 and 17 years of education, because the duration of bachelors and masters degree in Nepal is of three and two years respectively. We assume that professional degree holders have completed 15 years of education.

3. **Public Schools** – All the schools that are coded as Community/Government; community (public) campus; constituent campus and others, in the LSMS data are considered as public schools. The rest of the schools are considered as private schools.

4. **Jobs and Formality** – The "Wage jobs" section of LSMS documents job characteristics of household members who report themselves as wage earners, as opposed to self-employed. Using the job characteristics, we construct several measures of formality (details are given in the Appendix A.2). All the self-employed members are also considered as part of the informal sector. If any person is working in a non-agricultural enterprise, we use the "Non-agriculture enterprises/activities" section to ascertain whether the enterprise is registered with the government or not. Persons working in the registered enterprises are also considered to be in the formal sector. Finally, we use the "Jobs and time use" section of the LSMS to identify household members who are engaged in household work or not employed at all. Such members are considered to be in the informal sector.

5. **Household Consumption** – We construct measures of annual food and total consumption by multiplying the annual per capita consumption of each household, recorded in the "Poverty" file of the LSMS, with the total number of household members.

6. **Benefits** –The benefits received by each member of the household are recorded in the "Transfers, social assistance and Other Income" section of the LSMS. First, we annualize the benefits received by each member of the household under all the programs mentioned in the section. Then, we create a measure of total annual benefits received by the household by adding the benefits received by all the members of the household. This allows us to deduct the annual benefits from the annual tax payments to calcuate the net tax payments of a household. We use this measure in the sensitivity analysis as the main dependent variable. We also create a dummy variable for benefits received under programs where transfers are given in-kind rather than in cash. This variable is used to measure the gradient of take-up of welfare programs with respect to the education level.

7. **Value Added Tax** – The Value Added Tax, in our analysis, is equal to 13 percent of the total household consumption. An alternate measure of VAT excludes food consumption from the total consumption, because essential food items are zero-rated in Nepal.

8. **Mean remittances** - We use the "Absentees information" section of the LSMS data to calculate the average remittances sent by migrants across different education levels.

9. **Education subsidies** - We use National Education Accounts complied by the Nepalese government, UNESCO Institute for Statistics (UIS), International Institute for Educational Planning (IIEP) and Global Partnership for Education (GPE), to measure the subsidies incurred on education. Education subsidies are equal to the non-household expenditure which is defined as the expenditure by federal, state and local governments; NGOs, and school. The expenditure by government includes money spent by the ministry of education, district and village development committees, grants on budget, technical assistance off budget and administrative offices. Expenditure by NGOs includes both local and international NGOs. Finally, expenditure by schools is

recorded under the header of "Internally generated funds" in the data. We merge this data with the LSMS data using the education level of the household head and the type of school attended by him (public or private).

A.2 Alternative Definitions of Formality

The third round of Nepal Living Standards Measurement Survey (LSMS), conducted in 2010-11, asks every respondent if she is engaged in self or wage employment and further if the employment is in agriculture or non-agriculture sector. We construct four different definitions of formality using this information. While we use the first definition of formality in the main analysis, we also test if our results are robust to alternative definitions in the sensitivity analysis.

- Definition 1 - A wage-earning person is assigned to the formal sector if *any* of the jobs she works in displays *any* of the following features - tax is deducted by the employer, employee contributes to the employee provident fund, employee will receive pension on retirement, or subsidized medical care. Further, if the person is self-employed and the firm is registered with the government, then also she gets assigned to the formal sector. Conversely, if the person is engaged in agriculture then she is assigned to informal sector, as the agricultural income is exempt from personal income-tax in Nepal. Unemployed, household workers and students are also assigned to the informal sector.

- Definition 2 - A person who is wage-employed is assigned to formal sector only if *any* of the jobs she works in displays *all* the job features listed above. All else is similar to Definition 1.

- Definition 3 - For this definition, we consider one more job criterion mentioned in the survey - if the employer has more or less than 10 workers employed. Several labor law regulations, particularly those pertaining to hiring and firing of workers are only applicable to firms that employ more than 10 workers. All else is similar to Definition 1.

- Definition 4 - In this case, all the self-employed people are considered to be in the informal sector. All else is similar to Definition 1.

A.3 Methodology of Imputing Income Tax Payments

We impute and assign the income tax payments to each household by constructing a tax table and merging it with the LSMS data. We only do this for households heads that are employed in the formal sector as defined in the previous section of the appendix. Households heads who are employed in the informal sector, including agriculture, are assumed to pay zero income tax.

First, we create an income tax table that shows tax payments for each possible level of income by using the income tax schedule of Nepal. Then, household's consumption, c, equals $f(s) - T(s)$, where $f(s)$ is the taxable income and $T(s)$ is the income tax payment. For example, if the taxable income of a single male is NPR 2,00,000, then the income tax—according to the tax schedule—is NPR 7,600 and the after-tax consumption is NPR 192,400.

Next, we merge the income tax table with the LSMS data by matching the imputed consumption from the tax table to the reported consumption in the LSMS data. The income tax schedule of Nepal, like most countries, has a non-decreasing average tax rate over income. This ensures a monotonic relation between consumption and taxable income. Thus, we can assign the taxable income and tax payment to each household in the LSMS data using the tax table. Using the previous example, if some household(s) reports consumption of NPR 192,400 in the LSMS survey, then the income tax payments of that household is imputed as NPR 7,600. In this exercise, we are making three assumptions. First, it is the household head who is earning all the income and therefore, a single tax return is filed per household. Second, a proportion of the household consumption may be deductible from income for tax purposes. For instance, a self-employed person might claim business expenses as itemized deductions. In the absence of access to administrative data, we do not know whether such claims are made. Third, we assume that there is full tax compliance by people employed in the formal sector.

Finally, in the above analysis we create separate income tax tables for married and single household heads as they face different tax schedules according to the income tax law. Furthermore, single women face the same tax schedule as single men, however, they get a 10% deduction from their total tax liability. Thus, we create separate tax tables for each category of taxpayers and match them to the LSMS data using the process described above. The income tax schedules are described below:

Table: Marginal income tax schedules

Panel A: For a single male filer

Taxable Income (In NPRs)	Marginal tax rate(In percent)
Less than 160,000	1
Between 160,000 & 260,000	15
Between 260,000 & 2,500,000	25
Above 2,500,000	35

Panel B: For a married couple filing jointly

Less than 200,000	1
Between 200,000 & 300,000	15
Between 300,000 & 2,500,000	25
Above 2,500,000	35

A.4 Methodology to calculate the present value of lifetimes taxes

We use the average of the present value of taxes paid annually by the household heads as the dependent variable in the sensitivity analysis described in the Section A.5 with the estimates of the fiscal gap reported in the Row 10 of Appendix Table 2. Here, we describe the method used to compute the dependent variable.

First we impute the income stream of an individual till the age of retirement. To do so, we estimate the growth rate of wage over time (g_t^w) which can be disaggregated into two components:

$$g_t^w = g^m + g_t^e,$$

where g^m is the average growth rate of GDP per worker and g_t^e represents the monetary returns to t years of experience. To estimate the value of g_t^e, we use the following regression model:

$$log(y_{ih}) = \alpha_0 + \beta_1 Eduyears_{ih} + \sum_{j=1}^{4} \gamma_j Workex_{ih}^j + \mathbf{Z}_h'\delta_1 + u_{ih},$$

where y_{ih} is the income of the household head i living in household h. Work experience ($Workex$) is the difference between current age and the age at which the person leaves school and enters labor force. If the reported age of leaving school is less than 15 years, then we assume that the person starts working at the age of 15 years. The retirement age is considered to be 60 years. The γ_j coefficients are then used to estimate the growth rates of wages at different levels of work experience.

Since we observe the household head's income t years after he leaves school, therefore, his income at the time she leaves school is given by $y_{iS} = y_{it}/\prod_t(1 + g_t^w)$. Using the growth rates and the initial income level, we calculate the entire income stream of the individual up to the retirement age. Next, we use the income tax schedule (described in section A.3 to calculate the income tax payment (T_{it}) at each income level . The average present value of income taxes per year is given by: $\sum_{t=0}^{t=60-S} \frac{T_t}{(1+0.051)^t}/(60-S)$, where the discount rate of 5.1% is the approximate opportunity cost of government investment. We again assume that only people employed in the formal sector pay income taxes.

We also calculate the consumption stream after observing the consumption of an individual, t years after she leaves school. The VAT is 13% of the consumption. The present value of the VAT payments per year can be calculated using the method described above.

The average present value of taxes paid each year is the sum of the average present values of the income and consumption taxes paid each year by the individual during his working life.

A.5 Additional Sensitivity Analyses

In this appendix, we describe some more robustness checks and report the alternate estimates of the fiscal gap in Appendix Table 2. The estimation strategy remains unchanged from the one described in the main text.

We first explore sensitivity of the results to funding levels. In Row 1, we repeat the analysis from Table 2.1, but only with household heads who reported attending public schools. Estimates of the fiscal loss or gain are similar to the baseline, with the exception of primary school, where the losses appear worse, yet small in magnitude. Next, we treat higher education as extending all the way through to the Masters level. There appears to be a fiscal gain at this level as well, although this represents a trivial part of the sample. (See Row 2.) We turn next to the anomalously large administrative expenditure associated with grade 10. Nepal conducts national-level exam at grade 10 which is compulsory for all students to graduate to the next level. The cost incurred in conducting this exam can explain the jump in the subsidy reported in the National Education Accounts data. Removing the administrative cost component from the subsidy data reduces the gap at the secondary level and brings it closer to zero.

We now check for the sensitivity of our results to the measure of formality by using a more conservative measure which reduces the proportion of people employed in the formal sector at each level of education. Specifically, we impose the restriction that a wage earner will be considered in the formal sector only when the job includes *all* of the following features : tax deduction by the employer, contribution to the provident fund, pension on retirement and subsidized medical care. (This is definition 2 of formality described in the section A.2. The gradients of different definitions of formality with education are shown in the Appendix Figure 1.) A reduction in the formal sector employment causes a decrease in the imputed income tax payments, which in turn affects both the tax gradient with respect to education and the opportunity cost of spending an extra year in school. Row 4 shows that for most of the specifications, the fiscal gap worsens due to a decline in income tax payments.

In the next three rows, we consider a few alternative ways of accounting for differences in household composition. Our sample consists of households whose household-heads are aged between 20 and 80 years. This includes some household heads that are currently pursuing higher education and still enrolled in school. In Row 5, we only include household heads that have

finished schooling which reduces the sample in the higher education category from 893 to 808. The fiscal balance now becomes significant at the lower quantiles of the distribution and increases in magnitude for all the specifications. In Row 6, we restrict our analysis to male-headed households only. For primary and secondary education, the fiscal balance associated with an additional year of schooling looks worse, but looks slightly better for tertiary. None of the resulting changes are especially large, however, when considered as fractions of household consumption. Next, we consider an alternative to our default strategy of controlling for the education of other household members. Instead of using the sum of years of schooling held by other household members, in Row 7, we use the maximum education attained by a household member other than the head. These results are quite similar to the baseline.

In the next two rows, we modify the definition of education intervals for secondary and higher level. In Row 8, we change the starting grade of secondary education to grade 5 which is the last grade of primary education. Similarly, the beginning of higher education is taken as grade 10 instead of grade 11. Now, the tax gradient not only captures the effect of increasing education within secondary or higher level but also transitioning from previous level to the current level. This does not change the results very much, though the gap improves a little for all the specifications in the secondary level. This is possible if there are larger gains in income from transitioning from primary to secondary level than increasing years of education within secondary level. Lastly, we modify the definition of completing grade 10. The LSMS data distinguishes between people who have completed grade 10 versus those who have passed the national-level exam at the end of grade 10. The next education grade reported in the data is graduating from grade 12. Thus, anyone who drops out of grade 11 or 12 is coded as having passed the national-level 10th exam. Due to this peculiar feature of the data, we assume that anyone who passes the national-level grade 10 exam has 11 years of education. In Row 9, we use an alternate definition – people who passed national level education have only 10 years of education. This increases the sample size at the secondary level and reduces it at the higher level. The estimates of the fiscal balance improves at the secondary level and worsen at the higher level due to this modification.

Finally, we change our dependent variable to explicitly account for growth rate of wages with the non-linear income tax schedule. In the main analysis, we estimate the marginal benefit of years of schooling by using imputed tax payments paid by an individual when she is surveyed after leaving school.

We flexibly control for age in the regressions to account for experience. The implicit assumption is that for a person, with given years of schooling, the marginal tax rate doesn't change as the income changes. To check if the assumption has significant effects on our results, we impute the lifetime income and consumption stream of the person and then calculate the present value of the income and VAT payments at the point a person leaves school. (The detailed methodology is described in the section A.4) We then use the average present value of tax payment per year to calculate the fiscal gap by using the regression models described in the empirical model section. We use r instead of $\tilde{r}$ as the discount rate because the growth rate of wages is taken into consideration while calculating the income and consumption stream. Row 10 shows that the fiscal balance deteriorates across all the specifications.