Essays in Development Economics and the Economics of Education

by

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# Dedication

To my parents, with love. You have not lived to see me graduate, but I am sure that you never doubted my potential. To my brother Yakub who worked hard to set a very high standard that served as a model for me growing up. To my brother Issa who had to interrupt his education to help make mine possible. To my sisters Adissa, Maimouna, Fati, and Abiba who did not have the chance to acquire education but who have always supported me and encouraged me to pursue my highest dreams. To my wife Berthyle Fortunat Blimpo for her unconditional support.

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# Abstract

Education is a powerful tool to improve lives and enhance the prospect of innovation and development of nations. While primary school enrollment has increased considerably over the past few decades in Sub-Saharan Africa, learning and the retention rate have remained low. The first two chapters of this dissertation analyze two dimensions in a bid to improve learning: Students incentives to learn and the parents interest and participation in the school affairs. In the first chapter, I use theoretical analysis and a field randomized experiment to assess the impact of monetary incentives on students performance. I find that student performance and learning can be improved substantially by providing them direct short-term incentive. This finding is theoretically grounded on the fact that students might not internalize all the future payoffs of acquiring human capital through education. In the second chapter, a comprehensive survey and test score data from a representative sample of Benin's primary schools were used to assess the impact of PTAs on the schools and students performance outcomes. We find that a well structured and well

functioning PTAs have a substantially large and statistically significant positive impact on students' performance. This result is obtained after controlling for other key contributing factors to the students performance and using the instrumental variable technique to determine the causal relation. The third chapter tackles the question of reliance on informal institutions and norms for economics activities in many developing countries. In the motorcycle taxi market in Sub-Saharan Africa two contracts co-exist between owners and conductor. One of the contracts is a seemingly sub-optimal, and I show that an element of trust between owners and the conductors can explain that deviation. It is often argued that trust is good for economic relationship. Our results suggest that in an asymmetric information setting, relying solely on trust may be damaging for economic activities.

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# Chapter 1

# Team Incentives for Education in Developing Countries: A Randomized Field Experiment

Over the past two decades, a wide range of concerted efforts at both the national and international levels have led to a substantial increase in primary school enrollment in Sub-Saharan Africa[1]. While primary school enrollment has increased considerably, the retention rate has remained low. The primary school completion rate for primary-age children in Sub-Saharan Africa was 63% in 2007. With 43% of its population between the ages of 0 and 14, Sub-Saharan Africa must pair a sustained increase in enrollment with good educational

[1]Net primary school enrollment exceeded 95% in countries like Uganda, Rwanda, and Madagascar in 2007 and it was 93% in Benin in 2008.

outcomes in order to achieve long-term development[2]. There are many causes of low performance and retention rates, including the need for children to work and other cultural reasons (particularly for females). One important reason for low retention is the low perceived return on the investment in schooling by parents and students. Following independence in the sixties, even a basic education was enough to land a well-paying public job. However, over time, the labor market has become incapable of absorbing new graduates. This makes schooling less attractive to families, especially those without a long tradition of formal schooling. If students do not internalize the entire future payoff of acquiring education, they will underinvest in their learning efforts. Providing short-term incentives to learn marks one way to improve learning and retention[3].

A recent strand of academic literature has focused on quantifying the power of monetary and other incentives to improve school attendance and grades[4]. The literature has hitherto studied rewards dependent solely on the pupil's individual performance. Moreover, in most cases the incentives are delivered to the students' caregivers rather than to the students themselves. No attention

[2]In a recent paper, Hanushek and Woessmann (2009) show evidence suggesting that cognitive skills may explain the slow growth in South America. Whereas enrollment and attainment have been sufficiently high, what the students actually learn has been poor.

[3]Over 50% of the students interviewed in the baseline survey reported that the lack of effort and enthusiasm of students is the primary cause of poor performance.

[4]Two large-scale examples are the PROGRESA program in Mexico and the PACES program in Colombia. See (Angrist, Bettinger, and Kremer 2005)

has been paid to different incentive schemes for students, such as *team incentives*, where rewards are based on the performance of a team. Team incentives have been found to be very effective in developing countries in other areas such as microcredit (group lending). There are at least two reasons to believe that team incentives might also be useful in incentivizing students to learn. The first reason relates to moral hazard and peer monitoring. Pupil effort is unobservable to education authorities and incentives must be conditioned on the noisy signal of performance. Team members may be in a position to observe, and presumably encourage, effort. The second reason is peer effects. Having higher-skilled peers can have a positive effect on one's own skills and performance. In a recent paper, De Giorgi et al. (2010) show the presence of peer effects in the choice of college major in Italy. Ding and Lehrer (2007) provide evidence of peer effects on students achievement in Chinese secondary schools. Peer effects may be strengthened in the presence of team incentives.

Using a field experiment to test the predictions, I randomly assign tenth-grade students from 100 Beninese secondary schools to three treatment groups and a control group. In the first group (Individual Target), each participant is offered a monetary promise to be paid to her individually based on her performance on the secondary school certication examination, the "Brevet d' Etudes du Premier Cycle" (BEPC). In the second group (Team Target), I randomly assign participants to teams of four students. Each team is offered a monetary reward to be paid to the team based on its average performance

on the BEPC. In the third group (Team Tournament), I randomly assign participants to 84 teams of four students across the country. Each of the three teams with the greatest average performance on the BEPC win a prize.

The contribution of this paper is twofold. First, it uses a field experiment to measure the impact of direct team incentives on student performance. Second, it provides a unique opportunity to compare team incentives with individual incentives. In addition, the design of the field experiment also allows for the comparison of team incentives in a target-based scheme to team incentives in a tournament-based scheme (i.e., with an endogenous target).

I start by analyzing a simple theoretical framework in which students with heterogeneous abilities choose their level of effort in response to an exogenous incentive. Both ability and effort positively relate to performance. Following Itoh (1993), students can allocate their effort to improving their own performance or to helping another student. Effort is costly only to the supplier, but the supplier benefits from learning and from obtaining the incentive payment. In this setting, I show that a standard individual performance-based incentive, one in which students win a prize if their performance reaches or exceeds an established standard, is only effective on students with an intermediate level of ability. Students in the lower tail of ability find the target out of reach, whereas students in the higher ability range perform above the target regardless of incentives. When students are randomly assigned to teams and performance is judged by the team's average outcome, two equilibrium outcomes result: one

with free riding[5] and one without. In the equilibrium without free riding, there is an incentive for the high-ability students to help their teammates. However, the incentive to help may be weak unless low ability students could commit to transfer part of their payoffs to the high ability students. Team Target incentives may be ineffective because of multiple equilibria and potential coordination problems. The free riding problem in the Team Target scheme is consistent with Holmstrom's theorem (Holmstrom 1982). However, the free riding problem in this context is mitigated by the fact that only part of the "output" is shared equally.

In the third scenario analyzed, teams of students compete over a prize. Given that the teams are formed randomly, they are ex-ante identical. Arrangement of teams in a tournament makes the target endogenous. Because there is uncertainty about the probability of winning, effort matters even for weak teams, and the free riding equilibrium is ruled out. The size of the incentive is a contributing factor, and the incentive effect depends on the difference between the prize for the winners and the prize for those who lose[6].

To empirically test these predictions, I design a field experiment in Benin (West Africa). I randomly assign tenth-grade students from 100 randomly selected secondary schools to one of the three treatment groups or to the

[5]Here, "free riding" refers to an equilibrium where only certain team members supply the higher effort needed to win.

[6]The prizes are set in a way that the expected cost of all the prizes allocated in each treatment group is equal. Therefore, it follows that the prizes in the tournament scheme should be bigger.

control group. In the first group, called *Individual Target*, each participant receives a promise of 5000 Francs CFA ($10)[7] to be paid if she passes her secondary school certification examination(BEPC). This promise includes a bonus of 15,000 Francs CFA ($30) if she succeeds with honors. In the second group, called *Team Target*, I randomly assign participants to teams of four students. Each team receives a promise of 20,000 Francs CFA ($40) to be paid to the team if its average score equals or exceeds the passing grade on the BEPC. The team is also offered an additional bonus of 60,000 Francs CFA ($120) if its average score equals or exceeds the required grade to pass with honors. In the third group, called *Team Tournament*, I randomly assign participants to 84 teams of four students each, drawn from across the country. The three teams with the highest average scores each win a prize of 320,000 Francs CFA ($640). Finally, I do not alter incentives in the control schools. I collect baseline data and end line data on student performance and school and student characteristics in all groups including the control group.

I estimate the average treatment effect by testing the average BEPC scores in the control group against those of each treatment group. To check for the presence of heterogeneity in the treatment effect, I use simultaneous quantile regressions to estimate the effect of the treatment at lower quantiles, around the median, and at higher quantiles. I find that, on average, students pass

[7] $10 represents about 4.5 weeks of students' reported average weekly pocket money or 17% of the official monthly minimum wage in Benin.

the BEPC at a higher (about 10% higher) rate in the treatment groups than in the control group. Honors are awarded to 7% of students in the control group, compared with 11% in the Individual Target group, 13% in the Team Target group, and 16% in the Team Tournament treatment group. The average treatment effect on the overall test score is 0.29 standard deviations in the Individual Target group, 0.27 standard deviations in the Team Target (significant at 10%), and 0.34 standard deviations in the Team Tournament. The treatment effect is similar on higher order thinking skills test scores (HOTS). However, only the Team Tournament has a positive and significant effect (of 0.30 standard deviations) on Rote Memory test scores . This suggests that in the presence of incentives, students tend to work harder primarily on higher-order thinking subjects. This is not surprising, as the potential margin of improvement is likely to be higher on those subjects. The evidence from simultaneous quantile regressions point to the presence of heterogeneity in the treatment effect, as is predicted theoretically. The effect in the Individual Target group is 0.43 standard deviations at the $15^{th}$ percentile, 0.67 standard deviations at the median, and 0.17 standard deviations (not statistically significant) at the $85^{th}$ percentile. Heterogeneity is present in the three treatment groups, but only the Team Tournament scheme has a positive and significant effect at the $15^{th}$ quantile, the median, and the $85^{th}$ quantile. Further analysis indicates that poorly performing students, if incentivized individually, work

harder on subjects that require higher-order skills. However, in the team incentive schemes, these students receive some form of help from their peers on such difficult subjects, leaving them with more time to improve basic skills and subjects that require rote memorization. The magnitude of the treatment effect is highest in the Team Tournament group and is significant at the 1% level. Using the Kolmogorov-Smirnov test of the equality of distribution, I reject (at the 1% significance level) the null hypothesis that the distribution of test scores in the treatment groups is identical to that of the control group.

## 1.1 Related Literature

Conditional Cash Transfer programs have received growing attention in recent years. The importance of such programs stems from the observation that the poor segment of the population, especially in developing countries, lacks proper incentives to invest sufficiently in human capital. The present work spans three domains of the economic literature: incentive programs, team or group incentive mechanisms, and the tournament literature.

The Colombian government instated a private school voucher program in partnership with private schools called PACES, which was intended to target the poor. Students who qualified and were selected received a government transfer every year upon satisfactory progress toward graduation. A recent evaluation of the program showed a large improvement in the participants'

school outcomes (Kremer 2005). Another successful large-scale example of conditional cash transfers is Mexico's Progresa program , where cash payments are made to families in exchange for, among other things, regular school attendance and clinic visits. New York City's "Opportunity NYC" program is a model based on these two programs that is designed to target low-income households. These programs induce families and parents to be supportive of their children's education and to actually send the children to school in the first place. Oftentimes, however, these programs do not address the children's own interest and motivation in learning at school. In a recent study in India, Berry (2009) found that the effect of incentives differs depending on whether the incentives are directed to the families (parents) or to the children. That study reported that for children with low initial test scores and less productive parents, incentives yield better outcomes when given directly to the child . Merit scholarships provide an additional mechanism for directly incentivizing students. Merit scholarships are special cases of conditional cash transfers that are used in many education systems around the world. These types of programs have been evaluated by Kremer et al. (2007) in Kenya. Sixth-grade girls were promised a tuition waiver and cash grants for school supplies, conditional on scoring in the top 15% of examinees. The program produced an improvement of up to 0.30 standard deviations in test scores. More recently, Angrist and Lavy (2009) evaluated an incentive program in Israel where eligible high school students could gain up to $2400 over three years based on their

performance. The female participants who received the incentives recorded significantly higher certification rates than their control group counterparts. Merit scholarships are often awarded for good performance. However, Merit scholarships do not, in themselves, address the many other causes of poor performance besides the lack of effort from students and their incentives for success. In many cases, such as when students are competing for the incentives, poor performers may find the performance target out of reach. In addition, the reason for poor performance may not be a lack of effort, and in this case, the incentive may not work. Therefore, it is of great interest to compare the effect of different forms of incentives to determine which is the most effective.

This project uses the approach of team incentives to directly address the students' lack of incentive to learn and to create conditions to encourage students to help each other, and eventually to transfer skills from high performers to poor performers. This particular aspect has been theoretically investigated by Itoh (1991) . This study shows that teamwork is optimal when each agent increases her effort in response to an increase in help from other agents (i.e., efforts are complements). Team incentives have also been successfully exploited in the operation of microcredit institutions in developing countries. Whereas additional factors enter into play in the case of microcredit, peer monitoring and within-group insurance are the key features that make the system work in this case (Stiglitz 1990). Students' effort and help from other students are complements. Help from other students can remove important barriers and

create more interest for the recipient. Slavin (1984) reviews this aspect and shows that group study and group rewards schemes lead to high individual accountability[8]. There is empirical evidence of the effectiveness of team incentives in other settings. For example, Hamilton, Nickerson, and Owan (2003) provide evidence from the garment industry that the adoption of teams at the plant has improved workers productivity by 14%. They find that after controlling for average ability, heterogeneity within teams was positively related to productivity.

There is good reason to believe that team incentives and the resulting competition among teams can enhance the incentive effect. When teams are incentivized with a pre-specified target, the heterogeneity of the strength of the teams may raise challenges similar to Individual Target incentives. Although the overall adverse effect is less than for the individual incentives, weak teams may still drop out of the program and strong teams can win without extra effort. A tournament system will eliminate this problem, as uncertainty about the strength of the other team increases the incentive effect. In a laboratory experiment, Nalbantian and Schotter (1997) provide evidence that tournaments are an effective mechanism to increase group effort[9]. This work constitutes

[8] Lavy (2002) found a positive effect of teachers' group monetary incentives on student performance in Israel. Muralidharan and Sundararaman (2009) found no significant advantage of teachers' group incentives over individual incentives in an experimental study in India during the first year. The individual incentives outperformed the group incentives in the second year of the program

[9]Green and Stokey (1983) derived conditions under which tournaments dominate independent contracts. Related works are Mookherjee (1984) , Lazear and Rosen (1981), Nalebuff and Stiglitz (1983), Che and Yoo (2001).

a unique empirical opportunity to compare individual incentives with team incentives, team incentives under target-based schemes and team incentives under tournament schemes in the context of Sub-Saharan Africa.

## 1.2 Background and context

Benin has a population of about 8.8 million that is skewed very young. Over 46% of the Beninese population was between the ages of 0 and 14 in 2008 (43% for Sub-Saharan Africa in 2007)[10]. The literacy rate was 35% in 2005[11], and the estimated school life expectancy was about 7 years in 2002. While primary school enrollment has continuously increased, the retention rate has been lagging[12]. There is a stark regional difference in educational achievement across Benin. The southern region (Atlantic and Littoral regions) performs better than its northern counterpart does overall. This phenomenon holds true for most Sub-Saharan African countries.

In Benin, primary and secondary education lasts a total of 13 years (six years in primary, four years in middle, and three years in high school). At the primary school level, each class has one teacher who teaches all subjects. Progress to the higher grades is determined by school level examinations. Students must score an overall average of 10 out of 20 in order to progress to a

[10] According to the World Bank's World Development Indicators.

[11] (World Development Report 2009)

[12] Figure 1 shows the rate of progress from grade to grade in 2004 . While over 90% progressed from grade 1 to grade 2, only 20% of the students remaining in the year before high school made the transition to high school.

higher grade the following year. At the end of the last year of primary school, there is a national standard certification examination called CEP. Students must pass the CEP in order to progress to middle school. Middle school lasts four years and is under the authority of the Ministry of Secondary, Technical and Professional Training. There is one national director of secondary education and six regional directors. Each regional director is in charge of the schools in two of the 12 regions of Benin, and serves as a liaison between the schools and the national authorities. Middle schools are organized in the same way as primary schools, except that teachers are subject-specific. At the end of the last year (grade 10), students take another national certification examination called BEPC. Students must score an overall average of 10 out of 20 in order to be allowed to progress to high school. High school lasts three years and ends with the baccalaureate degree. This project works with tenth-grade students who are at the end of their secondary education.

The primary and secondary education system has undergone a gradual change in curriculum over the past decade. The main changes include the design of new teaching materials and changes in teaching techniques. The implementation of reform started 10 years ago with the first grade curriculum, and since then it has been extended to the next grade every year. The new curriculum reached the tenth grade during the academic year 2008-2009, and while new tenth-grade students must be taught under the new curriculum, students who are repeating the tenth grade have the option to be taught under

the old curriculum. Only students following the new curriculum participated in this study.

Benin was chosen for this research based on three factors. First, in terms of socio-economic and demographic characteristics, most Sub-Saharan African countries are similar. Second, the problem of poor learning and retention is more severe in Benin than the African average. For example, in 2008, while Benin's primary net enrollment was 9 percentage points above the Sub-Saharan African average, its secondary net enrollment was 11 percentage points below the Sub-Saharan African average (Table 2). Third, my knowledge of the realities on the ground through my activities with the IERPE (a research institute in Cotonou) made Benin ideal for successful implementation of the field experiment.

## 1.3 A Simple Theoretical Framework

Consider a model in which students have different initial abilities and choose their optimal effort schedule in response to given incentives. The model is partially based on Itoh (1993). Assume a continuum of students characterized by their initial abilities $\theta \in [0, A]$. The ability reflects "innate aptitude", but it can also be affected by various factors such as peer effects.

All students must choose their level of effort from $a \in [0, +\infty)$ and $b \in [0, +\infty)$ where $a$ is allocation of effort to herself ( *own effort*)and $b$ is allocation

of effort to help another student *helping effort*. Students have the same cost of effort $C(a, b)$ where $C_a = C_b \geq 0$ , $C_{aa} \geq 0$, $C_{bb} \geq 0$, and $C_{ab} \geq 0$ .

Student $i$'s initial ability is $\theta_i$, but her ability can increase to $\psi(\theta_i, b_j)$ if she receives helping effort ($b_j > 0$) from another student $j$ with a higher ability. $\psi_\theta \geq 0$, $\psi_{\theta\theta} \leq 0$ , $\psi_b \geq 0$, $\psi_{bb} \leq 0$. $\psi$ is the source of complementarity between helping effort received and individual effort. Helping effort increases the ability of the receiver and thus induces a higher individual effort by the receiver.

The utility derived from ability and effort has two components: The first component, $\psi(\theta, b_j)a$, is the utility derived from the knowledge learned at school (the *Learning* component). It can interpreted a psychological pleasure gained. The second component $P$ is the part of utility derived from passing examinations and winning prizes (the *Incentive* component). For simplicity, the utility of a student can be thought of as her score.

### 1.3.1 Individual Incentives

In this particular context, an individual student receives a promise $P$ to be paid to her if her score reaches a certain threshold $S$. In prelude to the analysis of team incentive, I work in the context of two students. Therefore, $a_i$ is the effort of student $i$ for her own study, and $b_i$ is her helping effort toward student

$j$. Student $i$ chooses her effort schedule $(a_i\ ,\ b_i)$ to solve the following problem:

$$\max_{a_i,b_i}\ U^i(\theta_i, a_i, b_i, b_j) = \begin{cases} P + \psi(\theta_i, b_j)a_i - C(a_i + b_i) & \text{if} \quad \psi(\theta_i, b_j)a_i \geq S \\ \\ \psi(\theta_i, b_j)a_i - C(a_i + b_i) & \text{if} \quad \psi(\theta_i, b_j)a_i < S \end{cases} \tag{1.3.1}$$

Figure 1.1 shows the incentive faced by student before the experiment and during the experiment.

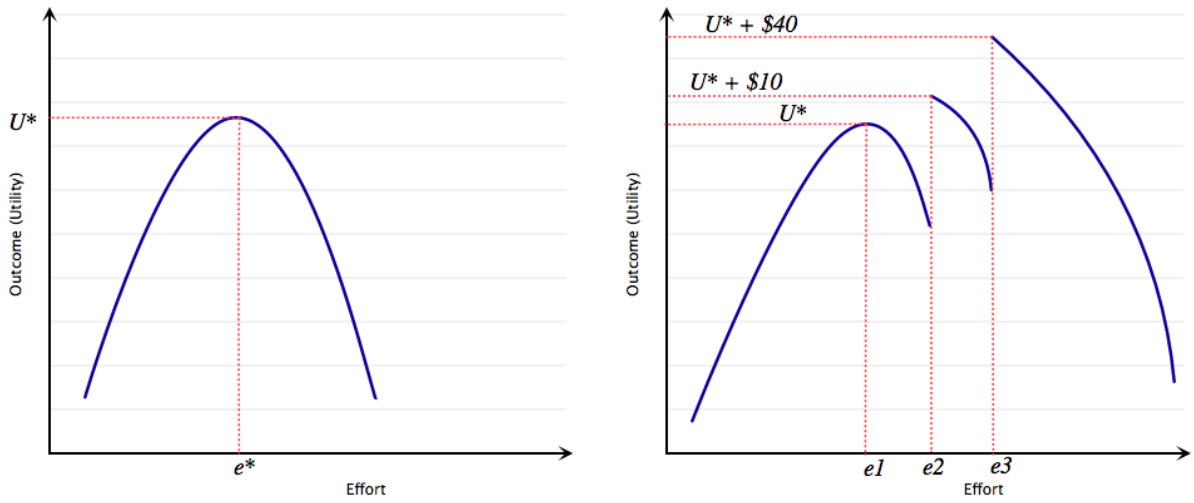


**Figure 1.1.** Incentives structure before (Left) and during (Right) the experiment

Let consider two students with initial abilities $\theta_1$ and $\theta_2$ such that $\theta_1 < \theta_2$, where the first student has a very low ability whereas the second student has a very high ability. For simplicity and without loss in generality, I assume that both the promise and the threshold are equal to $S$. The optimal solutions

for the two types of students are characterized in figure 1.2, and the main implications discussed below.

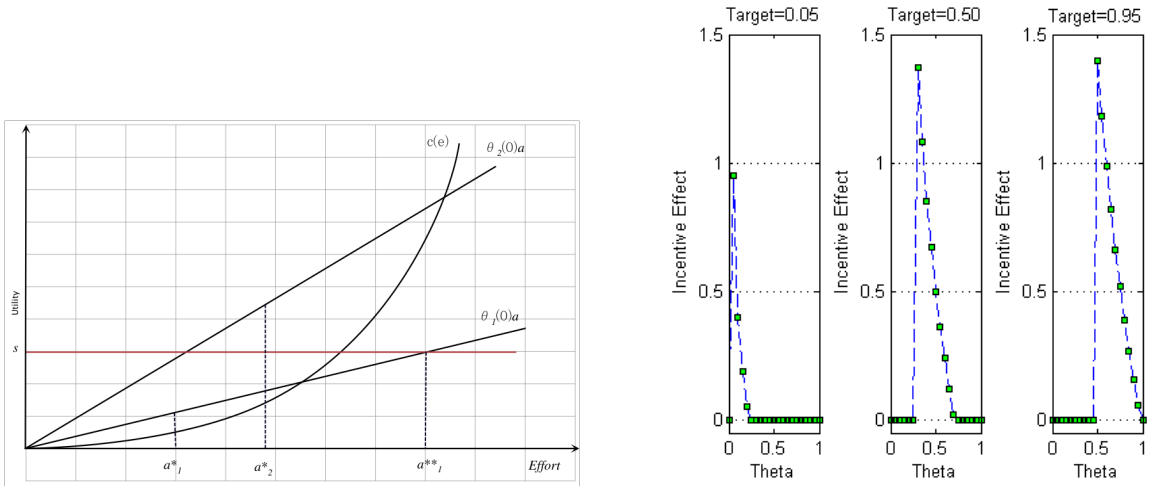


**Figure 1.2.** Optimal Effort and Incentive Effect under the Individual Incentives (Left) and Heterogeneity of the incentive effect (right) from a simulation.

The optimal own efforts are $a_1^*$ and $a_2^*$ for student 1 and 2, respectively. Since there is no gain from help, and the cost of help is positive, then $b_i^* = b_j^* = 0$. For the low ability student to win the prize, she must choose an own effort of $a_1^{**}$, which is too costly compared to the gain. The high ability student wins the prize without exercising higher effort than she would have without the promise. The following proposition summarizes this result.

**Definition 1** *Let $(a_i^{**}, b_i^{**})$ be the equilibrium effort of student $i$ without the incentive, let $(a_i^*, b_i^*)$ be the equilibrium effort of the same student under the incentive. Let $\delta_a = a_i^* - a_i^{**}$ and $\delta_b = b_i^* - b_i^{**}$. The pair $(\delta_a, \delta_b)$ is called the*

*incentive effect. There is a positive incentive effect when one component is strictly positive and there is no incentive effect when both component are equal to zero.*

**Proposition 1**

*(I) Without the incentive, the optimal effort is increasing with ability. With the incentive, the optimal effort does not necessary increase with ability. The optimal effort is increasing in $P$.*

*II-(i) If the student with the highest ability can reach the target without extra effort, then there are $\underline{\theta}$ and $\overline{\theta}$ where $0 < \underline{\theta} < \overline{\theta} < A$ such that for each student with ability $\theta$, the incentive effect is given by $\delta = [\frac{S}{\theta} - C'^{-1}(\theta)] \times I_{[\underline{\theta},\ \overline{\theta}]}(\theta)$.*

*II-(ii) Otherwise, there is $\underline{\theta}_2 \in [0, A]$ such that for each student with ability $\theta$, the incentive effect is given by $\delta = [\frac{S}{\theta} - C'^{-1}(\theta)] \times I_{[\underline{\theta}_2,\ A]}(\theta)$.*

**Proof.** Given that $b_i^* = b_j^* = 0$ and for simplicity without loss of generality, we can ignore help from the utility function. Because of the discontinuity in the student's utility at the effort level $a = \frac{S}{\theta}$, we can solve for the optimal effort level above and below the cut-off point and choose the one that yield the highest utility. Consider the following unconstrained problem:

$$\max_{a_i} \ \theta_i a_i - C(a_i)$$

The first order condition for the unconstrained problem for student $i$ is

$$C'(a_i^*) = \theta_i \tag{1.3.2}$$

and the optimal effort is

$$a_i^* = C'^{-1}(\theta_i) \tag{1.3.3}$$

The smallest level of effort necessary to win the prize is given by $a_i^{**}$ such that $\theta_i a_i^{**} = S$. That is:

$$a_i^{**} = \frac{S}{\theta_i} \tag{1.3.4}$$

The comparison of the utility from these two effort level determines the optimal choice and the incentive effect. (I) Given the convexity of the cost function of utility ($C'' > 0$), it follows from the FOC that, as $\theta$ increases the optimal effort level $a_i^*$ increases. To see that the monotonicity may no longer hold under the exogenous incentive, consider the student with ability $\overline{\theta}$ (I will show the existence of such student later.) and another student with ability $\overline{\theta} - \epsilon$: The former's optimal effort is $a_i^* = C'^{-1}(\overline{\theta})$, and that is just enough to win $P$. We know by construction of $\overline{\theta}$ that if $\epsilon$ is sufficiently small, it is optimal for the latter to supply extra effort, say $\delta$, just high enough to win $P$. Therefore, it follows that:

$$\overline{\theta} C'^{-1}(\overline{\theta}) = (\overline{\theta} - \epsilon) C'^{-1}(\overline{\theta} - \epsilon)$$

This implies that $C'^{-1}(\overline{\theta}-\epsilon) > C'^{-1}(\overline{\theta})$, and by the convexity of $C$, it follows that the student with lower ability chooses higher equilibrium effort.

(II-i) From the FOC in equation 1.3.3, it is clear that $\theta a^*$ is increasing in $\theta$ in the interval $[0,\theta)$, for $\theta$ small enough (Because the optimal effort is an interior solution in that range), the learning component for the student with ability $\theta$ is $\theta C'^{-1}(\theta)$. Given that the latter expression is continuous and increasing in $\theta$ and given that the student with the highest ability wins the prize without extra effort, then by the intermediate value theorem, there is $\overline{\theta}$ and the corresponding optimal effort $a^*_{\overline{\theta}}$, such that $\overline{\theta}a^*_{\overline{\theta}} = \overline{\theta}C'^{-1}(\overline{\theta}) = S$ and $\forall\ \theta > \overline{\theta}$, $\theta a^*_\theta > S$ (and for the students in that range, $a^*$ is also the optimal solution of the constrained problem because $a^*$ is enough to win the prize. )

Let $\theta$ be a student whose optimal effort without the incentive does not win the prize[13], for such a student to supply higher effort and win the prize, it must be that:

$$\theta C'^{-1}(\theta) - C[C'^{-1}(\theta)] \leq P + S - C(\frac{S}{\theta})$$

where the LHS is the net utility without extra effort and the RHS is the net utility with enough extra effort to win the prize. Let

$$f_{P,S}(\theta) = \theta C'^{-1}(\theta) - C[C'^{-1}(\theta)] - P - S + C(\frac{S}{\theta})$$

[13]The existence of such student is guarantee by the existence of the student with ability zero and by the continuity of ability to the right of zero.

Given $P$ and $S$, $f$ is continuous in $\theta$. Moreover, $\lim_{\theta \to 0} f_{P,S}(\theta) = +\infty$ and $\lim_{\theta \to \bar{\theta}} f_{P,S}(\bar{\theta}) = -P$. Therefore, by the intermediate value theorem, there exist $\underline{\theta} > 0$ such that $f_{P,S}(\underline{\theta}) = 0$. and $\forall\ \theta < \underline{\theta}$ the choice of extra effort to win the prize yields a net loss in utility, in particular if $\theta = 0$ (and thus by continuity, if $\theta$ is close enough to 0) the cost of the deviation is bigger than the gain. Similarly, for $\theta$ close enough to $\underline{\theta}$ to the right, the extra cost of winning the prize is $C(a^{**}) - C(a^{*})$ and the extra gain is $\theta a^{**} - \theta a^{*} + P$. By dividing these two terms by $a^{**} - a^{*}$ and by considering that $C'(a^{*}) = \theta$, it is easy to see that the gain is higher than the cost.

II-ii) This is a special case of II-i) and the same reasoning applies. ■

This proposition in (I) conveys the ideas that students normally spend more time studying subject that they are good at. This prediction is not, however, easily identifiable in the data. Even though higher performing student have reported higher study time, it is not clear whether they are performing better because of the study time or whether they are studying more because they are good at it. The third part of (I) is a trivial, but crucial prediction, that the incentives matter. $P$ is designed to induced higher effort and presumably higher performance. Since the students have the option to disregard the incentive, it follows that the optimal effort is weakly increasing in $P$. The rest of the proposition in II-i) suggests that the impact of the individual incentive will be smaller among the group of students with the lowest ability and the group of students with the highest ability. This observation will result in an

inverted U shape relation between initial ability or before treatment performance and the impact of the treatment. Therefore, if an incentive structure is designed for students individually, it will be ineffective for high ability students and low ability students. This is an important challenge to resolve given that it includes the most needy students. If this challenge can be resolved for high performing students by providing them with a separate incentive with a harder target to achieve, the problem remains unresolved for low performing students. I explore one approach to deal with this challenge through the team incentives. Part II-ii) of the proposition is a special case of part A) where the set of students who win the prize without extra effort is empty. For the rest of this section, I assume that there is at least one student who can win the prize without any extra effort, that is $0 < S \leq Ae_A^*$. This is a reasonable assumption since the incentives, at least in the context of this research, are designed mostly to improve the performance of the poorer performing students. Therefore, the target must be attainable to the average student.

### 1.3.2 Team Target Based Incentives

Now assume that there are two students $(i)$ and $(j)$ such that $\theta_i < \theta_j$ who form a team and receive a joint incentive to win $S$ each, if their average learning component exceeds $S$. The ability is known within the team. In this scenario, student $i$ takes the other student's type and choice of effort as given and

chooses her own effort to solve the following problem:

$$\max_{(a_i,b_i)} \quad U^i(\theta_i, a_i, b_i, b_j) = \begin{cases} P + \psi(\theta_i, b_j)a_i - C(e_i) & \text{if} \quad \frac{\psi(\theta_i,b_j)a_i+\theta_j a_j}{2} \geq S \\ \\ \psi(\theta_i, b_j)a_i - C(e_i) & \textit{Otherwise} \end{cases} \tag{1.3.5}$$

The following working assumptions are necessary for the next result:

**Assumption 1** *Let two students* $(i)$ *and* $(j)$ *be such that* $\theta_i \leq \theta_j$*. For all then we have the following: (a)* $U^i_{b_j}(\theta_i, a_i, b_i, b_j) \geq U^j_{a_j}(\theta_j, a_j, b_j, b_i)$ *(b)* $U^i_{a_i}(\theta_i, a_i, b_i, b_j) \geq U^j_{b_i}(\theta_j, a_j, b_j, b_i)$

This assumption states that, it is marginally less costly for the high ability to improve the low ability through help than to improve her own performance by the same amount. Reciprocally, it is marginally more costly for the low ability student to improve the high ability student's performance through help, than to improve her own performance by the same amount. These are reasonable assumptions, and the rational behind them is that, high ability students have a smaller margin for improvement and at the same time the marginal cost of effort is increasing in effort level (convexity of the cost of effort). In addition, the help represents the spreading the one's knowledge than acquiring new knowledge. Therefore, it is quite reasonable to think that it is more valuable from top down.

Now, consider the two students from the previous section. Taken individually, the incentives were irrelevant and only $\theta_2$ won the prize. In the context of this section, their individual optimal choices may amount to both not winning the prize as their average learning component may be less than $S$. However, under certain conditions, it will be in the best interest of $\theta_2$ to increase $b_1$ which will increase $\theta_1(.)$ (upward shift of the learning component the student 1) and this, in turn, will lead to higher optimal effort by $\theta_1$ sufficient enough for both students to win $S$. The graphical representation below conveys this argument, and Proposition 2 presents the formal results of this section.

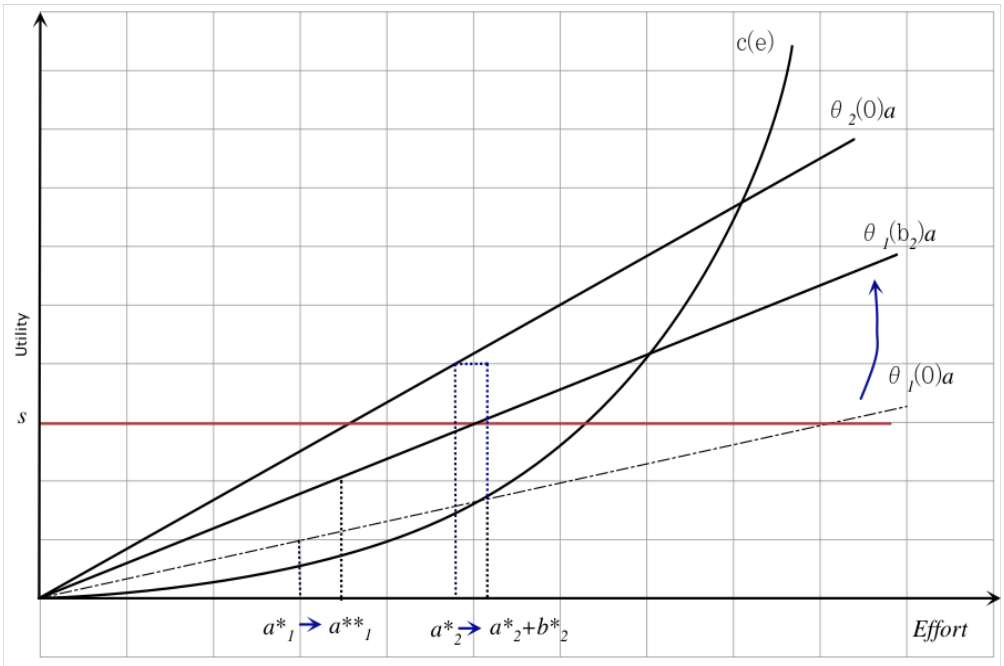


**Figure 1.3.** Illustration of the Team Target Incentive

**Definition 2** *Let $A$ and $B$ be two incentive schemes and let $S_A$ and $S_B$ be the set of students on whom incentives $A$ and $B$ have a positive incentive effect respectively:*

*(i) The incentive scheme $A$ dominates the incentive scheme $B$, if* $\frac{\sum_{i\in A}\delta_a^i+\delta_b^i}{|S_A|} \geq \frac{\sum_{j\in B}\delta_a^j+\delta_b^j}{|S_B|}$

*(ii) If in addition the cardinality of $S_A$ is greater than the cardinality of $S_B$ then the incentive scheme $A$ strictly dominates the incentive scheme $B$.*

Consider $\theta_1 < \theta_2$. The optimal efforts without an incentive is given respectively by $a_1^* = C'^{-1}(\theta_1),\ b_1^* = 0$ and $a_2^* = C'^{-1}(\theta_2),\ b_2^* = 0$. To have an equilibrium with positive incentive effect, it is necessary that:

$$\frac{\theta_1 C'^{-1}(\theta_1) + \theta_2 C'^{-1}(\theta_2)}{2} < S \tag{1.3.6}$$

In addition to the necessary condition above, the following set of conditions must be satisfied:

$$\begin{cases} \frac{\psi(\theta_1, b_2^{**})a_1^{**} + \psi(\theta_2, b_1^{**})a_2^{**}}{2} = S & (WC) \\ \theta_1 a_1^* - C(a_1^*, 0) \leq \psi(\theta_1, b_2^{**})a_1^{**} + P - C(a_1^{**}, b_1^{**}) & (IC1) \\ \theta_2 a_2^* - C(a_2^*, 0) \leq \psi(\theta_2, b_1^{**})a_2^{**} + P - C(a_2^{**}, b_2^{**}) & (IC2) \\ b_1^{**} = 0 & (A) \end{cases}$$

Where (WC) ensures the sufficient condition to win the prize, (IC1) and (IC2) are the incentive compatibility conditions for each student, and (A) is direct consequence of assumption 1. Many scenarios arise and correspond to the different possible outcomes under this incentive scheme.

**Case 1** *If equation 1.3.6 is NOT satisfied, then the resulting team will yield no incentive effect.*

This is the case where two high ability students belong to the same team. In this case, the incentive effect is identical to that of individual incentive. Moreover, team incentive could be strictly dominated by individual incentives. This is the case where a team is made of a very high ability student and another student below $\overline{\theta}$ of proposition 1.

**Case 2** *If equation 1.3.6 is satisfied, but for all* $(a_1^{**}, b_1^{**}, a_2^{**}, b_2^{**})$ *that satisfies (WC), either (IC1) or (IC2) or both are not satisfied, then the resulting team yields no incentive effect.*

This scenario corresponds to a team made of two very low ability students or any combination of ability that makes the target out of reach.

**Case 3** *The cases where (6), (WC), (IC1), (IC2) are simultaneously satisfied corresponds to equilibria with positive incentive effect.*

I show that there is an arrangement of teams under which the team incentive strictly dominate the individual incentive. The following proposition gives one possibility of such arrangement.

**Proposition 2** *Consider two students* $(\theta_1,\ \theta_2)$ *such that* $\theta_1 < \theta_2$. *Denote by* $(\delta_{a1}, \delta_b 1)$ *and* $(\delta_{a2}, \beta_{b2})$ *the equilibrium incentive effect of student 1 and 2 respectively. Let* $\underline{\theta}$ *be the lower bound from proposition 1. We have:*

$(i)$ *For* $\theta_2 \geq \underline{\theta}\ \exists\ \tilde{\theta} \in [0,\ \underline{\theta})$ *such that the team incentive effect on the team* $(\tilde{\theta},\ \theta_2)$ *strictly dominates the individual incentive effect in equilibrium. Furthermore,* $\tilde{\theta}$ *decreases as* $\theta_2$ *increases.*

$(ii)$ *There are two types of equilibria with positive incentive effects: The cooperative Equilibriumwith* $(\delta_{a2} >= 0, \delta_{b2} > 0)$ *or* $(\delta_{a1} > 0, \delta_{b1} = 0)$ *and* The Free Riding Equilibrium *with* $(\delta_{a2} = 0, \delta_{b2} = 0)$ *and* $(\delta_a 1 > 0, \delta_{b1} = 0)$

**Proof.** (i) $\forall \theta_2 > \underline{\theta}$, let $\tilde{\theta} = \underline{\theta}$, and the result is immediate. (and by continuity, $\tilde{\theta} = \underline{\theta} - \epsilon$ for $\epsilon$ small enough). As the higher ability increases, it requires less and less Learning component from the teammate in order to reach the target. Therefore, it requires a smaller and smaller ability teammates to generate an equilibrium with positive incentive effect.

(ii) First, note that in any equilibrium with positive incentive effect, the team supplies additional effort just enough to wins the prize. Otherwise, it is optimal to set the its incentive effect to zero. That being said, it is easy to verify that the two incentives effect schedule are consistent with equilibrium, as no student finds it in her best interest to deviate. ■ It follows from Proposition 2 that teams of high ability $(\theta > \overline{\theta})$ and low ability $(\theta < \underline{\theta})$ can be formed such that it induces a positive incentive effect. In addition, note that teams of students

with abilities between $\underline{\theta}$ and $\overline{\theta}$ have an incentive effect of at least as big as that of the individual incentive[14]. Therefore, the combination of these two types of teams will dominate the individual incentive scheme. In the equilibrium with incentive effect, the incentive to help stems from two factors. First, the margin of improvement of the low performer is higher than that of high performers. Second, the relative cost of improving low performer is lower than that of increasing the performance of a high performer. Therefore, when put in teams, it is of the interest of high performers to help low performers. In any equilibrium where the high performer supplies higher effort, her help to the low performer is strictly positive for the same reasons as in the cooperative equilibrium. But by the complementarity of effort, the poor performer now finds it optimal to increase her own effort. If the primary goal is to improve the performance of poor performers, then team incentives are desirable as in both equilibria the incentive effect is positive for poor performers. If the goal is to improve the performance of poor performers and cultivate excellence for high performers, then it is desirable to rule out the free riding equilibrium. One way to induce the cooperative equilibrium could be to allow for side transfers from low performers to high performers within the teams. But this scenario is hard to implement in the field. In addition, to the multiplicity of equilibria, it require precise information about students abilities ex-ante in order to form

[14]Whereas assortative matching style classes may be desirable for effective teaching (Kremer et al. 2009), it is counterproductive in the specific context and goals of this study as illustrated in case 1 and case 2.

the teams properly. Therefore, the optimal team target incentive may would be hard to implement on the field. A random formation of teams would not guarantee a better outcome than individual incentives. I explore whether by introducing competition among teams, one could rule out the undesired equilibria and improve the outcome.

### 1.3.3 Team Incentives and Tournaments

This section follows Lazear and Rosen (1981). Assume that there are two teams. The members of each team know the abilities of their teammates, but they do not know the abilities of the other teams. The uncertainty about abilities in the other teams is characterized by a random variable $\zeta$ that has a normal distribution with mean zero and variance $\sigma^2$. The realization of $\zeta$ is known within a team but it is i.i.d and unknown across teams. In each team, student $i$'s ability is lower than student $j$'s ability. To win, unlike in the previous section, the average learning component must be greater than that of the other team. The winning team gets the bigger prize $W$ and the losing team gets a smaller prize $w$ (which could be zero). The payoff of student $i$ of team 1 is defined as:

$$\begin{cases} \frac{W}{2} + \psi(\theta_{1i}, b_j)a_{1i} - C(a_{1i}, b_{1i}) & \text{if} \quad \frac{\psi(\theta_{1i},b_j)a_{1i}+\theta_{1j}a_{1j}}{2} + \zeta_1 \geq \frac{\psi(\theta_{1i},b_j)a_{2i}+\theta_{2j}a_{2j}}{2} + \zeta_2 \\ \frac{w}{2} + \psi(\theta_{1i}, b_j)a_{1i} - C(b_{1i}, a_{1i}) & \text{Otherwise} \end{cases} \tag{1.3.7}$$

She takes the effort schedule and abilities of her teammates and that of the other team as given, and chooses her own effort schedule to maximize her expected payoff. The expected payoff is the probability of winning times the net gain. Let $p$ be the probability of winning,[15] then student $i$ in team 1's expected payoff is:

$$p \times \frac{W}{2} + (1-p)\frac{w}{2} + \psi(\theta_{1i}, b_j)a_{1i} - C(a_{1i}, b_{1i}) \tag{1.3.8}$$

Let $\phi_{2\sigma^2}$ be the pdf of $\zeta_2 - \zeta_1$ and $\Phi_{2\sigma^2}$ its cdf.

The optimality condition is given by:

$$\begin{cases} (W-w)\frac{\partial p}{\partial a_1 i} + \psi(\theta_{1i}, b_j) - C_a(a_{1i}, b_{1i}) = 0 \\ (W-w)\frac{\partial p}{\partial b_1 i} + \psi(\theta_{1i}, b_j) - C_b(a_{1i}, b_{1i}) = 0 \\ x'Hx < 0 \end{cases}$$

where $x = (a_{1i}, b_{1i})$ and $H$ is the Hessian matrix. $\frac{\partial p}{\partial a_i} = \frac{\psi(\theta_{1i},b_j)}{2}\phi(\Delta)$. Next,

[15] $p = Prob(\zeta_2 - \zeta_1 \leq \Delta)$ where

$$\Delta = \frac{\psi(\theta_{1i}, b_j)a_{1i} + \theta_{1j}a_{1j}}{2} - \frac{\psi(\theta_{1i}, b_j)a_{2i} + \theta_{2j}a_{2j}}{2}$$

substitute this expression in the optimality condition above, and note that the optimality condition for the student with the lower ability in the other team is symmetrical. Therefore, it follows that in equilibrium $\Delta = 0$ and $p = \frac{1}{2}$. In equilibrium, the selection of the winner is random. Both teams supply effort to increase their ex-ante probability of winning. This establishes the basis for the following proposition:

**Proposition 3** *(i) Every equilibrium has a positive incentive effects. (ii) There is no free riding equilibrium as defined in Proposition 2 (iii) The incentive effect of the Team Target based scheme is dominated by that of the Team Tournament scheme.*

**Proof.** (i) Assume that this is not true. Then every player in each team will find it in her best interest to supply small effort and increase her probability of wining, which increases the expected payoff

(ii) Let's assume that there is an equilibrium in which the incentive effect is positive only for the low ability. By the same argument in (i), the high ability student can supply a small effort and increase his expected payoff.

(iii) This is a direct consequence of (i) and (ii). ■

## 1.4 The Experimental Design

I assigned 1476 students from 100 secondary schools to one of three treatment groups or to a control group. In the team incentive treatments, I formed the

teams randomly from a randomly selected class. Students are very familiar with study groups, with 65% of the participants reporting participation in a study group in the previous year. However, there are many reasons why the benefits of such groups may be limited. For instance, the groups are often very large, with an average of six but ranging up to 38 members. The groups are also often formed in an assortative matching manner. High-performing students benefit more by teaming up with other high-performing students, and thus the poor-performing students have no choice but to work together [16]. Whereas the assortative matching could help solve the adverse selection and credit rationing problem in the context of microcredit (Aghion et al. 2000) , it is not desirable in this context, where the key premise is to exploit the diversity of types and to diffuse skills from the high performers to the low performers. The complete set of instructions, consent forms, and survey instruments are available upon request. The key elements of the experiment are briefly described below.

### 1.4.1 Selection of participants

The Ministry of Education provided a list of all the secondary schools in the country. There are 1279 schools, with 818 registered private schools and 461 public schools. In the previous academic year (2007 - 2008), over 95,000 candidates took the BEPC and about 43% of them passed. I excluded schools

[16] A number of groups are also formed based on other affinity criteria such as family membership, area of residence, etc.

where the percentage of students who passed was 65% or more, because this program is intended for poorly performing areas.

I also excluded all schools that do not have the tenth grade and very small schools with less than 10 candidates. These are mostly urban, private schools. There were 749 schools remaining, and among them 411 are private and 338 are public. Next, I conducted a complete randomization to assign 100 participant schools to the four groups. The selected schools span 11 out of the 12 regions of Benin.

At the school level, I randomly selected a tenth-grade class and gave its students further details about the consent forms, their rights as participants (including the right to withdraw at any moment without any consequence to their normal academic progress). Then, I randomly selected 12 to 16 participant students from among those who consented[17]. Under-age (under 18 years old) students were required to return a signed parental consent form for their participation to take effect. Finally, I collected baseline information on the students and gave them the instructions about their specific incentive package.

[17]No student has ever withdrawn. However, students asked on several occasions whether we would actually pay them their incentives if they won.

### 1.4.2 The treatments

***Individual Target***-Based Incentives: Each participant received a promise of 5000 Francs CFA to be paid to them if their average score was between 10/20 (inclusive) and 12/20 (exclusive), and 20,000 Francs CFA if their score equaled or exceeded 12/20.

***Team Target*** -Based Incentives: Each team of four students received a promise of 20,000 Francs CFA to be paid to the team if its average score was between 10/20 (inclusive) and 12/20 (exclusive), and 80,000 Francs CFA if the average score of the team equaled or exceeded 12/20. We did not impose any restrictions on how the winning teams could share the prize.

***Team Tournament*** Incentives: Each team of four students received a promise of 320,000 Francs CFA to be paid to the team if its average score was among the top three best scores of the 84 teams taking part in this tournament. To address the adverse effect of competition within the same school, we had three identical prizes and no more than three teams in a given school. We did not impose any restriction on how the winning teams could share the prize.

***Control Group:*** No incentives were put in place for the control schools. I only collected baseline and follow up data in these schools.

### 1.4.3 Size of the incentives

Based on the statistics of the previous year performance, the prizes are set such that the expected payoff of each student is the same across the treatment groups. The sample is also chosen so that the ex-ante expected expenditure per group is the same.

Three factors determined the amounts of the incentives: First, the sample size necessary to obtain the relevant statistical power. I chose a sample size large enough to identify an effect of 0.3 standard deviations at a significance level of 95% with a statistical power of at least 80%. The second factor was the average reported weekly pocket money during a pretest of the survey instrument on selected students before the start of the academic year. This gave a better sense of the value of the incentive to the students. The final factor was budget constraints: 43% of the students passed the BEPC in the previous year, and I worked under the assumption that the current year's performance would be about 50% and that our treatment would further increase the rate in the treated sample to 65%. The second column of Table 3 on page 105 summarizes the incentives in nominal U.S. dollars. These amounts are also expressed in terms of reported weekly pocket money and as a share of the monthly minimum wage in Benin.

The individual incentive amounts to about $10 without honors and $40 with honors. This corresponds to 4.5 and 18 weeks, respectively, of the average

pocket money of the participants. It also represents 17% and 69%, respectively, of the official monthly minimum wage in Benin. Each of the three prizes in the Team Tournament treatment represents 291 weeks of the average weekly pocket money. Each member of a winning team could make as much as 1.4 years of average pocket money or 2.75 months of minimum wage.

## 1.5 The Data and Descriptive Statistics

### 1.5.1 Data

**The Baseline Data:** I collected three rounds of data during this experiment. At the beginning of the school year, the research team implemented the treatments and collected baseline data. The baseline data consisted of the school characteristics (through an in-depth interview with the head teachers at each of the schools). We also collected information about the school environment, the infrastructure, the size, the management, community participation, and so on. Next, we interviewed each student who agreed to participate. We collected socio-demographic information for each student, including past performance, information regarding their home environment, and opinions from students regarding various aspects of their education. In addition, we designed a short Mathematics and French test together with ninth-grade teachers that we gave to the students as an additional proxy of pre-treatment performance.

**The Follow up Data:** about two months before the final examination, we visited about half of the schools to remind students of the incentives and to collect some follow-up data. Unfortunately, due to budget constraints, we were only able to visit schools from the southern region. However, we called all the other schools by phone to remind them about the incentives. We also mailed an envelope with the data collection instruments and a pre-stamped envelope to a randomly selected set of schools. We were able to collect data from about half of the participants. These data included information about the other incentives that they received, if any; the team dynamics; and their expectations about the final examination.

**The Final Data:** The final data consists of the students' BEPC grade reports. This includes their grades in each subject, their final weighted average grade, and the decision of whether each student passed or not. We obtained this data officially through each regional directorate with the assistance of the Ministry of Education and the National Directorate of Secondary Education.

### 1.5.2 Treatment Groups Balance and Summary Statistics

The sample contains 63 private schools and 37 public schools. The average tenth-grade class size is 41.30 and there are about three tenth-grade classes per school. The average size of the schools is 15.61 classes per school and 695

students per school. Overall, public schools are far larger than private schools, with 9.68 classes on average in private schools versus 25.84 classes in public schools. The average number of students is 292 in the private schools versus 1359 in the public schools.

In terms of infrastructure and resources: 36% of the schools have a library, 73% have electricity, and only 16% have a health care center or a nurse on hand. 73% of the public schools are double-shift schools (versus only 10% for the private schools). The system of two shifts was established to deal with the limited resources in the face of sharp increases in enrollments. The double-shift schools function as if they are two schools, but with the infrastructure and human resources of one school. One group of students attends the morning shift and another group attends the afternoon shift. The tuition fee is on average about $140 per year in the private sector and less than $40 per year in the public sector. Despite these notable differences in resources, the performance of private schools does not differ statistically from that of public schools.

Of the 1476 students in the sample, 40% are females. The average age is 16.22, and the average is slightly higher for male (16.33) than female (16.06) students. This suggests that females are more likely than males to drop out after repeating a grade. 15% of the students reported having a paid tutor at home, and only 17% primarily speak French at home. Regarding family characteristics, 14% of the students reported that their father is deceased and 6% reported that their mother is deceased. The average number of siblings

is 6.54, and 37% of the students reported working for pay during the school year.

Since the assignment to the different groups was random, the groups are by construction comparable in the limit. Any observed differences are attributable to sampling rather than a systematic difference. More importantly, the treatment groups are also balanced in unobserved variables that affect students' performance. The treatment groups are balanced at the school level in terms of school characteristics, as table 5 shows. The only significant difference is that the head teacher's experience is greater in the Team Tournament group. This difference is driven by a few outliers, and it is attributable to sampling error rather than to a systematic difference.

The treatment groups are also balanced at the level of student characteristics. The key variables such as students' baseline performance and socio-demographic background, are similar across the treatment groups and control groups, as shown in Tables 7 and 8.

## 1.6 Econometrics Framework and Identification

As reported earlier, students received other incentives from relatives. Therefore, it would be possible to run an Ordinary Least Squares (OLS) regression

using that measure as an independent variable and using students' performance as the dependent variable. However, if the students who received the incentives have some characteristics in common and if those characteristics are correlated with their performance, then the OLS estimates will be biased. For example, it is reasonable to assume that students who have more educated and/or wealthier parents would be more likely to receive such incentives. Since wealth and parents' education are correlated with student performance, the OLS estimates mentioned above would be biased upward. On the other hand, if the students received the promises because of poor performance, then the estimates would be biased downward, as the average initial performance of those who received promises would be lower. One possible solution is to include control variables in the right-hand side of the regression equation. However, controlling by endogenous variables such as parents' education or wealth would yield estimates that are not consistent estimates of the population parameters. Even in the best-case scenario, where the control variables such as gender are exogenous, there is still doubt about the estimates because the unobserved characteristics would never be accounted for. Instrumental variables, when available, and regression discontinuity, when applicable, are excellent attempts to deal with these challenges. However, field randomized experiments are the ideal methodology available to circumvent these problems both for the observed and unobserved characteristics. Due to the random assignment to treatments, the different groups are initially comparable in the observed and

unobserved characteristics.

The focus of this paper is to estimate and compare the Average Treatment Effect of the three treatments and to test the validity of the theoretical prediction. Given that the schools and students were assigned randomly to the treatment groups and that the groups are balanced, a simple comparison of means yields a consistent, unbiased estimate of the causal Average Treatment Effect.

Let $Y_1$ be the average score of the group of treated students and $Y_0$ the average score of the same students had they not received the treatment. The test score depends on the characteristics of the students, both on observed characteristics such as family background and unobserved characteristics such as ability and emotion. Let $T$ be an indicator of the treatment status that takes on the value 1 if the student or group of students receives treatment and 0 otherwise. Finally, let $X^T_{o,u}$ be the set of characteristics, both observable and unobservable characteristics. The average treatment effect is given by:

$$E(Y_1 - Y_0/T = 1, X^1_{o,u}) = E(Y_1/T = 1, X^1_{o,u}) - E(Y_0/T = 1, X^1_{o,u})$$

This represents the difference between the mean test score of the treated group and the mean test score of the same group had they not received the treatment. Since only one of the two states can be observed at a time, it is

necessary to construct a valid counterfactual for the unobserved state. Randomized experiments offer the best way to construct such a counterfactual. By adding and subtracting $E(Y_0/T = 0, X^0_{o,u})$ to the previous equation and rearranging, we have:

$$\begin{aligned} E(Y_1 - Y_0/T = 1, X^1_{o,u}) &= \{E(Y_1/T = 1, X^1_{o,u}) - E(Y_0/T = 0, X^0_{o,u})\} \\ &\quad + \{E(Y_0/T = 0, X^0_{o,u}) - E(Y_0/T = 1, X^1_{o,u})\} \end{aligned}$$

The difference between the average test score of the treated group and the average test score of the untreated group $(\frac{\sum_{i=1}^{N} y_i}{N} - \frac{\sum_{j=1}^{N} y_j}{N})$ is an unbiased estimator of the first expression in bracket ( $E(Y_1/T = 1, X^1_{o,u}) - E(Y_0/T = 0, X^0_{o,u})$. However, this is not an unbiased estimator of the quantity of interest unless the expression in the second bracket is zero, which is only true if $X^1_{o,u} = X^0_{o,u}$, meaning that the treated group is identical to the untreated group in both their observable and unobservable characteristics. Here, randomization becomes crucial. Since students were assigned randomly to the two groups, the two groups will be the same on average in terms of both observable variables and unobservable characteristics.

To estimate the standard error of the treatment effect, I take into account the school level intra-cluster correlation by running the following model for each treatment, where the standard deviations are clustered at the school

level:

$$score_{is} = \beta_0 + \beta_1 \times T_{is} + \epsilon_{is} \tag{1.6.1}$$

where $score_{is}$ is the score of student $i$ in school $s$. $T_i$ is a dummy variable for the treatment status of individual $i$. For individuals who received an incentive, $T = 1$, and $T = 0$ otherwise.

The second model that I estimate is intended to investigate the theoretical prediction that treatment effects are heterogeneous. Quantiles or percentiles of student performance are unbiased estimates of their population counterparts. Percentiles before treatment are theoretically identical within treatment groups, as the groups were drawn randomly from the same distribution. The only difference between groups is treatment status. Therefore, observed differences in percentiles following treatment can be attributed to the treatment. One advantage of quantile regression is that it allows us to observe the impact of the treatments within different population subgroups. I run a simultaneous quantile regression (Gould 1998) and (Rogers 1994) at a low quantile, the median, and a high quantile. Simultaneous quantile regression is an extension of quantile regression (Koenker and Bassett 1978) and (Koenker 2005) that allows the estimation of the covariance matrix necessary to test for the eventual differences of the estimates at different percentiles in the distribution of scores. I estimate the following set of equations:

$$\begin{cases} Q_{\tau_l}(score/T) &= \beta_0(\tau_l) + \beta_1(\tau_l) \times T \\ Q_{\tau_m}(score/T) &= \beta_0(\tau_m) + \beta_1(\tau_m) \times T \\ Q_{\tau_h}(score/T) &= \beta_0(\tau_h) + \beta_1(\tau_h) \times T \end{cases} \tag{1.6.2}$$

where $Q_{\tau_l}(score/T), Q_{\tau_l}(score/T), Q_{\tau_l}(score/T)$ are the lower quantile, the median, and the higher quantile of the test scores, respectively, conditional on the treatment $T$ received. The parameters of interest are the triplet ( $\beta_1(\tau_l), \beta_1(\tau_m), \beta_1(\tau_h)$) for each treatment group. I estimate the system in equation 1.6.2 with $(\tau_l, \tau_m, \tau_h) = (0.15, 0.50, 0.85)$ [18].

## 1.7 Results and Discussions

### 1.7.1 The measure of performance: The BEPC

The BEPC is a national examination that all tenth-grade students must pass in order to advance to high school. The BEPC is a comprehensive examination that covers all subjects and is organized as follows. During each academic year, the National Directorate for Examinations and Concours (DEC) invites selected tenth-grade teachers from each subject to propose a test for their

[18] The results remain with the variations $(\tau_l, \tau_m, \tau_h) = (0.20, 0.50, 0.80)$, and $(0.25, 0.50, 0.75)$

subject on the BEPC. These teachers are selected from among the teachers who graded the previous year's BEPC. A committee is then formed at the national level for each subject and their mission is to evaluate the proposed tests and select four or so. Each committee is presided over by an inspector of secondary education. Each committee submits their selected tests to the National Director of Examinations and Concours. The National Director then selects one test for each subject among the proposed tests. The test is given the same day and time across the country, and the grading is centralized and anonymous.

The design of the tests is not based on psychometric measures, although knowledge of psychometric measures is especially important for analysis of the heterogeneity of the treatment effect. In fact, if the test is by design aimed at a subgroup of students, then the treatment effect may be higher for that subgroup because of the structure of the test and not necessarily because of the attitudes of those students toward the incentives. Our conversation with senior officials at the DEC can be summarized in the following statement: "The DEC does not use psychometric measures to design the tests; it uses the experience of the teachers in the field to come up with appropriate tests. The goal is for each test to be balanced in terms of the difficulty level of the questions. The DEC favors tests with difficulty levels such that the "average" student would score 10/20, which is the passing grade". Our further investigations with teachers suggest that the tests do not target a particular subgroup and

that the tests should be considered balanced.

The BEPC has two phases: the written phase and the oral phase. The written phase consists of seven subjects: (1) Mathematics, (2) Physics and Chemistry or English, (3) Natural Science, (4) History and Geography, (5) Writing, (6) Reading Comprehension and (7) French. The oral phase has two subjects: Sport and Oral Communication. To calculate the average score, Mathematics is weighted by three, Sport and Oral Communication are each weighted by one, and each remaining component is weighted by two.

Students first sit for the written phase. Those with an average score over the seven written subjects below a certain threshold (typically about 9 out of 20) are disqualified and do not take the oral exam. All the others, including those who have exceeded the passing grade, take the two oral subjects. There is an unwritten strong leniency policy that allows the students who qualify for the oral phase to almost always achieve a passing grade or increase their score. For this reason, very few students have a final grade in the range of 9 to 10. This custom is inconsequential to the identification strategy, because it applies to both the treated and the control groups the same way. However, given that it is easier to manipulate grades in the oral phase, I report the results based only on the written phase as well. This also permits all the students' scores to be based on the same number of subjects.

### 1.7.2 Summary statistics for the 2009 BEPC

The number of BEPC candidates has increased by 11.55% compared to the previous year. Of the 150,847 candidates who registered to take the BEPC in 2009, 63.12% are males and 36.88% are females. The youngest candidate was 12 years old, and the oldest was 52. The majority (70%) of the candidates attended the newly implemented curriculum. About 97% (145,889) of the registered candidates actually took the BEPC, and 44.81% of them passed. The percentage of candidates who passed is much lower (less than 30%) in the group that attended the old curriculum than in the group who attended the new curriculum (over 55%).

The summary statistics from the raw BEPC data indicate that on average, students assigned to treatment groups were about 10% more successful on the BEPC than students assigned to the control group. Honors were awarded to 7% of students in the control group, 11% in the Individual Target group, 13% in the Team Target group, and 16% in the Team Tournament treatment group. The lowest average score was in Mathematics, in which students scored on average 4.70 out of 20 possible points. The best group in Mathematics is the Team Tournament group, with an average of 5.11 out of 20. The Mathematics portion of the test requires higher-order thinking skills. At the baseline level, head teachers reported Mathematics as the most challenging subject for students (see Figure 2). On the written part of the test, students scored best

in History and Geography (12.82/20), a subject that requires the least analytical skill and more memorization. All three treatment groups scored better than the control group in all of the subjects except for writing, as shown in Table 10. However, not all of these differences are necessarily significant, and not all of them can be attributed to the treatments. The next few sections present the results of statistical tests to identify the causal effects of the various treatments.

### 1.7.3 Overall Average Treatment Effect (ATE)

**Individual Target:** The t-test comparing the means indicates that the Individual Target had an effect of 0.29 standard deviations on the overall average score on the BEPC 2009. According to the theoretical prediction in Proposition 1, this result may be driven entirely by students with an intermediate level of ability. If this is the case, the policy implication is different from a treatment where the effect is similar across the board. The former would be undesirable if the goal of the policy was to target the most needy or to encourage excellence; whereas in the latter case, the same policy can be applied and have the advantage of both improving the performance of the poor performing students and pushing high-performing students toward excellence. In the next section, I analyze this aspect more fully.

**Team Target:** The Team Target shows a similar (0.27 standard deviations) improvement in performance. Nevertheless, the difference from the control group is only statistically significant at the 10% level, and thus does not necessarily represent strong evidence of a treatment effect. In Proposition 2, I showed that the incentive induced by the Team Target treatment depends on the composition of the teams. The idea of the team incentives is that if the incentive is high enough, students will cooperate and help each other to improve their performance, especially the performance of the poor performing students. However, many factors could explain the lack of significant improvement with this treatment. The first factor is that just like in the Individual Target treatment, teams that judge the target to be out of reach may give up altogether. Second, the free riding problem may emerge within teams. Poorly performing students may choose to free ride on the performance of the higher performing students in equilibrium, resulting in no incentive effect (and vice versa in equilibrium with a positive incentive effect). The comparison between the Team Target and Team Tournament treatments will address these points.

**Team Tournament:** The greatest improvement was observed when teams of students compete for large prizes. The Team Tournament treatment has a positive and significant effect of 0.34 standard deviations. The average treatment effects are reported in Table 11.

Why did Team Tournament work better than the Team Target scheme? Many of the possible drawbacks of the Team Target treatment are mitigated

in the team competition case. First, since all the teams were formed randomly, there is no reason for a team to expect that most of the other teams will be substantially better. Therefore, each team may feel that they stand a chance to win one of the three prizes. Second, given that there is no set target, the calculation that leads to possible free riding is likely to be highly mitigated. Third, the average ex-post payoff for members of winning teams in the Team Tournament treatment is more than ten times higher than that of the other treatment groups. This may have a framing effect, such that the increase in individual effort is higher. Finally, the large literature on overconfidence leans in favor of the Tournament treatment. If most teams overestimate their average skill relative to the others, then they will overvalue the incentive payoff and work harder; due to their belief that there is a high chance to win the prize, they will actually prefer the tournament scheme[19].

### 1.7.4 Heterogeneity and the Theoretical Predictions

I plot the kernel distribution of the average test scores of each treatment group against the control group in Figures 8, 9, and 10. The double peak feature of all distributions is due to the BEPC grading policy in Benin that I mentioned earlier. Each of the three graphs suggests an improvement in the grades of the treated group. I conducted a Kolmogorov-Smirnov test of the equality of distribution of scores across groups, and the null hypothesis of equality could

[19] See (Hoff rage 2004) and (Lichtenstein et al. 1982) for a review on overconfidence.

be rejected with a p-value of 1% for the Individual Target treatment, 5% for the Team Target and 1% for the Team Tournament treatment. I now turn to the theoretical predictions to examine how the various treatments affect different subgroups of students. The treatment effect is heterogeneous in all treatment groups, as students at the intermediate level of performance (closer to the target) reacted more to the incentives.

**Individual Target:** To check for the presence of heterogeneity in the treatment effects, I run the quantile regression specified in equation 1.6.2 with $\tau_l = 0.15$ , $\tau_m = 0.5$ , and $\tau_h = 0.85$. The Individual Target treatment has a positive effect of 0.43 standard deviations on the $15^{th}$ quantile. The effect is significant at the 1% level. At the median or the $50^{th}$ quantile, the treatment effect is larger (0.67 standard deviations) and is significant at 5% level. Finally, at the $85^{th}$ quantile, the effect falls to 0.17 standard deviations and is not statistically significant. Figures 11, 12, and 13 further illustrate this result. It appears that the standard comparison of means may be misleading in this case. The average treatment effect is plotted on the same graph together with its 95% confidence interval. The ATE is outside the confidence interval around the median, indicating an underestimation of the effect in that region compared to others. This result is consistent with the theoretical predictions of Proposition 1. The significance of the effect on the $15^{th}$ percentile means either that the individual incentives can successfully incentivize poorly performing students or that the pool of poorly performing students is not large in the

population. In light of the distribution of the average and the fact that the Team Target treatment failed to incentivize the same subgroup of students, the former case appears to be more likely.

**Team Target:** Even though the ATE is not significant for the Team Target treatment, I found a significant effect of 0.66 standard deviations on the median and 0.28 standard deviations on the $85^{th}$ percentile. This suggests that a team incentive with a set target may not be effective in incentivizing poorly performing students within the team or for teams composed of poor performing students.

**Team Tournament:** The Team Tournament treatment has a positive and significant effect across the board. The effect on the $15^{th}$ quantile is 0.41 standard deviations and is significant at the 1% level. The effect on the median is also larger (0.67 standard deviations) and is significant at the 1% level. Team Tournament is the only treatment with a substantially large effect (0.38 standard deviations) at the higher tail of the distribution. The effect of 0.38 standard deviations on the $85^{th}$ quantile is significant at the 1% level. This finding is in line with the theoretical prediction.

### 1.7.5 Disaggregated Test Scores and Dynamics Within Teams

This section attempts to understand the mechanism through which the effect is produced. Do students in teams cooperate and help each other, or does each member simply work harder? On which subjects do the students focus their efforts? To answer these questions, I first looked at the reported study time in the follow-up data. The reported group study time is the highest in the Team Tournament group, whereas the average time that the students study alone is highest in the Team Target group. The Team Target treatment seems to induce higher personal effort within teams, but lower cooperation and mutual help than the Team Tournament scheme.

I investigate this finding further by looking at the distribution of the test score on higher-order thinking skill (HOTS) subjects and Rote Memory subjects. Mathematics and French" are reported by teachers to be among the hardest subjects that require higher-order skills to solve the problems, or to use critical thinking to analyze passages. The students in our sample scored an average of less than 5 out of 20 in Mathematics on the BEPC, and their second lowest scores were on French.

On the other hand, History, Geography and Biology require mostly memorization and are often deemed to be the easiest subjects. Panels C and D in Table 12 report the treatment effects on these two groups of subjects. The

results show that when incentivized individually, students work to improve HOTS. The first rows of panels C and D show a higher and statistically more significant improvement of HOTS. A similar pattern can be observed by comparing the middle rows of panels C and D. Policy makers sometimes attempt to put more emphasis on math and science and this might be ill perceived by teachers of other subjects. These results suggest that incentives could be tied to the overall performance and yet achieve greater effects on mathematics and science.

When incentivized individually, poorly performing students improved by 0.38 standard deviations in HOTS and by 0.30 standard deviations on the Rote Memory subjects. The Team Tournament treatment maintains a high improvement in HOTS (0.30 standard deviations) with double the improvement on the Rote Memory subjects. One possible interpretation is that within teams, lower-performing students may have received help from their peers on HOTS. This left them with more time to study the Rote Memory subjects. Even though students in the Team Tournament reported more group study time, it is also possible that other factors may be at play such as simple peer effects instead of direct help. It is beyond the scope of this paper to disentangle these two effects. If the incentives impacted poorly performing students more on HOTS, given that the incentive is not tied to a particular subject, then there are several plausible reasons that it did not impact the Rote Memory subjects much more. Either there was a lack of time to dedicate more effort

on such subjects, or the margin of improvement is small on such subjects. However, since the same category of students maintained the improvement in HOTS while doubling their improvement on Rote Memory subjects, the margin of improvement in Rote Memory subjects must be smaller. This observation also reinforces the observation that students focused first on HOTS in the Individual Treatment group.

### 1.7.6 Effect of Within Teams Heterogeneity

Controlling for the baseline average performance of a team, heterogeneity in the team is positively associated with the end-line performance. Figures 14 and 15 show a positive correlation between the variance in the performance within teams at the baseline (controlling for the average of the teams) and the final scores of team members. The results (Table 14) indicate that a one standard deviation increase in the dispersion of performance at baseline within a team is associated with an average improvement of the overall final score of the team members, with an effect of 13% (that is 2.59/20) in the Team Tournament group and 15% in the Team Target group.

### 1.7.7 Relative Cost of the Three Mechanisms

At the onset of the study, the estimated cost of each treatment was set to be equal. The Individual Target and the Team Target each cost $2000 and the

Team Tournament cost $1920. The cost of the Team Tournament should not vary in nominal terms because the top three teams win the same amounts each regardless of their performance. However, the cost of the other two treatments could change one way or the other depending on the students' performance. Table 15 shows those changes. The change in the cost of the Team Tournament is due to the appreciation of the local currency relative to the dollar between the start of the research and the time of the payment of incentives. The research is funded in U.S. dollars, but the incentives were given in the local currency so that the students would have a better sense of their real value. As shown in Table 15, the ex-post cost of the Individual Target was 54.50% greater than the estimated cost, and the cost of the Team Target was 43.50% lower than the estimated cost. First, note that given limited resources, with all else being equal, it is desirable to avoid uncertainty on the amount of the actual cost of programs like this one, and only the rank order tournament guarantees cost certainty. To have a better appreciation of the cost-benefit analysis, it is necessary to examine the average treatment effects relative to the costs. The quantile regressions gave a good sense of the heterogeneity of the treatment effect. However, it may be misleading to use them to conduct the cost-benefit analysis since changes in percentiles do not necessarily reflect the magnitude of the changes in the students test scores

Even though the Team Target turned out to be cheaper, ex-post, than the other treatments, its treatment effect is not significant at the traditional

accepted level of 5%. In addition, the lower ex-post cost may be due to the relative difficulty of achieving the target compared to the ex-ante perception. Therefore, over time, as students learn about the difficulty in achieving the target, the effect may drop. The Individual Target is appropriate if the goal is to promote excellence by targeting high performers (with a harder target to achieve) or intermediate performers (with an appropriate target). However, the goal of educational interventions is usually to improve the performance of students who perform poorly and are at a higher risk of dropping out. The results of quantile regressions suggest that the Team Tournament is effective at incentivizing students at all levels of performance. In addition, this treatment has the highest average treatment effect (0.35 standard deviations) and a perfectly predictable cost ex-ante. In light of all these considerations, the Team Tournament is the most cost-effective mechanism among the three.

### 1.7.8 Gaming and Intrinsic Valuation of School

Two main concerns regarding policies to induce higher education performance are the "Gaming" concern and the loss of intrinsic motivation. The first concern, "Gaming", refers to the situation wherein students focus on knowledge that is relevant to win prizes and thus neglect other important aspects of learning. The same incentive exists for teachers who focus more on teaching skills that are relevant to passing tests. Critics of the No Child Left Behind

policy in the U.S. have often pointed to this phenomenon as one of its key shortcomings. However, there are many reasons not to be concerned about this issue in this particular case.

First, I do not administer a standardized test. Instead, the incentives are based on a national certification test that students must take anyway. The national test is unknown to the students and their teachers prior to the actual date and time of the test. In addition, the content of the test in a given year does not predict the content in the following year. Therefore, the possibility of gaming is nonexistent. One way to check for this is to examine performance indicators that are not related to the incentive. At the follow-up level, we recorded participants' average scores at the mid-year examination. Students from the Individual Target and Team Target groups performed better than the control groups, and students from the Team Tournament scheme performed slightly worse. The quantile regression showed no effect for the lower and higher quantiles, but an effect of 0.30 standard deviations around the $60^{th}$ quantile[20].

The second concern is illustrated in a theoretical work by Benabou and Tirol (2006) in which rewards such as those in this experiment may create doubt about the true motives for which students perform. This could be

[20]This may be good enough as evidence for the presence of the incentive, but the mid-year tests are school-specific and are not necessarily comparable across schools. There is no reason, however, to believe that tests were easier in the control schools or vice versa. Another shortcoming of this statistic is that it is on a subsample of the participants, as I previously mentioned in the data section.

counterproductive, especially if the rewards are removed later. This concern is limited in cases such as this research because the incentive is presented more as an encouragement for good work. Students often receive such incentives, even from their parents. In fact, at the follow-up data collection level, over 55% of students in each of the treatment groups reported having received other forms of incentives and promises based on better performance [21]. Moreover, Kremer et al. (2007) found a persistent effect of such incentives in Kenya many years after the incentives were removed.

### 1.7.9 Self Selection

If the students or parents anticipated this study and desired to win the prize, high-performing students could have registered in the treatment schools prior to the study. If that happened, our results would be biased upward. However, self-selection into the treatment schools based on this study is extremely unlikely for two reasons: 1) The schools were selected after the start of the school year. The selection remained undisclosed until the day of implementation. Any transfer into a treatment school after treatment would not qualify the transferring students to participate. 2) The scope of this study is limited to only 16 students in each school and the size of the incentives, except for the competition prize, is relatively small.

[21] The proportion of students who reported having received other incentives is balanced across treatment groups

### 1.7.10 General Equilibrium Effect and Policy Recommendation

If this experiment were scaled up and implemented in all schools, many additional factors could come into play that may not have been present at the level of this research. For example, if the stakes increase, the effort from teachers or graders to manipulate the measure(s) of performance may increase. If the prizes are high and made public, parents may cut back on their own incentives that they provide to students. Parents or teachers may also put excessive pressure on students to win, which in some circumstances could become counterproductive. Many other factors may come into play at the larger scale. It is beyond the scope of this paper to provide answers to these challenges. However, I believe that a carefully planned mechanism that mimics the key features of this paper, would lead to similar results, and perhaps to a greater effect.

In light of the analysis conducted in this paper, I believe that a policy toward setting Team Tournament incentive schemes would be an effective way of incentivizing students to perform better. I propose here a concrete and practical way of implementing such a program at a larger scale, called the Best Team Accomplishment Award (BT2A). The BT2A can be implemented at each certification examination level. The first step is to design many large prizes (let us say $N > 1$ prizes of $\$P$ each) to be awarded to the top-performing

schools or classes. The fact that there are multiple prizes allows for neighboring schools to cooperate rather than to see each other as competitors. The multiple prizes can also be used to stratify the tournament by performance[22], gender, or regions, depending on the desired goals. Since the schools differ in size, it is not obvious how to determine what constitutes the "best performance" of a school. Neither the number of students who pass the examination or the rate of success will be a good measure because of differences in enrollment. If the performance were based on the higher tail of the distribution of grades, then it would be detrimental to students in the lower tail. If it were based on improvement, then it would be detrimental to the higher tail, since the margin of potential improvement is higher for more poorly performing students. Moreover, neither scenario resolves the challenge posed by differences in school size.

One way to overcome these challenges could be as follows: During the week before the certification test, the implementers of the BT2A randomly draw $l$ students from each school and seal the results. The implementers of the BT2A announce the draws at the same time as the results. The scores of the selected students are averaged in each school, and the resulting score is ranked. Selection of the students before the test would help prevent manipulation of the selection. After grading, the top $N$ schools with the best scores each win one of the $N$ prizes. Part of the prize could be shared among the students and

[22]Extra care is needed to prevent the gaming problem discussed earlier. The stratification should be done ex-post, and not based on a baseline performance.

another part could be shared among the teachers.

### 1.7.11 The Political Economy of Low Retention Rates

This section argues that low retention rates may be an optimal strategy for governments to overcome both political and resource constraints. If that is true, then caution should be used when taking the outcomes of government-designed tests as measures of performance and learning.

Governments in developing countries often have large resource constraints and many problems to address at the same time. The tradeoffs and the decision regarding which issue to tackle first (among, e.g., education, health, or security) are difficult decisions and the political implications of those decisions have an important role in the process. Many countries might not be able to afford to provide or subsidize a quality education to all of their citizens. Should they provide a quality education to some citizens, or alternatively, should they reduce the quality in order to be able to afford to provide education to a larger group, for example by increasing class size or hiring unqualified teachers?

With the Millennium Development Goal of universal primary education by 2015 (MOG 2) supported by the Fast Track Initiative (FTI), primary enrollment has increased considerably in recent years. In most Sub-Saharan African countries, education is highly subsidized. Even higher education is nearly free in many countries. Universities are functioning beyond full capacity. Reforms

that aim to increase tuition have been very unpopular and prone to riots in many cases. However, with the increase in primary enrollment, if the retention rates are high then either the reform must take place to increase tuition for secondary and higher education or else the government's budget for education would explode over time.

In the face of these political and resource constraints, one possible solution for governments would be to ration education through lower retention rates. The strategy would be to accept and implement universal education at the primary level or up to the level where it is affordable. This is partly paid for by international organizations and is politically popular. Then, in secondary or higher education, the standards for retention can be tightened, for example through difficult exams. Under these conditions, the best students are still on average more likely to advance, retention rates decrease, and enrollment in secondary and higher education drop to levels that can be supported. This political economy aspect remains a theoretical conjecture at this point, and it will be interesting to study it further.

## 1.8 Conclusion

This paper combines theoretical analysis and a field experiment in Benin (West Africa) to evaluate the impact of direct monetary incentives on student performance. It introduces the use of team incentives and compares the outcome of

such incentives to individual incentives. Individual target-based incentives are most effective for students at intermediate performance levels. At the lower tail of the performance distribution, students find the target out of reach, reducing the average effect. At the higher tail, students win the prizes without any need for extra effort, thus reducing the average impact of such incentives. Team incentives are intended to address this issue for the lower tail of the performance distribution based on the intuition that a joint incentive to win a prize creates an environment where high performers help the poor performers within the teams. In addition to the direct incentive to help, team incentives may also create an environment for peer effects to appear within teams of students who otherwise would have interacted less. Evidence from the field experiment shows that team tournaments are the most effective mechanism to enhance performance. The results of this paper suggest that there a substantial margin of improvement can be achieved in students' performance by motivating them to learn. The lack of resources is often singled out as the main cause of poor performance in developing countries. However, the main finding of this study is that as students become more interested in their educational achievements, learning and performance will rise. Even though this study has used direct monetary incentives, it is possible that other non-monetary incentives could work as well, as long as the students care about the reward.

# Chapter 2

# School-based Management and Primary Education Achievement in Benin (With Leonard Wantchekon)

Over the past few decades, most of the developing countries, in particular the Sub-Saharan African countries, have substantially increased their public spending in education. Even though enrollment rate continues to be lower than the developed countries, there has been a large increase over this time span, including the enrollment of the girls. However, the educational systems still face many challenges, especially regarding the staffing and the management

of the increasingly large public schools. As a result, effective learning and completion remain relatively poor.

Most of the interventions to address these issues of poor learning and low completion have long been limited to the questions of additional resources and improving the infrastructure. It is indeed likely that, everything else being equal, more books, more teachers, and well equipped classrooms may have a positive impact on educational achievements, especially for schools and students who lack those items. However, the challenges are far more complexes and resources have had limited impact and mixed impact on learning and completion. One of the important reasons why even additional resources may have limited effect lies in the lack of accountability at various level of management, including at the local level. This lack of accountability is often partly due to the lack of the local communities' involvement in the schools affaires.

For instance, Reinikka and Svensson(2004) found that only about 13% of the government expenditure on school grants reached the schools in the mid-90's in Ugandan, and that most schools actually received nothing. In order to curb this problem, the government has engaged in an aggressive newspaper campaign to inform the local communities and the schools periodically about the grants. In a follow up research, Reinikka and Svensson found that the information campaign had successfully cut the local capture from 80 percent to about 20%.

Although education expenditures represented 20% of the country's public

expenditure, it may fail to have the desired impact under this educational system because the resources are not even reaching the schools in the first place. Therefore, studying the underlying institutions that support the schools is as important as the availability of the resources. Important steps must be taken toward this end and more research should focus on understanding the basic institutions that support educational structure in the poor countries. The present paper aims to contribute to this end.

A recent and growing body of research, led by the donors community of the World Bank explores the merit of putting more responsibilities of the management of schools in the hands of the local communities. The communities may be more knowledgeable of the problems facing them and may be in a better position to circumvent those problems if they are given the power and the resources. The institutional structure of the educational system, both at the national and local levels, may play an important role in addressing these challenges. That is why it is important to understand, evaluate, and improve the underlying educational institutions in place.

In this paper, we proxy the level of decentralization in the context of school management and parent-community involvement by a composite measure of the quality of the PTA and school based management. Then, we assess its causal impact on several indicators of the schools and students performance in a literacy and numeracy testing. We use the instrumental variable approach to determine the causal relationship.

The central idea of this paper is illustrated in Table 18 on page 135 where two set of schools have similar characteristics but, except for the measures of quality of the PTAs, have a quite different level of performance by three different measures. The main findings of this paper suggest that well structured and well functioning PTAs have a large and statistically significant impact on the schools and students performance. This result is obtained after controlling for key contributing factors to the students performance and using an instrumental variable for the PTA.

A recent reform in Benin has granted more power to the local communities, through the PTAs, in the management of schools. It is of importance to study the implications of such policy. Does the decentralization of school management to local community have a direct effect on learning and performance of students? This study will help shed lights on the comparative advantages of decentralization of school management versus a centralized system. The overall impact of decentralization is ambiguous and context specific. On the positive side, decentralization permits the use of localized information in the delivery process. The local authorities know better the difficulties of their communities and are more accountable to them. On the negative side, it is commonly presumed that decentralization creates favorable opportunity for local capture by reinforcing the power of local interests groups. This concern of capture is exacerbated in heterogeneous environment such as in most African countries. Bardhan and Mookherjee (2002) analyzed these key trade-offs throughout in a

theoretical framework and the predictions call for empirical evidences to test the competing theories.

The importance of parental and community involvement in the schools' functioning has long been pointed out by sociologists. In his seminal paper on human capital, Coleman(88) recognized the influence of parental involvement and the community surrounding the school on the students achievements and dropout rate. This is one advantage that rural schools in the US have over their urban counterpart as argued in Bauch (2001) . However, in the context of developing countries where most rural parents have very little formal schooling, these relationships with the school remain to be built or strengthen. In the debate about the restructuring of the schools in the US, a great emphasis has been made on the parent participation Bauch and Goldring(1998) is a great and extensive review about this topic. However, very little rigorous empirical work has been conducted to support the arguments put forth. The goal of this paper is to contribute to that body of literature and further our understanding of the importance of local participation in the schools and students performance.

## 2.1 The Background and the Context

The primary education in Benin is under the administration of the Ministry of Primary and Secondary Education. The primary education lasts six years

and education is compulsory between the age of 6 and 11. There is a national exam at the end of the sixth year, which determines the admission to the secondary education. The system is uniform in the country and across sectors (public and private); the primary education is mainly a public sector with a ratio of about 10 public schools for one private school. Education is compulsory for children, although the law is not enforced. Primary education has been progressively made free starting in 1996 as part of one of the government aggressive policy toward improving the enrollment and the primary education in general. Enrollment has been steadily increasing for the past two decades. In 2000, the gross enrollment rate was 77.5% overall and more recent data show a primary gross enrollment rate of 98.85% in 2004 [1]. While higher enrollment is being achieved, the education system still suffers many difficulties. The student-teacher ratio has increased considerably from 36:1 in 1990 to 51:1 in 2007. Among other challenges, the primary education completion rate was only 48.83% in 2004. A test conducted in 2004 reveals that only 10% of students in early grades attained basic literacy in French. The gender gape has narrowed but remains important. There is a high teacher-student ratio (up to 70 in the Couffo province) and weak teacher training after teacher colleges were closed in 1991. The government mandated the Ministry of Primary and Secondary Education (MEPS) to implement a School-Based Management

[1] UNESCI Institute for Statistics (2007)

(SBM) program in 2006. The main targets of this decision was to (1) increase decision-making power of School councils and newly elected municipal councils, (2) increase parent participation and (3) transparent financial management. But the Benin SBM program was based on expert survey. There is a chronic lack of basic data on PTA, learning and rigorous prospective impact evaluation. This paper uses data on school management, PTAs, test scores in Mathematics and Reading, and classrooms observations to assess the impact of the quality of PTAs on students' learning and academic progress. Most of the schools in Benin, especially in the rural areas, are relatively under-equipped. The summary statistics from our representative sample of schools (Table 20 on page 137) indicates that only 4% of the schools have a library or a book storage on site, 43% of the schools provide clean water at school and, the schools have on average 5.17 classrooms, and the student-teacher ration is about 51. The head teachers (82% males) have an average of 21.28 years of experience in the profession. The overall school environment is relatively poor but notable improvements have been made over the recent years.

## 2.2 The data

Three data sets are combined for this study: The first data set comes from a comprehensive survey in over 600 schools across all the regions in Benin. The

National Institute for Statistics and Applied Economics of Benin and the research department of the Institute for Empirical Research in Political economy conducted the survey in 2005. In each of the 12 departments, 3 towns or villages were randomly selected. In each village or town, 17 schools are randomly selected for the survey. Table 16 (page 133)contains the localities that were selected for the survey. A wide range of information was collected about the schools characteristics, their functioning and past performance, community participation, etc.

The second data set is a literacy test given to about 10 3rd grade students who were randomly selected from 108 schools. These schools were among the initial 600 schools selected for the survey. The test was conducted in December 2007 and consisted of basic literacy questions such as letter recognition, word identification, pronunciation, etc.

The third data set was collected along with the literacy test. It is a comprehensive interview with the schools head teacher, the PTA committee members, and a few randomly selected households (3 to 5) in the community where the school is located. The combined data set is made of 1016 students, 108 schools, and 324 households.

## 2.3 Empirical Framework

We use principal component analysis to create a composite indicator for the PTA and SBM at the school level. We then use a linear instrumental variable model to assess the impact of the PTA score on the performance of the school at a national exam and the performance of the students in the literacy and numeracy test given in the process of the data collection.

Let $Y_{ij}$ be the score or the performance of student $i$ in school $j$,

$$\begin{aligned} Y_{ij} &= \beta_0 + \beta_1 PTA_i + \beta_2 X_i + \beta_3 X_{ij} \qquad (2.3.1) \\ E(PTA \times \varepsilon) &\neq 0 \text{ and } E(X \times \varepsilon) = 0 \end{aligned}$$

where

$$\begin{aligned} PTA_i &= \gamma_0 + \gamma_1 Z_i + \gamma_2 X_i + \gamma_3 X_{ij} + \nu_i \qquad (2.3.2) \\ E(Z \times \nu) &= 0 \text{ and } E(X \times \nu) = 0 \end{aligned}$$

Where $PTA_i$ is the quality of the PTA in school $i$, $X_i$ is a set of school specific variables that explain the variation in the school performance such as

the student-teacher ratio, the size of the school, the disposable resources to the school. $X_{ij}$ is set of student specific characteristics that have an impact on performance such as parents' literacy. The measure of the quality of the PTAs is a composite score measuring the PTA in school $i$ obtained through principal components analysis

$$PTA_i = \alpha_1 S_i + \alpha_2 HH_i + \alpha_3 P_i \tag{3}$$

Where $S_i$, $HH_i$, $P_i$ are a set of variables on the PTA obtained respectively through the school (Head teacher), the households living in the community, and the PTA committee members.

Even though the decentralization policy was exogenously given by the central government, it is unlikely that the quality of the PTAs is exogenous in equation (1). Therefore, $E(PTA \times \varepsilon) \neq 0$ and the estimates from that equation will be inconsistent and biased. To deal with this issue, we use the instrumental variable approach, which consist of variable $Z$ that is correlated with the quality of the PTA but that does not belong to the right hand side of equation (1). The first stage of the estimation consists of predicting the quality of the PTA with the instrumental variables in equation (2), which is then used in equation (1).

### 2.3.1 Independent Variable of Interest: PTA score

The PTA score is a composite variable capturing the functioning of the PTA. It is based on 16 variables from the interview with the households from the community where the school is located, the head teachers of the schools, and the PTA committee members. We use those 16 different variables to measure our variable of interest. We used principal component analysis to construct an overall measure of PTA. Most of the variables are objectives measures such as the number of meetings or whether the PTA has a bank account but we also use a few subjective measures such as whether the PTA committee functions well. Table 21 on page 138 contains the results of the principal component analysis along with the list of the 16 variables. The first two principal factors will be used for the rest of the analysis. The factor loadings indicate that the first factor (*PTA score 1*) captures the household membership and household participation with correlation of 0.87 and 0.66 respectively. The second factor (*PTA score 1*) captures the characteristics of the PTA such as record keeping (written status (0.61), archives keeping (0.62), ), number of members in the committee (0.37), election of the committee (0.29), and to some extend whether the PTA has a bank account or not (0.12). Both the two measures are expected to be overall positively correlated with better functioning PTA. A higher PTA score means a better PTA.

### 2.3.2 The dependent variable

We use three different measures of performance for the estimations. First, we use the percentage of success in the 2004's CEP in each school as a measure of performance of the schools. This measure has the advantage of being standard across schools in the whole country. It is a national exam that grants successful student with a diploma to pursue secondary education. Students take the same exam in every school in the country, in all fields, at the same time. However, this measure of performance does not account for the size of the school. That is, a school that realized 25 successes out of 50 is treated the same as a school that realizes 250 out of 500. To address this issue, we control for the size of the school by including a variable that tells the number of classrooms available in each school. Another limitation with this particular dependent variable is the lack of information at the student level.

The second dependent is the reported rate of success for the students from first grade to fifth grade on the last examination of each school. The challenge with this measure is mainly the difficulty to compare the rate of success across schools. It can also be thought that the test could have been calibrated in order to exhibit the desired results that the school wishes to achieve. However this concern is mitigated by the fact that the study was announced after the examinations.

The third dependent variable is designed to circumvent the challenges mentioned about the first two measures. A standardized literacy test is given to 10 randomly selected 3rd grade students in each participant school. The average score of each student is used as the measure of performance of that student and the average score of the students from the same school is the performance of that school.

## 2.4 Results and discussions

We find that both *PTA score 1* and *PTA score 2* are statistically significant at the 1% level in explaining the variation in the students test scores. The estimated coefficients (Tables 24 and 25 on pages 141 and 142) are respectively 20.55 and 26.17, suggesting that an improvement of parental participation in the PTA has a potentially large impact on students performance in term of the standardized test that was designed and given. The first stage regression has the correct expected positive sign of the instrument and the t-statistics of the instrument's coefficient are respectively 4.18 and 2.96 in the two models.

A few other important variables have a strong association with better test score, however the causal relationships remains to be establish. The children who attended kindergarten before the primary school have performed better in each of the five subcomponents of the test compared to their counterparts who did not attend kindergarten (Table 26, page 143 or Figure 18). This results

support the idea that early childhood investment has a long lasting positive impact on the child socioeconomic outcomes.

We found similar results for the children who have at least one literate parent (Figure 19 and 20), the children who have electricity at home, and the children who have at least one book at home (Tables 26, 27, and 28; pages 143, 144, and 145). However, even though the gender gap is an important issue in sub-Saharan Africa, we found no evidence of a substantial gender gap. It is very small and significant at the 5% level in only one subcomponent of the test. The latter result is consistent with the aggressive government effort in collaboration with the UNESCO in recent years towards the education of the girls.

In light of these results, it appears that small changes in parental involvement at the school level can make a big difference in the child's achievement. Carbonaro(1998) found similar results in an attempt to test Coleman's social capital theory. He found lower propensity for drop out for those students whose parents knew more of the peers' parents. However, his results were inconclusive in term of test scores as only the math test score turnout significant whereas the other subjects were not. In a very recent paper, Wooley et al. (2009) found that parental implication and monitoring is positively related to the middle school Latino student in the USA.

### 2.4.1 Robustness

In order to ensure that our findings are not driven by the specificity of the standardized test given, we have conducted similar analysis on two different additional measures of the students performances. First, we used the results of the last examination at the school level in (tables 7 and 8, pages 139 and 140). The findings remain statistically significant and have the same order of magnitude. *PTA score 1* and *PTA score 2* are both statistically significant at the 1% level and the coefficient estimates are respectively 19.53 and 21.56. First stage t-Statistics of the instrument's coefficient is respectively 4.36 and 3.51, a significance at the 1% level.

Since the school specific test is not readily comparable across schools, we have used, as a second measure, the results of the CEP 2004, which is a national end of year standard exam that determines progress to secondary education. The results are still maintained and statistically significant at the 1% level. The coefficient estimates on *PTA score 1* and *PTA score 2* are respectively 15.58 and 17.36. The instrument remains significant at the 1% level with t-statistics of respectively 3.77 and 3.05.

### 2.4.2 Endogeneity

As mentioned before, the formation and functioning of PTA is most likely to be endogenous. In general, PTAs and more involved parental participation

will kick-start when schools face major challenges including poor performance of its students. In this circumstance, a simple OLS regression will biased the coefficient on the PTA downward. In fact, the effect of PTAs maybe reversed to a negative association between PTAs and students or schools' performance.

To deal with this challenge, we use the time that the interviewed households, who have children in the school, have stayed in the community as an instrumental variable for the PTA formation and functioning. This is a valid instrument in the sense that staying longer in the same community is not inherently associated with the performance of the children at school. However, the longer the households stay in the same community, the higher the level of interaction they have among each other. These interactions strengthen the social capital and create the environment for the households to join their forces around their common challenges and that of the community at large such as the education of the children.

To test for the strength of this instrumental variable, we used the more robust methodology developed by Stock and Yogo (2005) as the Staiger-Stock's rule of thumb, which require a first stage F-statistics of 10 or more, is not appropriate in some cases. At the 5% significance level, the Yogo and Stock test indicate that the instrument carries only 5% of the OLS bias in the instrumental variable regression using the first factor and 20% in the instrumental variable regression using the second factor.

## 2.5 Concluding remarks

Using comprehensive surveys and test scores data from Benin's primary schools, we find that the existence and effectiveness of the PTAs has a positive and substantially large direct effect on the performance of the students. This result suggests that an effort that aims at getting PTAs more involved in schools' functioning will be rewarding. We have also found that kindergarten attendance; parent literacy and socioeconomic status are all positively correlated with students' performance. This suggest that one can expect an improvement in future generations, as the current generation satisfies more those conditions than the ones after the independence wave of the 60s. We found no substantial gender gap in the test scores. Whereas these evidences appear indisputable, the real mechanism through which it is achieved remains to be explored. It is not obvious that if one setup exogenously well structured new PTAs, the same results will follow. The local initiative in setting up their own PTAs may hold part of the key to their success. As a result, it might be more desirable to create conditions for the PTAs to emerge and strengthen gradually rather than mandating their creation.

# Chapter 3

# Trust and Moral Hazard: An Empirical Investigation from the Motor-taxi Drivers in Togo and Benin

In the motorcycle taxi market in Sub-Saharan Africa, the relation between the owners and the drivers is characterized by a principal agent problem with the following features: (i) the principal cannot observe the final output of the agent and therefore cannot condition his wage on it. (ii) The high effort from the agent depreciates the asset. These two features (i) and (ii) imply that the principal ideally wants the agent to exert as little effort as possible, while

still leasing the asset from him. The problem with low effort implementation is that the asset will not generate enough revenue. I analysis the contractual arrangements between the owners and the drivers in this market and use a survey data to address the determinant of the contracts and their implications. I show that trust between the principal and the agent can lead to the choice of a socially sub-optimal contract because of moral hazard problems.

In the standard moral hazard problem, it is often assumed that the output is observed and thus the compensation scheme relies directly on the observed output or an observable that correlate with the output . However, in many marketplace contracts in developing countries, this mechanism is not applicable. In particular, in the market of motorcycle taxi in Sub-Saharan countries, both the output and the effort are not observed. Yet, two type of contract coexist, one is a lease with a promise of transfer of ownership and the other being a simple lease arrangment. The *Lease with Ownership (LO henceforth)* basically consist of reselling the motorcycle to the rider at a price on average twice[1] its original value. They then agree on a weekly [2] minimum payment. The rider becomes the owner only when she finishes paying the entire amount initially agreed upon. With the *Simple Lease (L henceforth)* a daily fixed amount is agreed upon and the rider has to pay that amount everyday whether he makes more or less than that amount .

[1] The lack of alternative capital market account for the existence of such high interest rate.

[2] The gent could still pay daily if he would like to.

The difference between these two contracts is the central issue of ownership and the implications it has on both parties in the contract. The question of asset ownership in the economy is an important issue in industrial organization. Grossman and hart (1986) defined ownership as the monopole over residuals right that are not specified in a contract and argued that the distribution of those rights have efficiencies implications on the firm. Inefficiencies stem from the impact that ownership has on the incentives of the contracting parties. For instance, in the principal agent model context, a partial or total transfer of ownership to the agent solves partly the moral hazard problem. Conversely, in the environment where there is a lower moral hazard problem, one should observe more ownership to the principal. This is exactly one of the result by Baker and Hubbard (2003) regarding asset ownership in a trucking company. Among other things, they found that the adoption of a new class of on-board computer have significantly changed the patterns in theownership of the trucks.

In this work I derive the theoretical implications of this particular setting and then we find that the two contract are not equivalent in term of the induced incentives and the output. Therefore we ask the following question: What determined the choice of one contract or the other? What are the outcomes of one contract compares to the other? These are the main questions I seek to answer empirically in the context of motorcycle taxi activity widely present in Sub-Saharan Africa.

I conjecture that trust play a key role in the choice of the contract and

conduct an empirical investigation. The conjecture is supported by the observations in Table 29[3] which suggest that there could be an implicit element of trust between the contracting parties that plays an important role in the choice of one contract or the other.

It is important at this point to define what I mean by trust. To say that agent $A$ *trusts* agent $B$ is to say that $A$ *confidently believes* that $B$ will behave "appropriately" or that $B$ will not cheat. Therefore, if founded and reciprocal, trust makes cooperation more likely between two people. For instance, trust will allow longer cooperation in a repeated prisoner dilemma or in settings where the agents interact repeatedly. This view of trust stresses the fact that the belief on the trusted is rational. As mentioned by Hardin(2004) in his view of trust as encapsulated interests relation, *"I trust you because I believe it will be of your interest to be trustworthy"*. However, trust does not necessary have to involve a repeated interaction nor does it need to be founded. Experimental economists suggest that even in a situation of a one shot interaction, agents may cooperate as a result of believing that others will behave in a certain decent or fair manner (Camerer and Thaler, 1995). We do not adopt a rational view of trust nor see trust as encapsulated interest, rather, here we see trust as merely taking a risk due to the inability or impossibility to prevent the trusted from taking an inappropriate action. For Diego Gambetta (1988, 218-19) *"For*

[3] We will get back to this point in the data description section. Previous research have shown these variable to be highly predictive of trust and trustworthiness.

*trust to be relevant, there must be a possibility of exit, betrayal, defection"* . Therefore, trust involves situations where agents give up or are expected to choose to give up some opportunistic options.

## 3.1 The Context

The motorcycle taxi (informally known as "Zemindjans[4]" or "Zems" for short) activity started in Benin in the early 90's and kept growing ever since to constitute today an important economic sector, not only in Benin, but also in Togo, and many other African countries. The main reasons this system of transportation has been adopted and popularized, are that it was much cheaper than the existing traditional taxi fares. It also was, in most cases, more convenient, in the sense that it takes people to their front door while traditional taxis usually move from one station to another, and drop people on the roadside upon request. Finally, it is faster during rush hours since it allows to take shortcuts where a traditional taxi couldn't pass, it can move forward by dodging in and out of cars on the street when circulation is congested. This market is similar to the NYC taxi cabs[5] market. However, a notable difference is that it remains an informal market. There is no meter to record the earnings, many motorcycles are not ensured, there is no regulation for the

[4]Zemidjan stands for "Take me there fast" in the Fon Language, a language widely spoken in southern Benin.

[5] See Henry S. Farbar (2004), Ricardo Lagos (2003) for more details on the NYC taxi cabs market.

entries and exits, and most contract are not signed with the formal authority.

Albeit informal, this activity has become a large part of the economy in many countries. In Togo, as of 2009, there is an estimated 160,000 Zems in Togo[6] (Much more in Benin). Based on the reported daily revenue, this market account for nearly $0.4 billion worth of services yearly in Togo, which is a significant contribution to the economy.

By the time this study is being done, a typical motorcycle costs about $750, and riders have reported to make on average more than $10 a day (Owner's payment included). with fares starting at 20 cents and increase with the distance. The prices of new motorcycles have been decreasing over the years. The motorcycles are operated by young men on average in their late twenties. Many of them have another qualification in diverse sectors as construction, accounting etc. When asked why they are not working in their primary sector of choice, the typical answer translate literally as "There are no jobs" in their primary profession.

This sector has given rise to moral hazard problems. Those who own the motorcycles usually are not the riders themselves. However, the riders enter in a bilateral contract with the owners. Therefore, as in the case of workers in a firm, moral hazard problems emerge. The reason is that, there is practically no way the owner can observe or precisely predict the behavior of the agent. In general, In a standard moral hazard problem, the principal observes the

[6]Based estimates obtained from the Zems' Union in Togo.

output and base the compensation on it. Here, the principal cannot observe the output.

## 3.2 A Theoretical Framework

A principal invests $K > 0$ at time buy a business (or an asset) and hires an agent to operate the business for two periods. Since the owners are often much less credit constraint, it is reasonable to assume that the principal is risk neutral. The principal cannot observe the effort of the agent. In addition, contrary to the standard moral hazard problem, the principal cannot observe the output and therefore cannot condition his payment on it. However, it is known that higher effort increases the current output but it accelerates the deterioration of the capital.

The agent derives utility from consumption, $c$, and disutility from effort supplied, $e$, according to:

$$u(c, e) \tag{3.2.1}$$

Let $e_h$ be the high effort, $e_l$ the low effort, $R_h$ the higher revenue, and $R_l$ the lower revenue. If the agent supplies the high effort, she earns the higher revenue with a probability $p_h > \frac{1}{2}$, and thus she earns the lower revenue with a probability of $1 - p_h$. If the agent supplies effort $e_h$, there is a probability $\mu(e_h) > \frac{1}{2}$ that the asset will vanish in that period (and $\mu(e_l) = 1 - \mu(e_h)$).

The agent has a per period outside value of $\underline{u}$. The agent is credit constraint and cannot borrow or transfer consumption between the two periods. In all that follows, I make the following working assumptions: *(i)* $R_h > R_l$, $e_h > e_l$, and $p_h > \frac{1}{2}$ The first two inequalities are self-evident. The third suggest there is higher probability to get higher revenue under higher effort that it is under lower effort. *(ii)* $u_1 > 0$, $u_2 > 0$, $u_{22} < 0$, $u_{12} > 0$ *(iii)* $\mu(e_h) > \mu(e_l)$ and $\mu(.)$ convex.

Under this setup, the agent has a full discretion about the revenue earned and he has the incentives not to disclose the revenue truthfully. Therefore, the contract between the principal and the agent must have a form of lease. Let $r_1$and $r_2$ be the rental price paid to the principal in the first period and in the second period respectively.

**Lemma 1** *It is not optimal for the agent to choose the pair of efforts* $(e_h, e_l)$ *or* $(e_h, e_l)$ *for the two period.*

**Proof.** Under $C_1$: Starting in the second period, the agent compare $c(e_h) - c(e_l)$ and the extra gain from high effort over low effort. The resulting optimal choice is also the optimal choice in the first period because the agent faces an identical problem. Under $C_2$: Now the agent takes into account the deterioration of the asset that she will own at the end of the contract. The same argument as under $C_1$ holds. ■

From Lemma 1, the strategy set of the agent is reduced by removing the dominated strategies and the resulting normal form of the game between the agent and the principal is represented in the Table below:

| | $L$ | $LO$ |
|---|---|---|
| $(L,\ e_h)$ | $u(c_{L,1}(e_h), e_h) + u(c_{L,2}(e_h), e_h);\ r_1 + (1-\mu(e_h))(r_2 + (1-\mu(e_h))K)$ | $(0;0)$ |
| $(L,\ e_l)$ | $u(c_{L,1}(e_l),\ e_l) + u(c_{L,2}(e_l),\ e_l);\ r_1 + (1-\mu(e_l))(r_2 + (1-\mu(e_l))K)$ | $(0;0)$ |
| $(LO,\ e_h)$ | $(0;0)$ | $u(c_{LO,1}(e_h), e_h) + (1-\mu(e_h))u(c_{LO,2}(e_h), e_h) + \mu(e_h)\underline{u};\quad r_1 + r_2$ |
| $(LO,\ e_l)$ | $(0;0)$ | $u(c_{LO,1}(e_l), e_l) + \mu(e_h)u(c_{LO,2}(e_l), e_l) + (1-\mu(e_h))\underline{u};\quad r_1 + r_2$ |

**Table 3.1.** Normal form of the game between the agent and the principal

where $c_{L,t}(e_j)$=$p_j(R_j - r_t) + (1-p_j)(R_{-j} - r_t)$, $c_{LO,1}(e_j) = p_j(R_j - r_1) + (1-p_j)(R_{-j} - r_1)$, $c_{LO,2}(e_j) = p_j(R_j - r_2) + (1-p_j) \times (R_{-j} - r_2) + (1-\mu(e_j))K$.

We assume that, ceteris paribus, the higher the effort, the higher the revenue (and thus the higher the utility of the agent). However, the return to in term of utility satisfies the condition of diminishing return. Let $u(c_{it}(e_j), e_j)$ be the utility from the expected consumption ($c_{it}$) of the agent under contract $i = L, LO$ in period $t = 1, 2$, if the agent supplies effort $e_j$ where $j = h, l$. This assumption corresponds to $c'(e)u_1(c, e) + u_2(c, e)$ is decreasing. Intuitively, as the effort increases, the agent gains less and less from the additional effort. The depreciation of the asset due to higher effort will eventually outweigh

the gain. Now, it is easy to see that if the residual rights are in the hands of the agent ($L$), then the optimal effort is when these two opposing forces neutralize each other. However, if the owner keeps the residual rights ($LO$), then the agent will find it optimal to choose higher effort even though the loss incurred by the principal outweighs the gain for the agent. The problem with $L$ for the principal is that the agent does not internalize the loss of the asset's depreciation.

**Proposition 4** *Let $\pi$ be the total expected revenue of the principal. In the optimal contract, $r_1$ and $r_2$ are unspecified ex-ante and $\pi = r_1 + r_2$.*

This proposition is a direct result from two simple factors combined: First, given that the principal is risk neutral, the average gain is what matters to him and the variation in the payments from one period to the next does not. However, the agent is risk averse and strictly prefers the flexibility in the payment for consumption smoothing motive.

Let $n$ be such that $r_2 = \frac{K}{n}$, that about the number of periods required for the principal to recover the initial investment. We have the following result:

**Proposition 5** *If $\mu(e_h)$ is sufficiently high, and specifically if $\mu(e_h) > \frac{1}{2n}(2n+1-\sqrt{4n+1})$, then the principal strictly prefers $LO$.*

**Proof.** Let $\Gamma_A(S)$ and $\Gamma_P(S)$ represent respectively the payoff of the agent under the strategy profile $S$ (respectively of the principal under the strategy

profile $S$)

$$\Gamma_P((LO,\ e_h),\ LO) - \Gamma_P((L,\ e_h),\ L) > 0 \tag{3.2.2}$$

$$\begin{aligned} \Longrightarrow \quad & r_1 + r_2 > r_1 + (1 - \mu(e_h))(r_2 + (1 - \mu(e_h))K \\ \Longrightarrow \quad & K\mu(e_h)^2 - (2K + r_2)\mu(e_h) + K < 0 \end{aligned}$$

Consider the roots of the quadratic equation in $\mu(e_h)$ :

$$K\mu(e_h)^2 - (2K + r_2)\mu(e_h) + K = 0$$

Let $X = \mu(e_h$, we have

$$\begin{aligned} X_1 \quad &= \quad \frac{1}{2n}\left[2n + 1 - \sqrt{4n+1}\right] \\ &\text{and} \\ X_2 \quad &= \quad \frac{1}{2n}\left[2n + 1 + \sqrt{4n+1}\right] \end{aligned}$$

The initial inequality is satisfied for

$$X \in (-\infty, X_1) \cup (X_2, +\infty)$$

But given that $X$ is bounded between 0 and 1, it follows that $1 \geq \mu(e_h) > \frac{1}{2n}(2n + 1 - \sqrt{4n+1})$ ■

In this particular two period model, it is reasonable to assume that $n$ is bounded above by 2, which means that the principal expect to receive at least an amount equals to the initial investment $K$. This particular bound translates into $\mu(e_h) \in (\frac{1}{2}, 1]$. I now characterize the optimal contract in the following proposition:

**Proposition 6** *The optimal contract has the following characteristics: The agent chooses $e_h$ under $L$ and $e_l$ under $LO$. The principal chooses $LO$.*

One of the central question that this paper aims to answer is why do we observe a high prevalence of $L$ in the data? There are alternative explanations that I consider in the next section, but I argue that trust between the agent and the principal play the most important role in explaining this choice.

## 3.3 The choice of L

### 3.3.1 Trust

The choice of $L$ is grounded on the belief that the agent will choose lower effort. Since the principal cannot verify the effort of the agent, this belief satisfies the definition of trust as I previously stated. The main result of the theoretical analysis is then that trust can explain the deviation from the optimal contract that is observed in the data. Trust is often modeled in a way that amounts to the rationalist view of trust. This can be done her by making the agent

internalize the loss of the principal due to higher effort under $L$. However, as I argued earlier, trust does not have to be grounded on rational beliefs. This view leaves trust as an essentially empirical question.

It is expected that a good measure of trust between the agents and principal will be a significant variable in explaining the choice between the observed contracts. More specifically, the more trusting is the principal, the more likely he is to choose $L$. On the agents' side, one should expect the data to display substantial disparity in their outcome per contract in term proxy variables that measure effort. Agent under $L$ is expected to supply more effort than the agent under $LO$.

### 3.3.2 Alternative Explanations

*Transfers:* If voluntary transfers between the agent and the principal is possible, then the agent could choose lower effort under $L$ and in the second period the principal would transfer some of the proceeds from the depreciated asset to the agent. However, note that there is no a self-enforcing mechanism to prevent the problem of time inconsistency.

*Heterogeneity:* Adding heterogeneity in the preferences of either the agents or the principals can also explain the choice of $L$. This is also true if it is assumed that some principals manage to monitor the agent whereas others cannot. However this is unlikely to be the case because no Zem bears a meter

or other devices to measure effort or other outcomes.

## 3.4 Implications and Empirical Evidences

### 3.4.1 Hypothesis

The key hypothesis is that trust is positively and significantly related to the likelihood of the choice of $L$. The second hypothesis consists of analyzing the implication of the incentives induced by the two contracts. More specifically, one would expect to observe higher efforts under $L$ and under $LO$. Finally, we attempt to answer to the question whether it pays to trust. Do the agents under $L$ respond more to the trust put in them or do they respond more the induced incentives of the contract.

### 3.4.2 Data

The data used in this paper were collected first in summer 2006 in Lome, Togo by a group of college students at the University of Lome. The data were expanded during the summer of 2009 by second round of data collection in southern Benin. Students at the University of Abomey Calavi in Benin conducted this second survey.

The most challenging part of the empirical analysis the measure of the main independent variable, *Trust*. One way of measuring trust is to conduct a

survey, asking people directly about their past trusting behavior and whether they trust others. The first predicts whether they are trusting and the latter if they are trustworthy[7]. Since we are interested in the trustworthiness of the riders, we asked the following question drawn from the GSS[8] questions: *"Generally speaking, would you say that most people can be trusted or that you can't be too careful in dealing with people?"*. But this method may suffer some problems of interpretation as the concept is very subjective. This problem is exacerbated by the fact that the interviews were often conducted in the local languages. Therefore, we do not rely on this variable.

Alternatively, one can ask questions about variables that previous studies have shown to be indicative of level of trust between two people. Both experimental and survey studies by Glaeser et al. (2000) suggest that trust and trustworthiness increase as the individuals have closer ties and, decrease when they are from different nationality, race, ethnic group or family. I surveyed the riders mainly on three sets of questions: The first is our dependent variable, which is the type of contract. The second set of variables helps predict the level of trust between the two parties. Those variables are for instance the time since they have known each other, whether the rider has worked for/with the owner before utilizing his motorcycle, whether they have family/ethnic/community ties, etc. Finally, variables such as speed, length of

[7] See Glaeser et al.(2000) for more details.
[8] General Social Survey

daily breaks, daily revenues, etc. are used to characterize behavior per type of contracts[9]. The survey was conducted from July 15 to July 19 in Lome, the capital city of Togo and Cotonou, the capital city of Benin. Further details on the survey are available upon request.

### 3.4.3 Empirical framework

I model the probability of choosing $L$ in a standard Probit specification where our main independent variable is *trust* related variables. I create a score variable for trust which we will describe next. As in the standard probit model, it is assumed that the choice of the contract is determined by an unobserved or latent variable $h^*$ which modeled as:

$$\begin{aligned} h^* &= \beta_0 + \beta_1 Trust + \delta_1 X_{i,A} + \delta_1 X_{i,P} + \varepsilon_i \\ & \varepsilon_i \overset{\text{i.i.d}}{\rightsquigarrow} N(0,1) \end{aligned}$$

where $X_{i,A}$ and $X_{i,P}$ are observable covariates on the agent respectively on the principal such as education level, age, other source of revenues, the price of the asset etc. The econometrician observes only the type of the contract, which is presumably determined by the value of the latent variable according

[9]We have also collected many control variables as well. Those are variables such as the age, education, marital status, Number of motorcycles that the owner has, etc.
The complete survey questions and data set are available upon request.

to the following equation:

$$\begin{aligned} Prob(L) &= Prob(h^* \geq 0) \\ &= Prob(\varepsilon_i \geq 0) \\ &= \Phi(\beta_0 + \beta_1 Trust + \delta_1 X_{i,A} + \delta_1 X_{i,P}) \end{aligned}$$

where $\Phi$ is the $CDF$ of the standard normal distribution,

$$Trust = f(X_{iAP})$$

and $f(.)$ is the principal component analysis that creates a score of trust based on a number variable ($X_{iAP}$) determinant of trust. Those variables include the parental, ethnic, and professional relation between the agent and the principal.

## 3.5 Results and Discussions

Before we look at the probit estimates, let's look first, at some basic statistical indicators, in Table 29, that affect the choice of contract through trust. A test of comparison of mean is conducted between the two contracts. Table 29 hints clearly results which are consistent with our predictions. Having known

each other for a longer time, having had previous professional relationship, or being from the same ethnic group tend to favor significantly the choice of $L$. Remember that $L$, as argued before, is more likely to be chosen where there is higher trust between the parties. Three quarters of the L contracts did not involve a collateral whereas about half of the LO contract did not. More than half (58%) of the contract $L$ are agreed under non-formal setting (no collateral, no formal representative), whereas only 34% do the same thing under $LO$.

If trust plays a role, as hypothesis, this observation suggests that, in absence of trust, people tends to sign formal contracts and rely more on legal system.

The probit estimates in Table 30 support the main argument that trust plays an important role when it comes to choosing a contract. After controlling for the variables such as the owner's education, the number of motorcycles owned and other variables, the composite variable "trust" has a persistently significant, and positive effect on the choice of $L$. The more educated is the owner, the less likely he is to choose the inefficient contract $L$. However, the owner's education becomes insignificant as more controls enter into the specification.

In Table 31, trust is defined as dummy variable that take the value one if the owner and the rider share the same ethnic group or if they are from the same family. This alternative definition of trust is used and the results have remained similar.

If the outcomes of the two contracts are equivalent in term of the riders behavior and risk taking on the road, then there is no inefficiency arising from the existence of these two contracts. However, the evidence indicates otherwise[10]. Evidence show that riders have the worse behavior under $L$. That is, the incentive implied by their contract dominate the response to trust. One can see this by simply looking at the basic statistics from the data as shown in Table 32. On average, riders drive faster under $L$ than those under $LO$. They take less breaks (77% under L versus 86% under $LO$). There is 6% more accidents and mishaps under $L$, but the difference is not statistically significant. The riders reported their earning the day before the interview and the average is about $14 under L and $11 under LO. There is also a noticeable difference in the distribution of the revenue per contract. Figure 21 show the distribution reported daily revenues between the two contract. It shown that distribution under L is shifted to the right relative to the distribution under LO. This is in line with the behavior described above. The riders under L reported to have had on average 2.40 owners in the past whereas the riders under LO have reported on average 1.70. The difference is statistically significant and suggests that L is less stable. Maybe over time, the owner learns about the moral hazard associated with trust.

[10]A similar work on NYC taxicabs found that riders under lease have the worse outcome (Schneider 2007)

The key variables in Table 32 are combined to construct a composite variable capturing the behavior of the riders. The resulting variable is used to assess its association with the type of contract and the measure of trust. Table 33, reports the estimates of the impact of the contract type on the behavior of the rider. The contract type is found to have a significant effect on the behavior of the rider, even when controlling for the measure of trust. This indicates a significant difference in behavior per contract type. However, trust does not seem to affect significantly the ex-post behavior of the rider. The evidence suggests that excessive effort is being supplied by $L$ riders. People under $L$ are trying to make the most of the day and do not care too much about the maintenance of the motorcycle. The incentives induced by the contract override the trusting relation.

## 3.6 Conclusion

In the market of motorcycle taxis in Sub-Saharan Africa, a seemingly suboptimal contract coexists with the optimal contract between owners and riders. Our analysis in this paper shows that the contract is actually suboptimal and that trust plays a significant role in the choice of that contract. We have first developed a simple moral hazard model that accounts for trust and the main implication is that the higher the trust level between the contracting parties, the higher the probability of choosing the suboptimal contract. We have then

constructed a measure of trust based on proxy variables from survey data, and found it to have a positive significant effect on the choice of the inefficient contract. The data suggests that riders under this contract are subject to the daily shocks and hence behave more aggressively. Their behavior is not only a threat to the public safety, but it also reduces the future earnings of the owner through the deterioration of the motorcycle.

In this work, trust seems then to be the main source of inefficiencies. However, the large literature on trust tend to support that trust is good for economic activities both at micro level and macro level[11] Fukuyama (1995), La Ports et. al.(1997). In this work however, trust tends to make contracts further incomplete than they would have been otherwise and the problems of time inconsistency tends to ignored in presence of trust. These are the main sources through which trust creates inefficiencies.

[11] For a criticism of this view, see Roberts Solow's 1995 article in the New Republic

# Appendices

# Appendix A1: Tables for chapter 1

| | Benin | SS Africa | World |
|---|---|---|---|
| Percent Pop Below age 14 | 44 | 44 | 29 |
| Primary Net Enrollment | 79 | 70 | - |
| Secondary Net Enrollment | 17 | 28 | - |
| GNI PPP per Capita, 2007 | 1310 | 1830 | 9,600 |

Source: 2008 Africa Population Data Sheet, Population reference Bureau.

**Table 2.** Some Statistics for Benin and the Sub-Saharan Africa

| | Amount (USD) | Pocket Money Nber of Weeks | Minimum Wage % Monthly |
|---|---|---|---|
| Individual - Passing | 10 | 4.5 | 17% |
| Individual - Honors | 40 | 18 | 69% |
| Team Target- Pass | 40 | 18 | 69% |
| Team Target - Honors | 160 | 72 | 271% |
| Team Tourn.- Top 3 | 640 | 291 | 1085% |

The Incentives in term of number of weeks of pocket money is obtained by dividing the size of the incentive in USD by the average weekly pocket money in the data

**Table 3.** Size of the incentives relative to the local wages and in perspective of the students

| | Indiv. | Team Targ. | Team Tourn. |
|---|---|---|---|
| Clusters(J) | 44 | 44 | 56 |
| Students per Cluster(N) | 16 | 16 | 12 |
| Intra-group Correlation ($\rho$) | 0.05 | 0.05 | 0.05 |
| Minimum Effect Size ($\delta$) | 0.30 | 0.30 | 0.30 |
| Significance Level | 0.05 | 0.05 | 0.05 |
| Minimum Statistical power | 0.84 | 0.84 | 0.86 |
| Power based on actual treatment effect | | | |
| Effect Size ($\delta$) | 0.29 | 0.27 | 0.34 |
| Statistical power | 0.81 | 0.76 | 0.93 |

The same control is used for all 3 treatment groups. In a few small schools the number of untreated student was very small and we decided to give the incentive to all. This affect the power calculation for the individual target treatment. The power calculations are done using Optimal Design (od)

**Table 4.** Statistical Power Calculation

| Variables | All | Private | Public | Control | Individual | Team Targ. | Team Tourn. |
|---|---|---|---|---|---|---|---|
| Percent Success BEPC 08 | .35 | .34 | .37 | .37 | .35 | .33 | .36 |
| | (.15) | (.15) | (.14) | (.14) | (.15) | (.17) | (.14) |
| Female % Success BEPC 08 | .29 | .29 | .27 | .28 | .28 | .28 | .31 |
| | (.18) | (.17) | (.18) | (.16) | (.16) | (.19) | (.20) |
| Male % Success BEPC 08 | .39 | .38 | .39 | .43 | .38 | .36 | .37 |
| | (.17) | (.18) | (.15) | (.17) | (.16) | (.18) | (.16) |
| Class Size (Grade 10) | 41.30 | 36.92 | 48.51 | 40.16 | 40.39 | 44.71 | 40.40 |
| | (14.97) | (15.51) | (10.81) | (15.78) | (16.66) | (13.64) | (14.15) |
| Number of Grade 10 Classes | 2.89 | 1.63 | 5.05 | 3.04 | 2.41 | 2.86 | 3.14 |
| | (2.64) | (1.26) | (2.96) | (3.23) | (2.48) | (2.29) | (2.43) |
| Head Experience (Years) | 15.35 | 12.19 | 20.73 | 13.54 | 14.59 | 13.91 | 18.89** |
| | (9.81) | (9.44) | (7.97) | (9.42) | (9.26) | (9.70) | (10.26) |
| Head Experience Here | 4.93 | 5.24 | 4.41 | 4.44 | 5.82 | 6.45* | 3.5 |
| | (3.67) | (3.57) | (3.83) | (2.58) | (3.76) | (5.14) | (2.46) |
| Number of Classes | 15.61 | 9.68 | 25.84 | 17.14 | 13.73 | 15.18 | 15.89 |
| | (14.20) | (8.07) | (16.52) | (14.87) | (15.84) | (13.58) | (13.18) |
| Double Shifts? | .33 | .10 | .73 | .32 | .27 | .36 | .36 |
| | (.47) | (.30) | (.45) | (.48) | (.46) | (.49) | (.49) |
| Observations | 100 | 63 | 37 | 28 | 22 | 22 | 28 |

Standard deviations in parentheses. *** 1% Significance Level, **5% Significance Level, *10% Significance Level. The first three rows are official data from the Ministry of Education. The test of comparison of mean is between each treatment group and the control group.

**Table 5.** School Characteristics and Group Comparison

| Variables | All | Private | Public | Control | Individual | Team Targ. | Team Tourn. |
|---|---|---|---|---|---|---|---|
| Number of Classrooms | 13.18 | 10.12 | 18.38 | 14.25 | 11.09 | 13.13 | 13.79 |
| | (9.53) | (6.69) | (11.34) | (9.13) | (10.01) | (10.77) | (8.73) |
| Number of Students | 695.12 | 292.26 | 1359.30 | 756.52 | 659.19 | 666.68 | 685.21 |
| | (851.84) | (389.26) | (987.04) | (934.64) | (1028.22) | (784.88) | (705.60) |
| Tuition in 1000s of CFA | 50.12 | 69.33 | 18.45 | 55.51 | 55.36 | 47.76 | 42.58 |
| | (34.6) | (27.44) | (17.72) | (38.72) | (31.74) | (33.23) | (33.50) |
| School Has a Library? | .36 | .37 | .35 | .39 | .41 | .36 | .29 |
| | (.48) | (.49) | (.48) | (.50) | (.50) | (.49) | (.46) |
| School Has Electricity? | .73 | .81 | .59 | .75 | .77 | .64 | .75 |
| | (.45) | (.40) | (.50) | (.44) | (.43) | (.49) | (.44) |
| School Has Healthcenter? | .16 | .21 | .08 | .14 | .18 | .09 | .21 |
| | (.37) | (.41) | (.28) | (.36) | (.39) | (.29) | (.42) |
| School Has a PTA? | .75 | .60 | 1 | .75 | .68 | .64 | .89 |
| | (.44) | (.49) | (0) | (.44) | (.48) | (.49) | (.32) |
| Observations | 100 | 63 | 37 | 28 | 22 | 22 | 28 |

Standard deviations in parentheses. *** 1% Significance Level, **5% Significance Level, *10% Significance Level. The first three rows are official data from the Ministry of Education. The test of comparison of mean is between each treatment group and the control group.

**Table 6.** School Characteristics and Group Comparison (Con't)

| Variables | All | Male | Female | Control | Individual | Team Targ. | Team Tourn. |
|---|---|---|---|---|---|---|---|
| Last Year's Score (Overall) | 11.35 | 11.47 | 11.17 | 11.20 | 11.22 | 11.60*** | 11.40 |
| | (1.78) | (1.87) | (1.60) | (1.91) | (1.95) | (1.61) | (1.54) |
| Last Year's Score (Math) | 10.49 | 10.75 | 10.09 | 10.33 | 10.52 | 10.61 | 10.52 |
| | (2.97) | (3.09) | (2.74) | (3.08) | (2.96) | (2.96) | (2.87) |
| Last Year's Score (History) | 12.80 | 13.01 | 12.49 | 12.90 | 12.53* | 13.12 | 12.64 |
| | (2.54) | (2.57) | (2.47) | (2.58) | (2.47) | (2.57) | (2.52) |
| Last Year's Score (French) | 11.95 | 11.86 | 12.08 | 11.93 | 11.59* | 12.31* | 11.96 |
| | (2.50) | (2.55) | (2.42) | (2.62) | (2.43) | (2.42) | (2.46) |
| Repetition (ever) | 1.42 | 1.49 | 1.31 | 1.55 | 1.51 | 1.31*** | 1.27*** |
| | (1.24) | (1.29) | (1.15) | (1.31) | (1.26) | (1.20) | (1.15) |
| Repetition (Last 3 Yrs) | .49 | .49 | .48 | .57 | .50 | .43*** | .43*** |
| | (.68) | (.69) | (.66) | (.71) | (.68) | (.66) | (.64) |
| Have a Paid Tutor | .15 | .11 | .21 | .16 | .14 | .15 | .16 |
| | (.36) | (.32) | (.40) | (.37) | (.34) | (.36) | (.36) |
| French Test (%) | 51.56 | 50.84 | 52.62 | 51.62 | 50.09 | 51.68 | 52.85 |
| | (20.57) | (20.48) | (20.68) | (18.98) | (21.58) | (20.57) | (21.41) |
| Math Test (%) | 41.36 | 41.25 | 41.53 | 38.57 | 42.03** | 42.73*** | 42.67** |
| | (23.37) | (23.76) | (22.80) | (23.16) | (21.89) | (24.02) | (24.18) |
| Test Overall (%) | 46.46 | 46.04 | 47.07 | 45.09 | 46.06 | 47.23 | 47.76** |
| | (17.59) | (17.40) | (17.85) | (17.21) | (17.18) | (17.82) | (18.15) |
| Observations | 1476 | 878 | 598 | 423 | 347 | 367 | 339 |

Standard deviations in parentheses. * 10% significance level, **5%, and ***1%

**Table 7.** Students Baseline Performance Performance

| Variable | All | Male | Female | Control | Individual | Team Targ. | Team Tourn. |
|---|---|---|---|---|---|---|---|
| Student's Age | 16.22 | 16.33 | 16.06 | 16.20 | 16.40 | 16.20 | 16.07 |
| | (1.84) | (1.88) | (1.78) | (1.84) | (1.97) | (1.80) | (1.75) |
| Student's Gender | .60 | 1 | 0 | .60 | .58 | .60 | .60 |
| | (.49) | (0) | (0) | (.49) | (.49) | (.49) | (.49) |
| Father Living | .86 | .86 | .86 | .88 | .85 | .84* | .88 |
| | (.35) | (.35) | (.34) | (.33) | (.36) | (.37) | (.33) |
| Mother Living | .94 | .93 | .94 | .94 | .93 | .93 | .94 |
| | (.24) | (.25) | (.23) | (.24) | (.25) | (.25) | (.24) |
| Number of Siblings | 6.54 | 6.70 | 6.31 | 6.31 | 6.26 | 6.99** | 6.61 |
| | (4.58) | (4.57) | (4.59) | (4.23) | (4.59) | (5.07) | (4.42) |
| Car at Home? | .33 | .28 | .39 | .36 | .33 | .28** | .33 |
| | (.47) | (.45) | (.49) | (.48) | (.47) | (.45) | (.47) |
| Has a Cell Phone? | .37 | .40 | .33 | .41 | .38 | .35 | .35 |
| | (.48) | (.49) | (.47) | (.49) | (.48) | (.48) | (.48) |
| Weekly Pocket Money | 1204.63 | 1152.60 | 1281.77 | 1291.22 | 1173.12 | 1136.6 | 1201.34 |
| | (1495.48) | (1489.09) | (1502.86) | (1674.47) | (1289.90) | (1533.75) | (1408.01) |
| Works for Pay? | .39 | .46 | .29 | .41 | .38 | .38 | .41 |
| | (.49) | (.50) | (.46) | (.49) | (.49) | (.49) | (.49) |
| Time to School | 25.01 | 26.67 | 22.58 | 24.65 | 22.14* | 27.92 | 25.25 |
| | (18.75) | (20.75) | (15.04) | (19.15) | (16.47) | (19.59) | (19.12) |
| Observations | 1476 | 878 | 598 | 423 | 347 | 367 | 339 |

Standard deviations in parentheses. * 10% significance level, **5%, and ***1%

**Table 8.** Students Socio-demographic Characteristics

| Variable | Control | Indiv. Target | Team Target | Team Tourn. |
|---|---|---|---|---|
| Average Score at the latest exam | 10.22 | 10.56 | 10.55 | 9.69 |
| | (1.88) | (1.56) | (1.58) | (1.87) |
| Expected Average Score at BEPC 09 | 11.70 | 11.94 | 11.87 | 11.75 |
| | (1.70) | (1.50) | (1.56) | (1.44) |
| Do you have a regular study group? | 0.68 | 0.61 | 0.79 | 0.69 |
| | (0.47) | (0.49) | (0.41) | (0.47) |
| Do you have a regular study group? | 0.68 | 0.61 | 0.79 | 0.69 |
| | (0.47) | (0.49) | (0.41) | (0.47) |
| Received other incentive/promise | - | 0.55 | 0.61 | 0.57 |
| | - | (0.50) | (0.49) | (0.50) |
| Weekly hours of study alone | 6.44 | 6.05 | 9.28 | 7.26 |
| | (3.16) | (4.31) | (5.12) | (6.90) |
| Weekly hours of study in group | 8.79 | 9.30 | 9.28 | 9.45 |
| | (5.37) | (6.87) | (8.07) | (5.19) |
| Observations | 180 | 175 | 186 | 107 |

Standard deviations in parentheses

**Table 9.** Summary Statistics from first Follow Up Data

| Variable | All | Control | Indiv. | Team Tar. | Team Tour. |
|---|---|---|---|---|---|
| BEPC Passing Rate | .55 | .47 | .57 | .56 | .58 |
| | (.50) | (.50) | (.49) | (.49) | (.49) |
| Passed with Honors | .12 | .07 | .11 | .13 | .16 |
| | (.32) | (.27) | (.32) | (.33) | (.36) |
| Average score (1) | 9.09 | 8.50 | 9.30 | 9.23 | 9.41 |
| | (2.67) | (2.69) | (2.45) | (2.81) | (2.63) |
| Average score (2) | 8.53 | 8.01 | 8.69 | 8.65 | 8.82 |
| | (2.30) | (2.26) | (2.07) | (2.46) | (2.32) |
| Writing | 8.14 | 8.23 | 8.39 | 7.92 | 8.04 |
| | (2.61) | (2.51) | (2.55) | (2.68) | (2.70) |
| Reading | 9.09 | 8.58 | 9.00 | 9.42 | 9.41 |
| | (3.26) | (3.39) | (2.87) | (3.33) | (3.34) |
| Mathematics | 4.70 | 4.06 | 4.85 | 4.87 | 5.11 |
| | (2.84) | (2.60) | (2.75) | (2.78) | (3.17) |
| 2nd Lang. or Phys. | 9.64 | 8.90 | 9.96 | 9.81 | 10 |
| | (3.96) | (3.84) | (3.88) | (3.99) | (4.03) |
| Natural Science | 9.37 | 8.89 | 9.26 | 9.60 | 9.78 |
| | (3.30) | (3.32) | (3.14) | (3.37) | (3.29) |
| History &geography | 12.82 | 12.11 | 13.25 | 12.88 | 13.14 |
| | (4.52) | (4.72) | (4.42) | (4.50) | (4.35) |
| First Language score | 7.81 | 7.24 | 8.07 | 7.91 | 8.09 |
| | (3.50) | (3.36) | (3.18) | (3.61) | (3.78) |
| Oral Communication | 16.73 | 16.77 | 16.78 | 16.68 | 16.71 |
| | (1.19) | (1.11) | (1.10) | (1.17) | (1.29) |
| Sport | 14.25 | 13.98 | 14.13 | 14.62 | 14.22 |
| | (2.98) | (3.43) | (2.95) | (2.49) | (3.05) |
| Observations | 1383 | 378 | 328 | 351 | 326 |

Standard deviations in parentheses. Standard errors clustered at the school level. All the scores are over twenty possible points. (1) All the subjects (2) Only written subjects

**Table 10.** Summary Statistics of Students Performance on the BEPC 2009

| | All BEPC | Written BEPC | HOTS | Rote Mem. | Obs. |
|---|---|---|---|---|---|
| | (I) | (II) | (III) | (IV) | |
| Individual Targ. | 0.29** | 0.29** | 0.30** | 0.23* | 706 |
| | (0.12) | (2.19) | (0.12) | (0.13) | |
| Team Targ. | 0.27* | 0.27* | 0.27** | 0.22 | 729 |
| | (0.15) | (0.16) | (0.12) | (0.16) | |
| Team Tourn. | 0.34** | 0.35** | 0.36** | 0.30** | 703 |
| | (0.13) | (0.14) | (0.14) | (0.13) | |

Robust standard errors in parenthesis. *, **, and *** mean significant at 10% level, respectively 5%, and 1%. HOTS = Higher Order Thinking Skills

**Table 11.** Average Treatment Effect on the BEPC Score and on Selected Fields

| | 15th Quantile | 50th Quant. | 85th Quant. | Obs. |
|---|---|---|---|---|
| *Panel A: Normalized BEPC 09 Score* | | | | |
| Individual Target | 0.40*** | 0.93*** | 0.12* | 706 |
| | (0.10) | (0.31) | (0.07) | |
| Team Target | 0.18* | 0.93*** | 0.16** | 729 |
| | (0.09) | (0.35) | (0.08) | |
| Team Tourn. | 0.37*** | 0.91** | 0.27*** | 706 |
| | (0.07) | (0.37) | (0.10) | |
| *Panel B: Normalized Written BEPC 09 Score* | | | | |
| Individual Target | 0.43*** | 0.67*** | 0.17 | 705 |
| | (0.11) | (0.09) | (0.12) | |
| Team Target | 0.17 | 0.66*** | 0.28*** | 728 |
| | (0.12) | (0.17) | (0.10) | |
| Team Tourn. | 0.41*** | 0.67*** | 0.38*** | 703 |
| | (0.07) | (0.14) | (0.10) | |
| *Panel C: Normalized BEPC 09 Score: Higher Order Skills* | | | | |
| Individual Target | 0.38*** | 0.28*** | 0.19 | 705 |
| | (0.11) | (0.09) | (0.16) | |
| Team Target | 0.09 | 0.28** | 0.28* | 728 |
| | (0.12) | (0.12) | (0.15) | |
| Team Tourn. | 0.28*** | 0.28*** | 0.47** | 703 |
| | (0.10) | (0.11) | (0.20) | |
| *Panel D: Normalized BEPC 09 Score: Two Rote Memory Skills* | | | | |
| Individual Target | 0.30** | 0.23* | 0.08 | 706 |
| | (0.15) | (0.13) | (0.10) | |
| Team Target | 0.30* | 0.15 | 0.31*** | 729 |
| | (0.17) | (0.13) | (0.07) | |
| Team Tourn. | 0.61*** | 0.23** | 0.23*** | 704 |
| | (0.13) | (0.10) | (0.08) | |

Robust standard errors in parenthesis. *, **, and *** mean significant at 10% level, respectively 5%, and 1%. The middle row of Panel B is estimated at 45th quantile to adjust for the change in distribution after the oral subjects.

**Table 12.** Quantiles Treatment effect. Simultaneous Quantile regression

| | BEPC All | | BEPC Written | | |
|---|---|---|---|---|---|
| | K-S | p-value | K-S | p-value | Obs. |
| Individual Targ. vs. Contol | 0.16 | 0.000 | 0.17 | 0.000 | 705 |
| Team Target vs. Control | 0.13 | 0.004 | 0.16 | 0.000 | 728 |
| Team Tourn. vs. Control | 0.16 | 0.000 | 0.16 | 0.000 | 703 |

**Table 13.** Kolmogorov-Smirnov Test of Equality of Distributions

| | Team Tourn. | Team target |
|---|---|---|
| Previous year's average Score | 0.33* | 0.17 |
| | (0.18) | (0.10) |
| Within Team variance (Baseline) | 2.59** | 2.98** |
| | (0.98) | (1.09) |
| Constrant | 22.25 | 29.87 |
| | (9.63) | (6.33) |
| R squared | 0.07 | 0.05 |
| Obs. | 323 | 306 |

Robust standard errors in parenthesis. *, **, and *** mean significant at 10% level, respectively 5%, and 1%.

**Table 14.** Effect of the within team baseline variance on end-line test score

| | Individual | Team Targ. | Team Tourn. |
|---|---|---|---|
| Actual Cost | \$3421 | \$1481 | \$2237 |
| Ex-ante Estimated Cost | \$2000 | \$2000 | \$1920 |
| Percent Change* | +54.50% | −43.50% | 0% |
| Average Treatment Effect | 0.29** | 0.27* | 0.35** |
| | (0.13) | (0.16) | (0.14) |

Note: The currency is the US dollar. Robust standard errors of the average treatment effects in parentheses.

**Table 15.** Ex-post Relative Cost of the Three Treatments

# Appendix A2: Figures for chapter 1

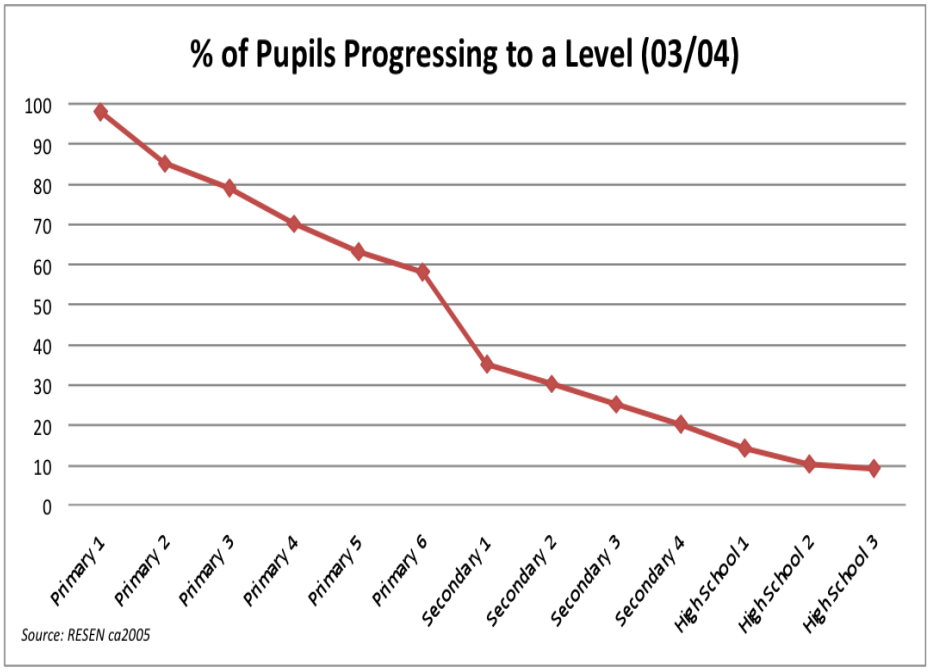


**Figure 1.** Repetition Rates in 2004

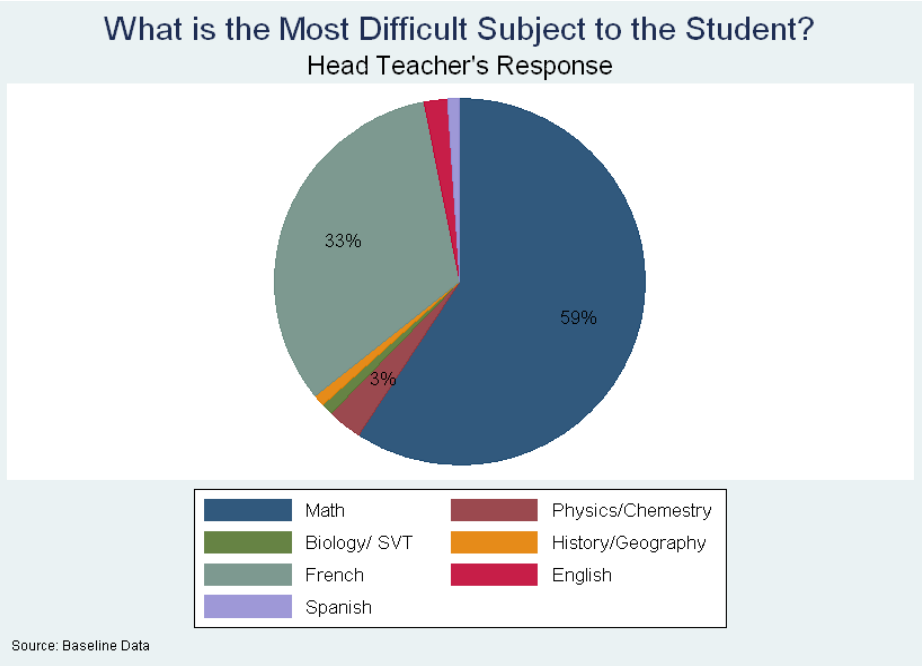


**Figure 2.** Most Difficult Subject

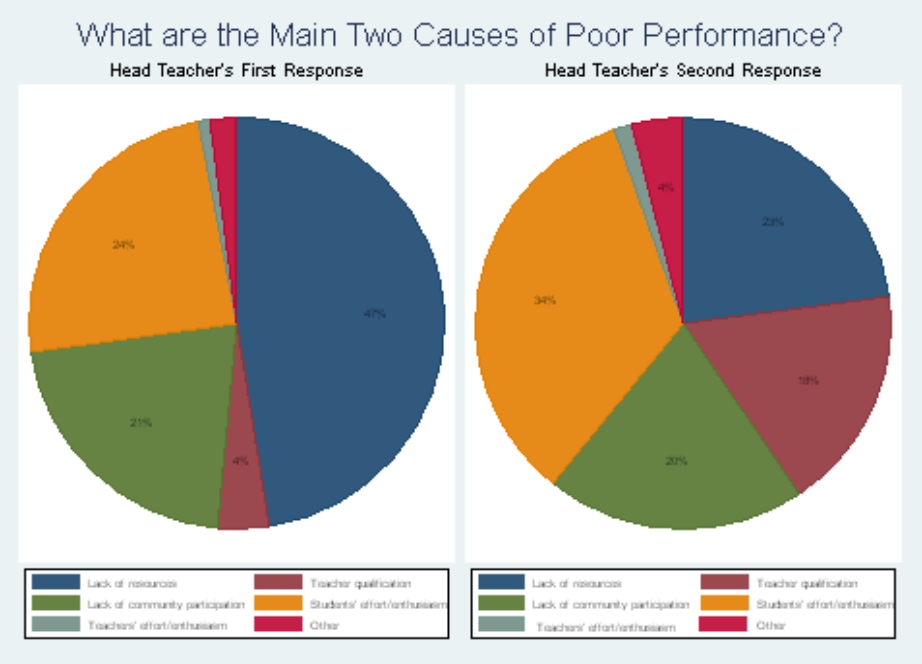


**Figure 3.** Causes of Poor Performance –Head Teachers' response

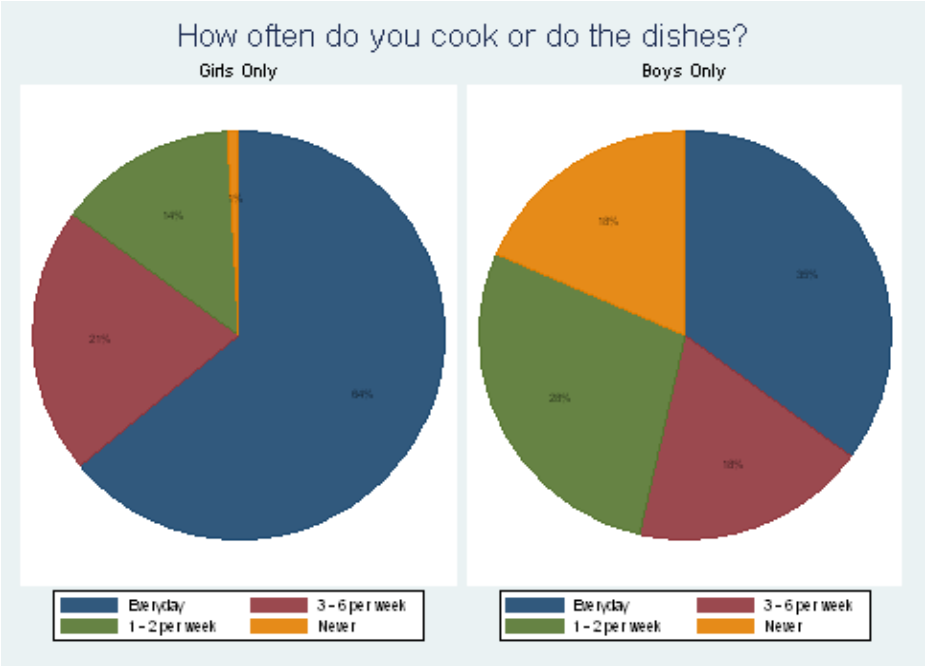


**Figure 4.** Student Labor at Home

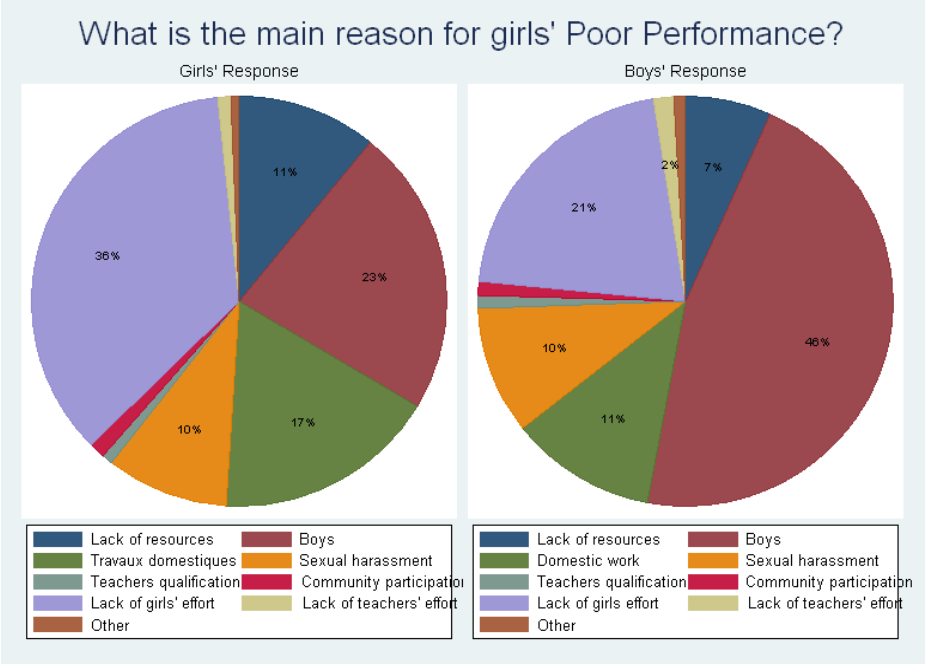


**Figure 5.** Causes for Females' Poor Performance

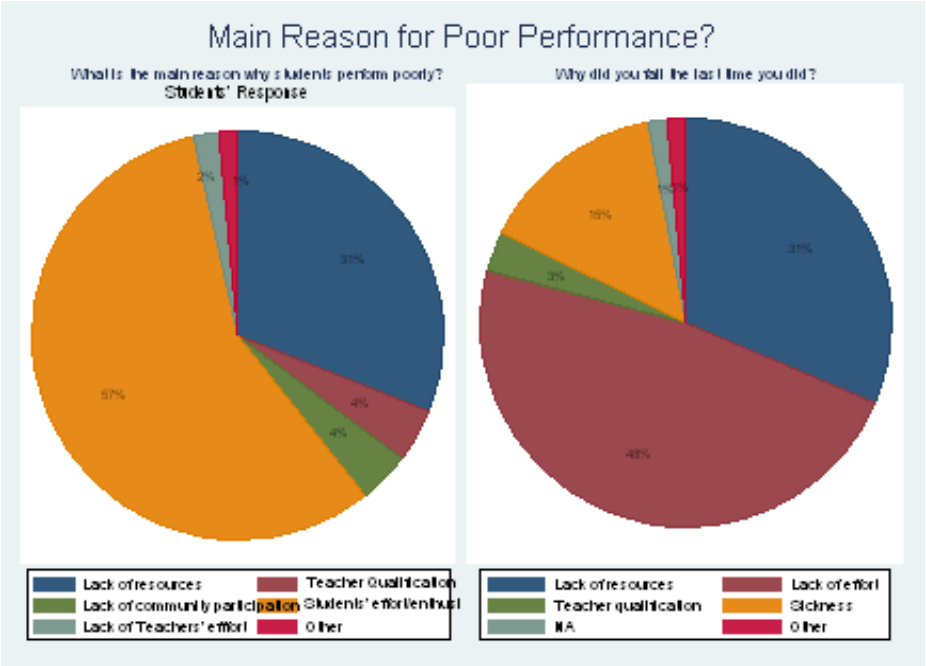


**Figure 6.** Causes of Poor Performance –Students' Response

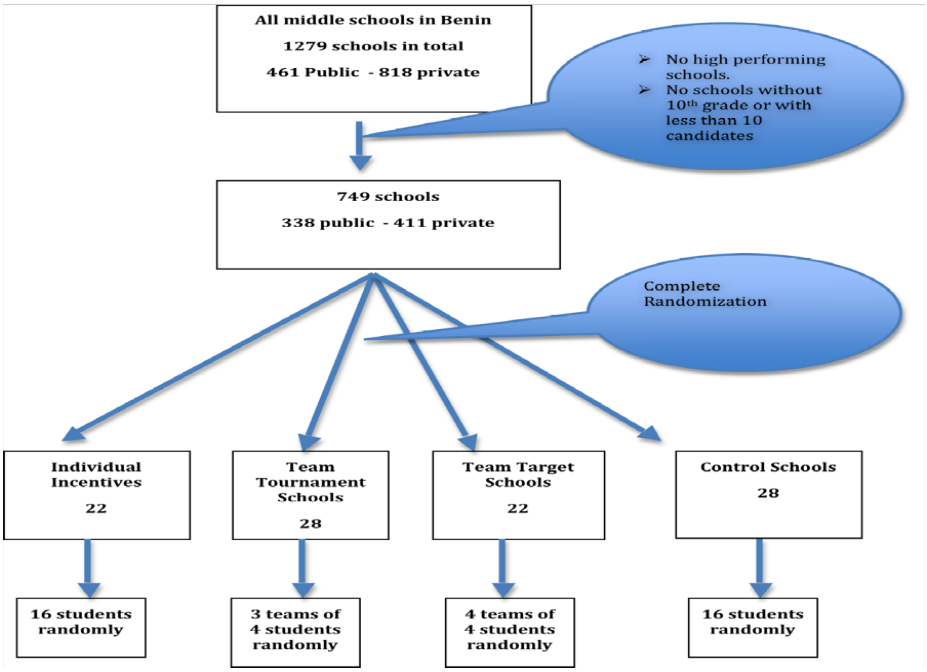


**Figure 7.** Selection of participants

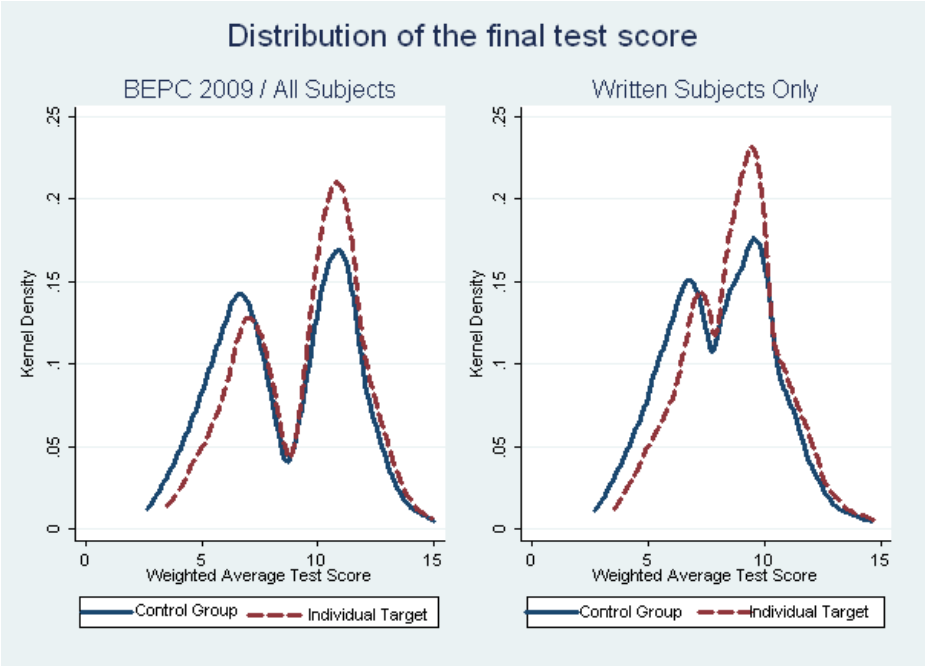


**Figure 8.** Distribution of Test Scores on the BEPC

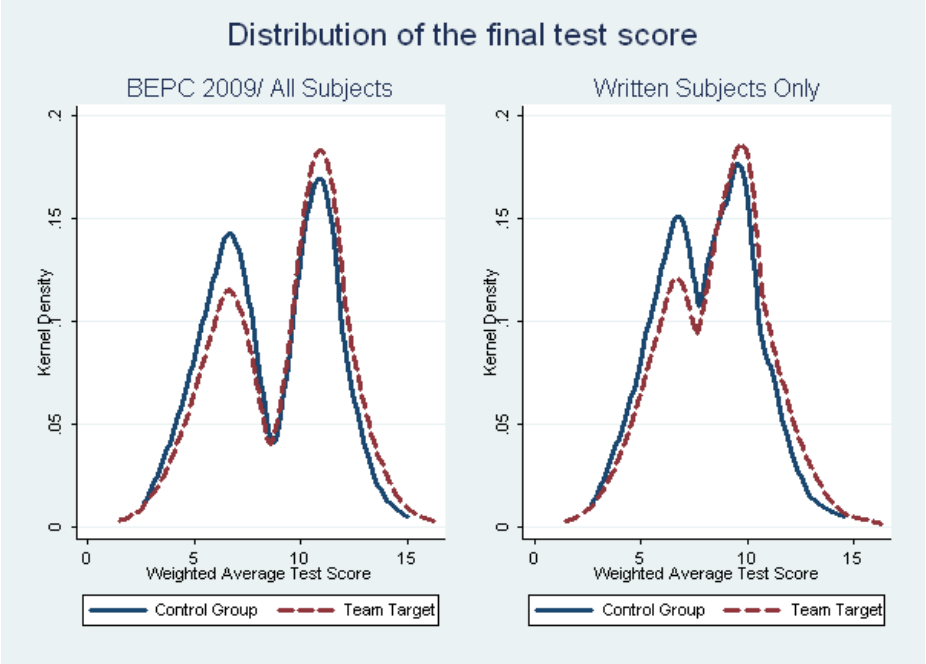


**Figure 9.** Distribution of Test Scores on the BEPC

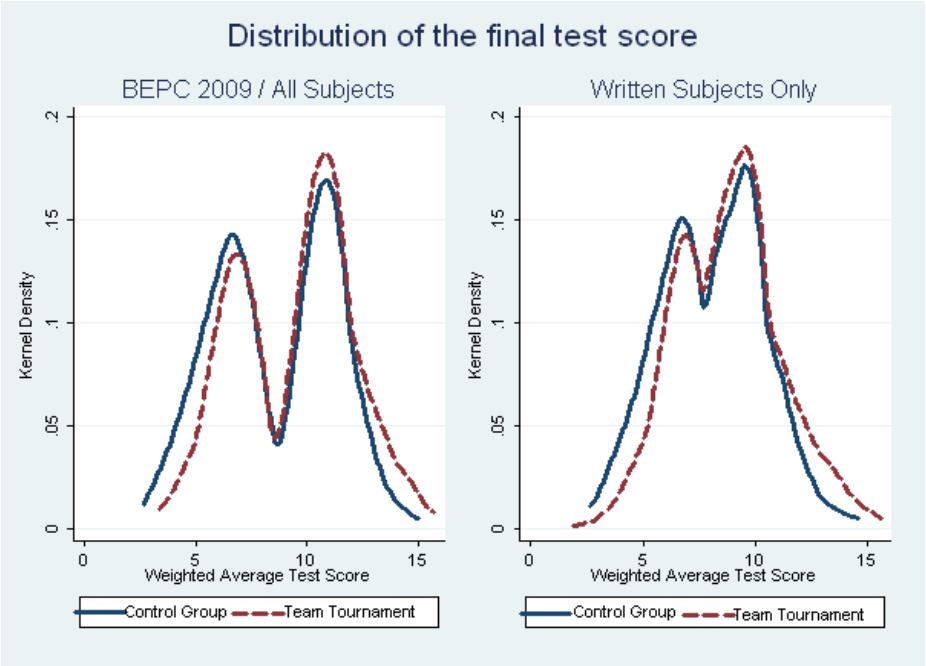


**Figure 10.** Distribution of Test Scores on the BEPC

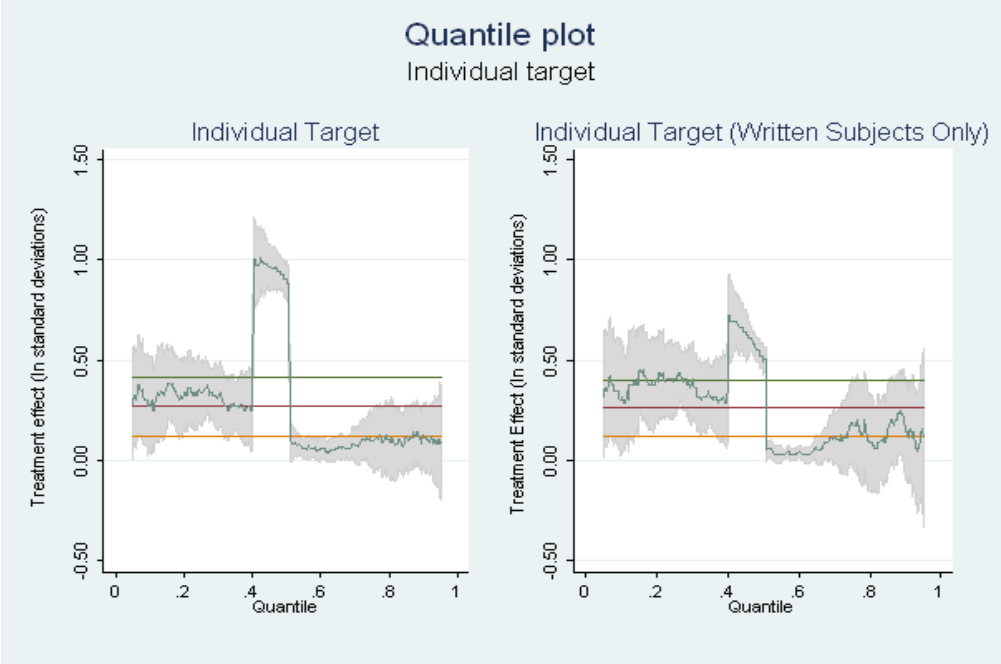


**Figure 11.** Quantile Regression for Individual Target

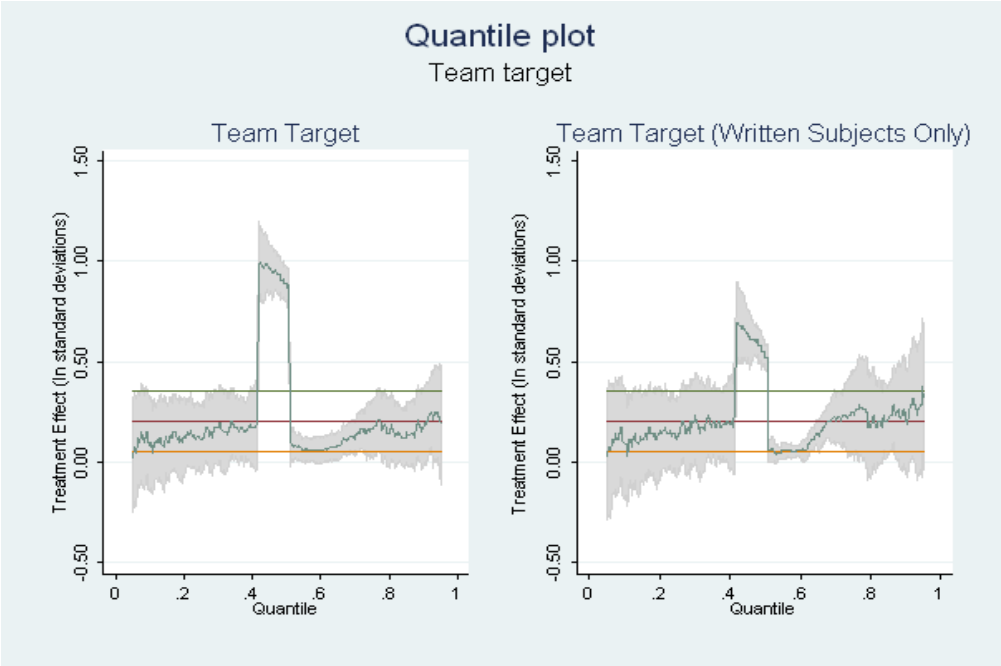


**Figure 12.** Quantile Regression for Team Target

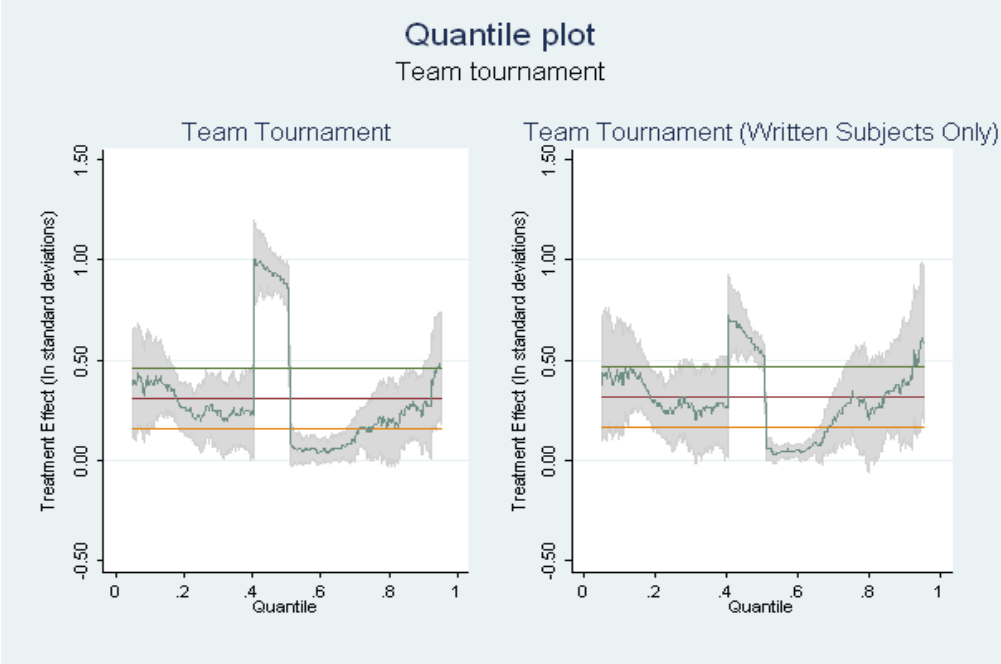


**Figure 13.** Quantile Regression for Team Tournament

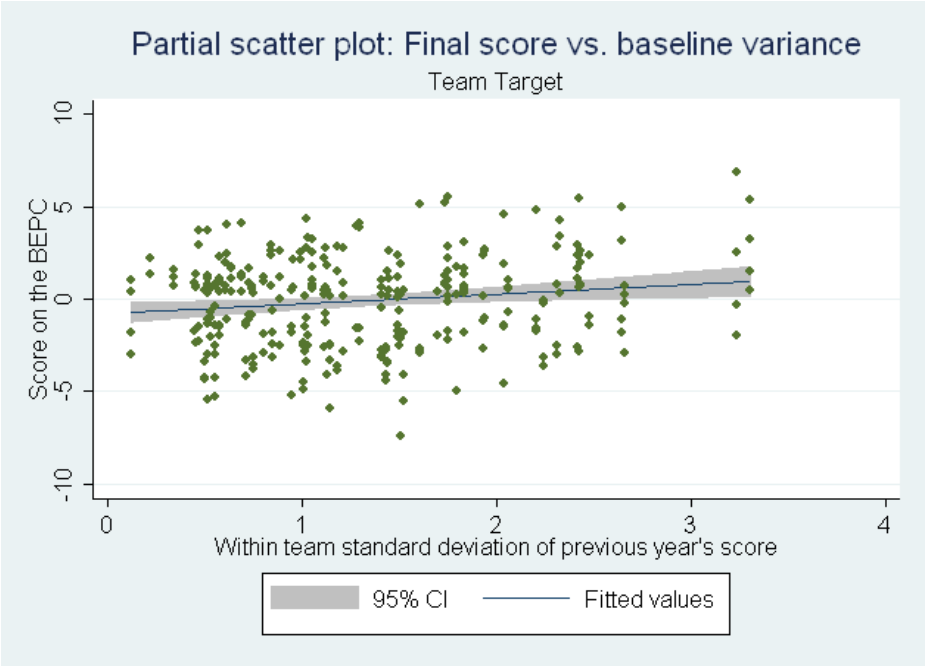


**Figure 14.** Heterogeneity within teams

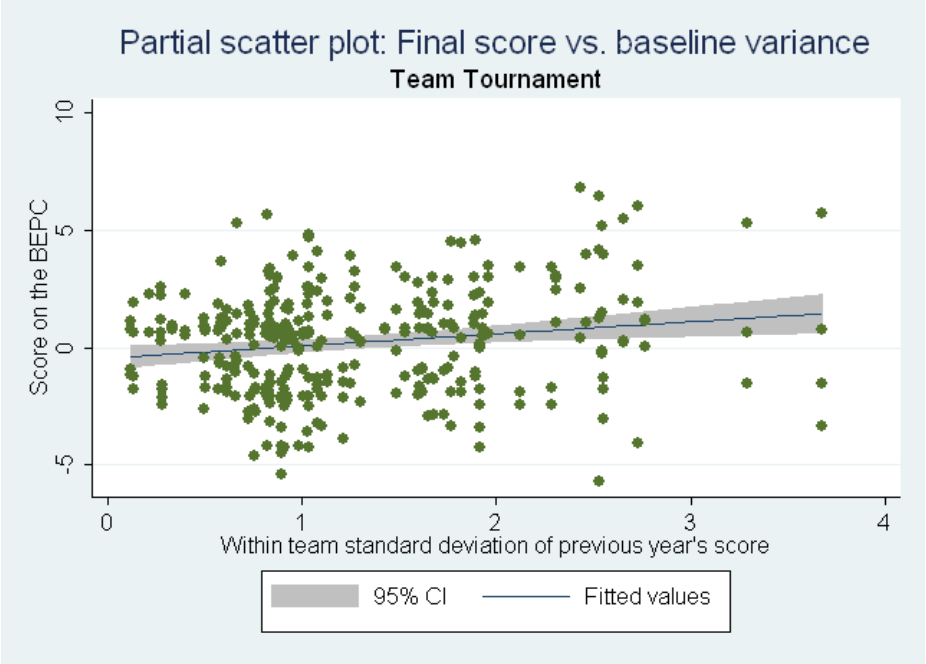


**Figure 15.** Heterogeneity within teams


**Figure 16.** Locations of participant schools across the country

# Appendix A3: Consent form and Timetable for chapter 1

NEW YORK UNIVERSITY
*A private university in the public service*

**University Committee on Activities Involving Human Subjects**
665 Broadway – Suite 804
New York, NY 10012
Telephone: 212-998-4808
Fax: 212-995-4304
Internet: www.nyu.edu/ucaihs

**MEMORANDUM**

**TO:** Pouguinimpo Blimpo

**FROM:** Jan Blustein, M.D., Ph.D., Chair
University Committee on Activities Involving Human Subjects

**DATE:** April 30, 2008

**RE:** **HS# 6453, "Team Incentives for Education in Developing countries"**
(*Approved* 1/2/2008)

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The above-referenced protocol has been approved by expedited review as applicable at 45 CFR 46.110(b)[1](4) by the University Committee on Activities Involving Human Subjects for the project year:

1/2/2008 to 1/1/2009

Please note the following:

- **If your study uses written consent, the approved, stamped versions are attached. You are required to use these forms for all recruitment.**
- Where consent forms are used, subjects must sign and must be given a copy (without signature) of the UCAIHS current stamped consent form before the subjects' participation.
- All data, as well as the investigator's copies of the signed consent forms, must be retained by the principal investigator for a period of at least three years following the termination of the project.
- If additional sites will be incorporated, **letters of approval from cooperating institution IRBs or other approvals for sites without an IRB must be submitted.**
- Should you wish to **make changes to the Committee-approved procedures**, the following materials must be submitted for Committee review and be approved by the Committee prior to being instituted:
  - **a description of proposed revisions**;
  - any **new or revised material**, such as recruitment fliers, letters or statements to subjects, or consent forms; and
  - copies of **approval letters from cooperating institutional IRBs,** *if applicable*.
- Should you wish to **conduct research for this study beyond 1/1/2009,** the following materials must be submitted for Committee review:
  - **"Continuing Review Progress Report"** (available from the UCAIHS website at www.nyu.edu/ucaihs);
  - **current stamped consent form(s) and an unstamped original consent form(s);**
  - *if applicable,* **updated letters of approval from cooperating institutions;** and
  - *if applicable,* any **new or revised material**, such as revised procedures, recruitment methods, statements to subjects, or consent forms.

If you have any questions regarding the Committee's requirements, please contact the UCAIHS office at 212-998-4808 or human.subjects@nyu.edu.

cc: Dr. Nicola Persico—Faculty Sponsor

**New York University**
*A private university in the public service*
Arts and Science
Department of Economics
19 West Fourth Street, 6th Floor
New York, NY 10012-1119

Telephone: (212) 998-8900
Fax: (212) 995-4186
http://www.nyu.edu/econ

## Consent Form

You have been invited to take part in a research study to learn more about team incentives on educational achievement. This study will be conducted by Pouguinimpo Blimpo (Moussa), Department of Economic (FAS), New York University, as part of his doctoral dissertation. His faculty sponsor is professor Nicola Persico, New York University FAS/Department of Economics.

If you agree to be in this study, you will be asked to do the following:

3. Complete a questionnaire about your background (age, gender, education, etc.)
4. Participate in an incentive program as member of an exogenously formed team or individually. You or your team will be promised a prize based on your performance at the end of year examination of BEPC or the performance of your team at the same examination if you entered as a team.

Participation in this study will involve about three hours of your time: two (1 hour twice) hours to complete the initial questionnaire and the final questionnaire, one hours for form teams if applicable and explain the instructions to you. The initial questionnaire will take place at the beginning of this project and the final one will take place around the end of the academic year.
There are no known risks associated with your participation in this research beyond those of everyday life.

Although you will receive no direct benefits, this research may help the investigator understand incentive programs for education better.

There is no participation fee. You will be paid solely based on your performance at your final examination (BEPC) or that of your group as a whole if you entered as a group. There is no payment for participation. If you withdraw before the end of the study, no payment will be given to you regardless of your results at the examination (BEPC).

Confidentiality of your research records will be strictly maintained by keeping consent forms separate from the data. In addition, the data will be recoded to avoid the possibility to relate them to the information you provided.

Your responses will be kept confidential with the following exception: the researcher is required by law to report to the appropriate authorities, suspicion of harm to yourself, to children, or to others.
Your responses will be kept confidential by the researcher, but the researcher cannot guarantee that others in the group will do the same.


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Participation in this study is voluntary. You may refuse to participate or withdraw at any time without penalty. For interviews, questionnaires or surveys, you have the right to skip or not answer any questions you prefer not to answer.
Non-participation or withdrawal will not affect your grades or academic standing.
If there is anything about the study or your participation that is unclear or that you do not understand, if you have questions or wish to report a research-related problem, you may contact us at the following addresses:

| In The United States of America | In Benin |
|---|---|
| Pouguinimpo Moussa Blimpo<br>New York University, Department of Economics<br>19W.4th Street, New York, NY 10012, USA.<br>Téléphone: (001) 212 998 8177<br>Email: pb597@nyu.edu | Pouguinimpo Moussa Blimpo<br>IREEP, BP 02 BP 372<br>Cotonou (Rep. du Bénin)<br>Tel : 229 21 30 79 92<br>Email: pb597@nyu.edu |
| Professeur Nicola persico<br>New York University, Department of Economics<br>19W.4th Street, New York, NY 10012, USA.<br>Téléphone: (001) 212 998 3889<br>Email: Nicola.persico@nyu.edu | |

For questions about your rights as a research participant, you may contact the University Committee on Activities Involving Human Subjects at:

New York University
UCAIHS Office of Research Compliance Administration
665 Broadway (between 3rd and Bleecker Streets) Suite 804
New York, NY 10012
Tel: 212-998-4808
Email: human.subjects@nyu.edu

You have received a copy of this consent document to keep.

Agreement to Participate

Signature Date

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| Date | Activity |
|---|---|
| December 2007 | Submitted the proposal to the NSF with the basic theoretical framework and the experimental design. The Institute for Empirical Research in political Economy (IERPE, Cotonou) agreed to host the experimental study. |
| April 15, 2008 | The NSF approved the grant application and agreed to fully fund the research. |
| 08/08 - 10/08 | Selected five (5) the research assistants from the IERPE. We pre-tested and finalized the survey instruments, obtained school records and the written authorization of the Ministry of Education, and conducted the school sampling. |
| 11/2008 | The research assistants travelled to each participant school in the country to implement the relevant treatment and collect the baseline data. |
| 03/09 - 04/09 | 1st Follow up: We Collected follow data in selected schools and reminded the incentives to all schools in the treatment groups |
| 06/08/09 | The written phase of the BEPC examination takes place in the entire country at the same time. |
| 06/22/09 | Grading phase of the BEPC. The grading takes place in six different location and the results are later aggregated at the National Directorate for Examinations. |
| 10 July 2009 | The results of the BEPC are announced. Successful candidates are incited to take two additional subjects and the final results are announced the following week. |
| 10/2009 | We obtained the BEPC results of participant students from each of the six grading centers with the support of the Ministry of Education |
| 10/2009 - 12/2009 | Phase of identification and payment of the incentives to the students who won. |

# Appendix B1: Tables for Chapter 2

| Department | Commune |
|---|---|
| Alibori | Kandi, Karimama, Gogounou |
| Atacora | Materi, Natitingou, Kouande |
| Zou | Zogbodome, Cove, Djidja |
| Plateau | Ifangni, Pobe, Ketou |
| Oueme | Seme-Kpodji, Aguegues, Adjarra |
| Mono | Athieme, Come, Lokossa |
| Donga | Ouake, Djougou, Bassila |
| Couffo | Toviklin, Aplahoue, Klouekamev |
| Collines | Bante, Save, Savalou |
| Borgou | Sinende, Kalale, Nikki |
| Atlantic | Ze, Ouidah, Abomey-Calavi |

Seventeen schools were selected in each locality to participat. 108 schools were subsequently selected randomly for the follow-up

**Table 16.** Participant Localities

| Name | Definition | Coding |
|---|---|---|
| PTA Score 1 | Quality of PTA | Continuous |
| PTA Score 2 | Quality of PTA | Continuous |
| Instrument | Stay in the community | 0 = 5 Years or less; 1 = More than 5 Years |
| CEP 04 | School's rate of sucess: CEP 04 | 0 - 100 |
| School Test | Last Examination at school level | 0 - 100 |
| Standardized Test | Student score: Standardized test | 0 - 100 |

**Table 17.** Definition of the key variables

| | Communes (I) | Communes (II) |
|---|---|---|
| *School Characteristics* | | |
| HT Experience | 21.34 | 22.12 |
| | (4.27) | (4.41) |
| Number of Classrooms | 5.29 | 5.70 |
| | (1.34) | (1.05) |
| Student Teacher Ratio | 52.78 | 52.34 |
| | (20.42) | (10.23) |
| Resources | 947.72 | 1518.07 |
| | (441.42) | (1781.61) |
| *School or Student Performance* | | |
| Score Standard Literacy Test | 36.26 | 24.53 |
| | (26.66) | (24.49) |
| CEP 04 | 73.12 | 63.23 |
| | (18.67) | (32.47) |
| School Level Test | 68.73 | 66.80 |
| | (11.99) | (12.66) |
| *PTA Indicators* | | |
| PTA Written Status | 0.50 | 0.47 |
| | (0.50) | (0.50) |
| PTA Committee Elected | 0.92 | 0.85 |
| | (0.25) | (0.35) |
| PTA Archives | 0.56 | 0.51 |
| | (0.50) | (0.50) |
| PTA Bank Account | 0.68 | 0.67 |
| | (0.47) | (0.47) |
| PTA Inform Community | 0.96 | 0.93 |
| | (0.18) | (0.25) |
| Observations | 239 | 135 |

Standard Deviations are clustered at the school level. The two groups are a random draw from the dataset

**Table 18.** Illustration of the Central Idea

| | Mean | Std Dev. | Min | Max | Obs. |
|---|---|---|---|---|---|
| HT SChool Has a PTA= 1 | 0.97 | 0.17 | 0 | 1 | 108 |
| HT Parents Contribute = 1 | 0.07 | 0.26 | 0 | 1 | 108 |
| HT Parents Approve Spending =1 | 0.13 | 0.34 | 0 | 1 | 108 |
| HH Is a PTA Member? = 1 | 0.56 | 0.49 | 0 | 1 | 108 |
| HH PTA Participation =1 | 0.37 | 0.48 | 0 | 1 | 108 |
| HH 5 Years More here? | 0.72 | 0.45 | 0 | 1 | 108 |
| PTA Has a Written Status = 1 | 0.42 | 0.49 | 0 | 1 | 108 |
| PTA Committee Works Well = 1 | 0.30 | 0.46 | 0 | 1 | 108 |
| PTA Committee is Elected = 1 | 0.85 | 0.35 | 0 | 1 | 108 |
| PTA Keeps Archives = 1 | 0.46 | 0.50 | 0 | 1 | 108 |
| PTA Plan Activities in Ahead = 1 | 0.47 | 0.50 | 0 | 1 | 108 |
| PTA Has Bank Account = 1 | 0.67 | 0.47 | 0 | 1 | 108 |
| PTA Pays Teachers = 1 | 0.48 | 0.50 | 0 | 1 | 108 |
| PTA Informs Community = 1 | 0.95 | 0.22 | 0 | 1 | 108 |
| PTA Set Contribution Amounts= 1 | 0.21 | 0.41 | 0 | 1 | 108 |
| PTA Size of Committee | 10.50 | 2.40 | 2 | 17 | 108 |
| PTA Number of Meetings | 5.93 | 5.01 | 2 | 45 | 108 |

The variables labels starting with HT means it is the Head teacher's response, HH means Household's response, PTA = PTA member's response

**Table 19.** PTA Summary Statistics

| | Mean | Std Dev. | Min | Max | Obs |
|---|---|---|---|---|---|
| *School Characteristics* | | | | | |
| Funds Received (USD) | 1137.79 | 856.33 | 0 | 7760 | 108 |
| School Feeding = 1 | 0.14 | 0.35 | 0 | 1 | 108 |
| School Fee (USD) | 1.42 | 2.29 | 0 | 12 | 108 |
| Clean Water = 1 | 0.43 | 0.49 | 0 | 1 | 108 |
| Library = 1 | 0.04 | 0.19 | 0 | 1 | 108 |
| Student Teacher Ratio | 51 | 28.78 | 18.14 | 269 | 108 |
| Head Teacher is Male = 1 | 0.82 | 0.39 | 0 | 1 | 108 |
| Head Teacher's Tenure (Yrs) | 21.28 | 5.30 | 2 | 31 | 108 |
| Number of Classrooms | 5.17 | 1.41 | 1 | 8 | 108 |
| *School/Student Performance* | | | | | |
| Success Rate CEP 2004 | 72.30 | 22.40 | 0 | 100 | 108 |
| Success Rate Last Test | 69.55 | 20.70 | 36.71 | 100 | 108 |
| Standardized Literacy Score | 29.83 | 24.97 | 0 | 100 | 910 |
| *Student* | | | | | |
| Student Gender Male = 1 | 0.51 | 0.50 | 0 | 1 | 982 |
| Student Age | 9.12 | 1.81 | 5 | 18 | 877 |
| Class Size | 51.27 | 19.72 | 6 | 114 | 974 |

**Table 20.** School Characteristics summary Statistics

| Factor | Eigenvalue | Variable | Factor Loadings 1 | Factor Loadings 2 |
|---|---|---|---|---|
| 1 | 1.65 | HH PTA Member = 1 | 0.87 | 0.03 |
| 2 | 1.20 | HH PTA Participation =1 | 0.66 | -0.05 |
| 3 | 0.67 | PTA Written Status = 1 | 0.03 | 0.61 |
| 4 | 0.49 | PTA Committee Funct = 1 | 0.01 | 0.13 |
| 5 | - | PTA Committee elected=1 | -0.14 | 0.29 |
| 6 | - | PTA Keeps Archives = 1 | 0.02 | 0.62 |
| 7 | - | PTA Plan Activities = 1 | 0.04 | 0.40 |
| 8 | - | PTA Has Bank Account = 1 | -0.01 | 0.12 |
| 9 | - | PTA Pays Teachers = 1 | -0.26 | -0.01 |
| 10 | - | PTA Informs Community = 1 | 0.03 | 0.14 |
| 11 | - | HT Parents Contribute = 1 | -0.01 | -0.03 |
| 12 | - | HT Parents Approves Expenses = 1 | -0.29 | 0.17 |
| 13 | - | PTA Set Contribution = 1 | -0.23 | 0.24 |
| 14 | - | PTA Member of Committee = 1 | -0.22 | 0.37 |
| 15 | - | PTA Nber Meetings | -0.31 | -.01 |
| 16 | - | HT PTA Exist = 1 | 0.05 | 0.05 |

**Table 21.** Factor Analysis (Rotated Loadings)

| Dependent Variable | Success Rate CEP 04 | | Last School Test | |
|---|---|---|---|---|
| | 1st Stage | 2nd Stage | 1st Stage | 2nd Stage |
| Instrument | 0.33*** | - | 0.34*** | |
| | (0.08) | - | (0.09) | |
| PTA Score 1 | - | 15.58*** | - | 19.53*** |
| | - | (6.12) | - | (5.95) |
| Student teacher Ratio | 0.00 | -0.06** | 0.00 | 0.06 |
| | (0.00) | (0.03) | (0.00) | (0.06) |
| Number of classroom | -0.19*** | 3.92*** | -0.22*** | 3.83** |
| | (0.03) | (1.40) | (0.04) | (1.59) |
| Experience Head | 0.00 | -0.83*** | -0.03*** | 0.05 |
| | (0.00) | (0.18) | (0.01) | (0.27) |
| Resources | 0.00 | 0.002** | -0.00 | 0.004*** |
| | (0.00) | (0.001) | (0.00) | (0.001) |
| Tuition | -0.07*** | 1.80*** | -0.06*** | 2.73*** |
| | (0.01) | (0.58) | (0.02) | (0.57) |
| Constant | 0.89*** | 67.54*** | 1.59*** | 35.15*** |
| | (0.18) | (8.37) | (0.29) | (13.04) |
| Observation | 108 | 108 | 108 | 108 |
| R Squared | 0.11 | - | 0.12 | - |

t-statistics in parentheses, *= 10% significant, **= 5%, and ***= 1%

**Table 22.** 2SLS Estimates with First factor for the PTA

| Dependent Variable | Success Rate CEP 04 | | Last School Test | |
|---|---|---|---|---|
| | 1st Stage | 2nd Stage | 1st Stage | 2nd Stage |
| Instrument | 0.28*** | - | 0.31*** | - |
| | (0.08) | - | (0.10) | - |
| PTA Score 2 | - | 17.36*** | - | 21.56*** |
| | - | (6.99) | - | (7.54) |
| Student teacher Ratio | 0.00 | -0.06* | 0.004 | 0.00 |
| | (0.00) | (0.03) | (0.002) | (0.00) |
| Number of classroom | 0.11*** | -1.12 | 0.02 | -0.44 |
| | (0.03) | (1.08) | (0.04) | (1.06) |
| Experience Head | 0.03*** | -1.39*** | -0.00 | -0.44** |
| | (0.01) | (0.26) | (0.00) | (0.23) |
| Resources | 0.00*** | 0.00 | 0.00** | 0.00 |
| | (0.00) | (0.00) | (0.00) | (0.00) |
| Tuition | 0.07*** | -0.73 | 0.05** | 0.35 |
| | (0.02) | (0.72) | (0.02) | (0.58) |
| Constant | -1.70** | 110.98 | -0.63* | 79.70*** |
| | (0.20) | | (0.33) | (7.55) |
| Obs. | 108 | 108 | 108 | 108 |
| R Squared | 0.11 | - | 0.04 | - |

t-statistics in parentheses, *= 10% significant, **= 5%, and ***= 1%

**Table 23.** 2SLS Estimates with Second factor for the PTA

| Standardized Literacy Test | 1st Stage | 2nd Stage |
|---|---|---|
| Instrument | 0.33 *** | - |
| | (0.08) | - |
| PTA Score 1 | - | 20.55 *** |
| | - | (7.34) |
| Student teacher Ratio | -0.00 | 0.07 |
| | (0.00) | (0.04) |
| Number of classroom | -0.17 *** | 3.25 ** |
| | (0.03) | (1.48) |
| Experience Head | 0.00 | -0.47 ** |
| | (0.00) | (0.21) |
| Resources | 0.00 | 0.00 |
| | (0.00) | (0.00) |
| Tuition | -0.08 *** | 3.65*** |
| | (0.02) | (0.72) |
| Kindergarten | 0.20 *** | 1.55 |
| | (0.10) | (3.21) |
| Parent Literacy | -0.30 *** | 0.11 |
| | (0.07) | |
| Constant | 0.91 *** | 5.42 |
| | (0.19) | (10.07) |
| Obs. | 895 | 895 |
| R Squared | 0.12 | - |

t-statistics in parentheses. Standard error clustered at school level *= 10% significant, **= 5%, and ***= 1%

**Table 24.** 2SLS Estimates with First factor for the PTA.

| Standardized Literacy Test | 1st Stage | 2nd Stage |
|---|---|---|
| Instrument | 0.26*** | - |
| | (0.09) | - |
| PTA Score 2 | - | 26.17*** |
| | - | (9.85) |
| Student teacher Ratio | 0.00 | 0.02 |
| | (0.00) | (0.05) |
| Number of classroom | 0.08*** | -2.29* |
| | (0.03) | (1.2) |
| Experience Head | 0.03*** | -1.21*** |
| | (0.00) | (0.34) |
| Resources | 0.00*** | -0.00 |
| | (0.00) | (0.00) |
| Tuition | 0.08*** | -0.03 |
| | (0.02) | (0.97) |
| Constant | -1.85*** | 72.75*** |
| | (0.21) | (17.35) |
| Kindergarten | 0.06 | 3.94 |
| | (0.10) | (3.07) |
| Parents Literacy | 0.46*** | -6.67 |
| | (0.08) | (5.19) |
| Obs. | 895 | 895 |
| R Squared | 0.14 | . |

t-statistics in parentheses. Standard error clustered at school level *= 10% significant, **= 5%, and ***= 1%

**Table 25.** 2SLS Estimates with Second factor for the PTA.

| | Obs. | All | Kindergarten? | | Books home? | |
|---|---|---|---|---|---|---|
| | | | No | Yes | No | Yes |
| Overall Score | 920 | 0.35 | 0.34 | 0.39*** | .26 | .35*** |
| | | (0.19) | (0.18) | (0.20) | (.23) | (.25) |
| Understanding | 987 | 0.38 | .36 | .45*** | .33 | .43 *** |
| | | (.28) | (.27) | (.28) | (.27) | (.27) |
| Coherent Reading | 967 | .21 | .19 | .28*** | .16 | |
| | | (.27) | (.25) | (.32) | (.14) | |
| Sound Id. | 1016 | .19 | .18 | .24*** | .15 | .23*** |
| | | (.26) | (.25) | (.29) | (.22) | (.29) |
| Letter recognition | 1018 | .38 | .37 | .44*** | .35 | .42*** |
| | | (.29) | (.28) | (.31) | (.28) | (.30) |
| Word Identification | 1012 | .21 | .19 | .27*** | .17 | .25*** |
| | | (.27) | (.25) | (.30) | (.23) | (.29) |
| Word Segmentation | 1016 | .45 | .43 | .52*** | .40 | .50*** |
| | | (.30) | (.30) | (.30) | (.30) | (.29) |

t-statistics in parentheses. Standard error clustered at school level *= 10% significant, **= 5%, and ***= 1%

**Table 26.** Test of comparison of means: Kindergarten attendance and possession of books

| | Observations | All | Parent Literate? | |
|---|---|---|---|---|
| | | | No | Yes |
| Overall Score | 920 | 0.35 | .32 | .35*** |
| | | (0.19) | (.17) | (.19) |
| Understanding | 987 | 0.38 | .31 | .42*** |
| | | (.28) | (.26) | (.28) |
| Coherent Reading | 967 | .21 | .16 | .23*** |
| | | (.27) | (.23) | (.28) |
| Sound Identification | 1016 | .19 | .16 | .21*** |
| | | (.26) | (.13) | (.19) |
| Letter recognition | 1018 | .38 | .34 | .41*** |
| | | (.29) | (.26) | (.30) |
| Word Identification | 1012 | .21 | .17 | .23*** |
| | | (.26) | (.25) | (.27) |
| Word Segmentation | 1016 | .45 | .31 | .41*** |
| | | (.30) | (.29) | (.38) |

t-statistics in parentheses. Standard error clustered at school level *= 10% significant, **= 5%, and ***= 1%

**Table 27.** Test of comparison of means. Literacy of the parents

| | | | Gender | | Electricity at Home? | |
|---|---|---|---|---|---|---|
| | Obs. | All | Female | Male | No | Yes |
| Overall Score | 920 | 0.35 | .29 | .31* | .25 | .36*** |
| | | (0.19) | (.27) | (.29) | (.21) | (.26) |
| Understanding | 987 | .0.38 | .37 | .38 | .31 | .44*** |
| | | (.28) | (.35) | (.36) | (.25) | (.28) |
| Coherent Read | 967 | .21 | .20 | .22 | 0.15 | 0.26*** |
| | | (.27) | (.26) | (.28) | (0.21) | (0.26) |
| Sound Identif. | 1016 | .19 | .17 | .20* | .15 | .23*** |
| | | (.26) | (.24) | (.28) | (.22) | (.29) |
| Letter Recogn. | 1018 | .38 | .37 | .40* | .35 | .43*** |
| | | (.291) | (.29) | (.29) | (.27) | (.31) |
| Word Identif. | 1012 | .21 | .19 | .22** | .17 | .25*** |
| | | (.26) | (.25) | (.29) | (.23) | (.29) |
| Word Segm | 1016 | .45 | .43 | .47 | .41 | .49*** |
| | | (.30) | (.29) | (.31) | (.30) | .29 |

t-statistics in parentheses. Standard error clustered at school level *= 10% significant, **= 5%, and ***= 1%

**Table 28.** Test of comparison of means. Gender and electricity at home

# Appendix B2: Figures for chapter 2

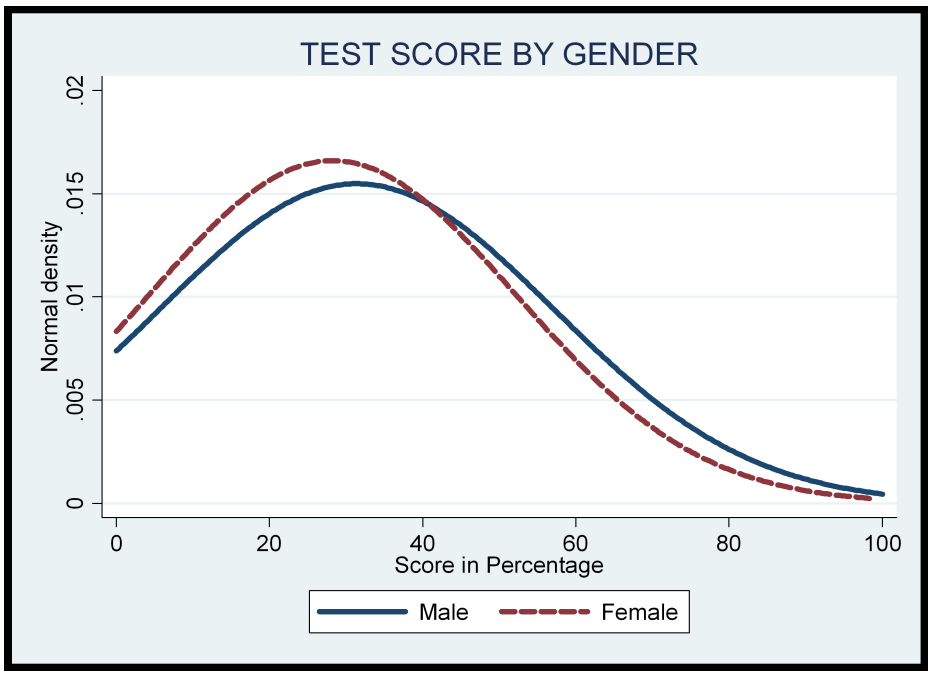


**Figure 17.** Test Score by Gender

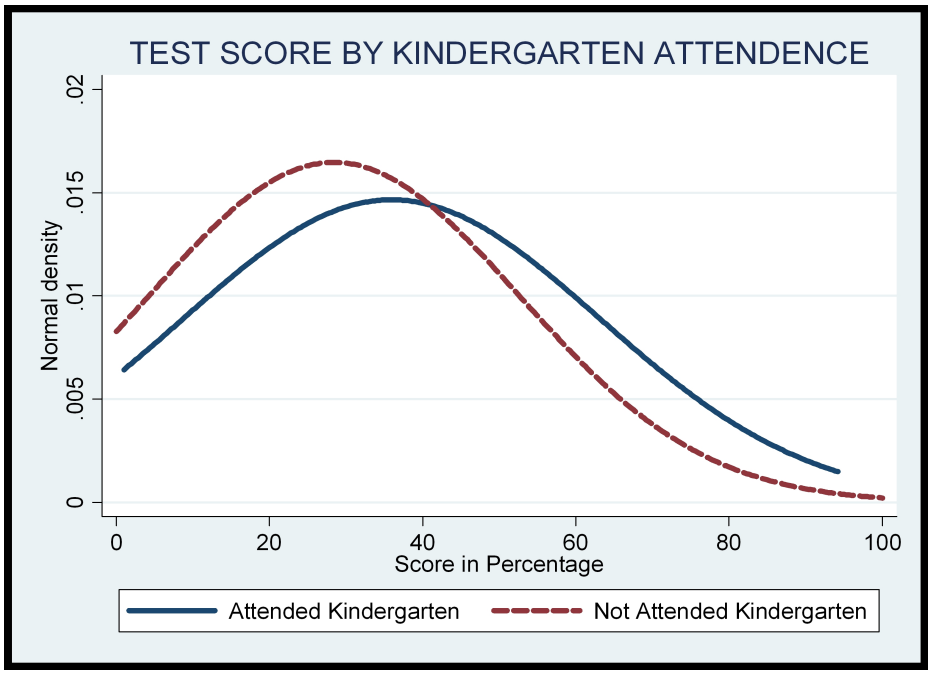


**Figure 18.** Test Score by Kindergarten Attendance

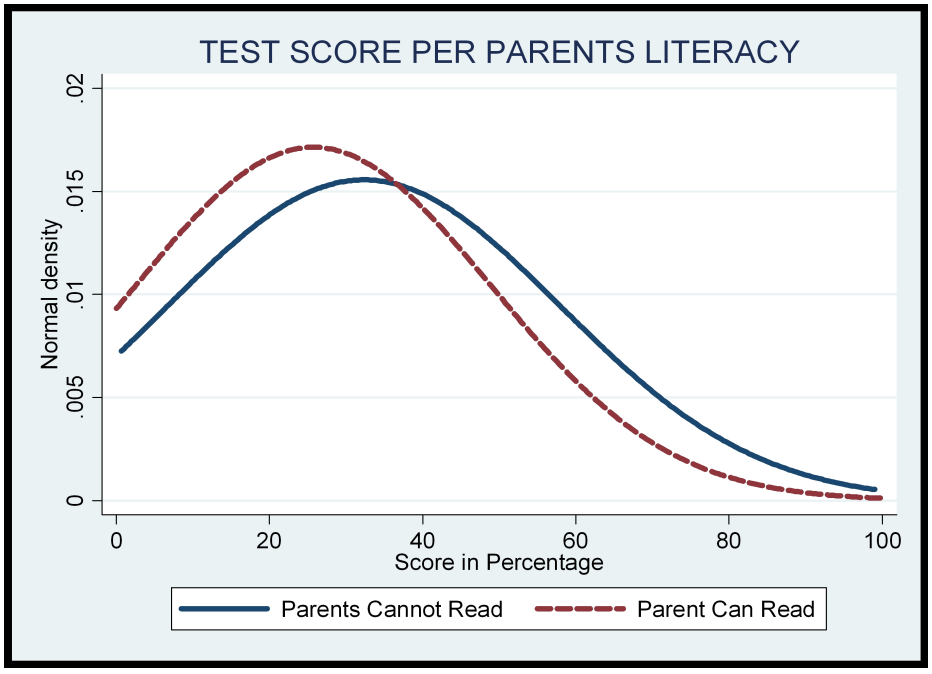


**Figure 19.** Test Score by Parents' Literacy

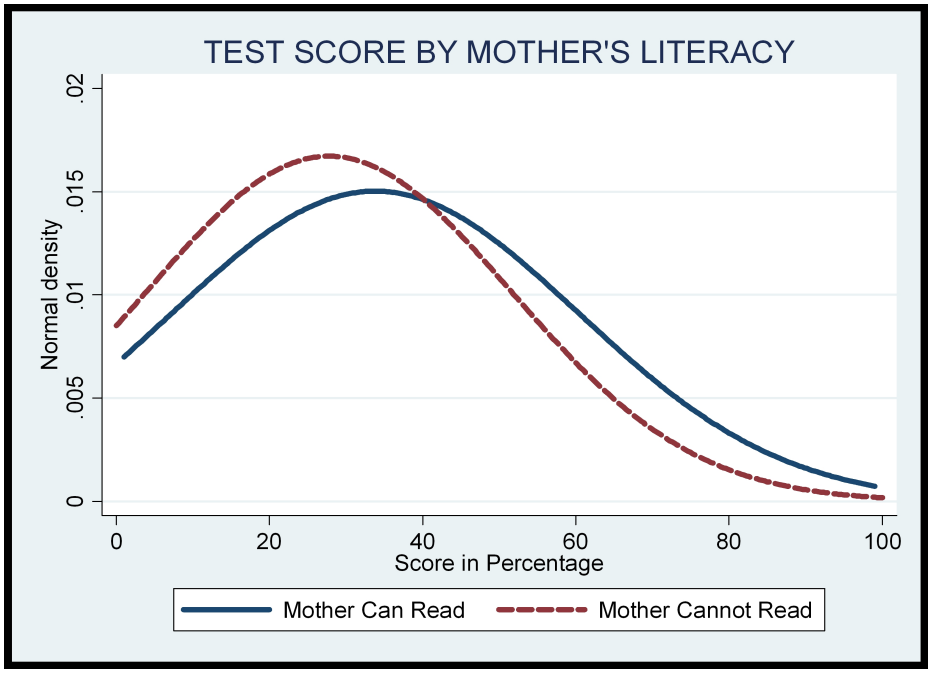


**Figure 20.** Test Score by Mother's Literacy

# Appendix C1: Tables for Chapter 3

| | *L* | *LO* |
|---|---|---|
| Time since known each other (Month) | 81.48*** | 47.17 |
| | (10.20) | (6.40) |
| Had Past Professional relation =1 | 0.46*** | 0.18 |
| | (0.04) | (0.02) |
| Same ethnic group = 1 | 0.63*** | 0.48 |
| | (0.04) | (0.03) |
| Age of the rider | 28.11 | 28.84 |
| | (0.53) | (0.37) |
| Formal Contract =1 | 0.42*** | 0.66 |
| | (0.05) | (0.04) |
| Collateral = 1 | 0.24 | 0.43*** |
| | (0.04) | (0.03) |
| Price of the Motorcycle | 392 | 432** |
| | (14.22) | (8.87) |
| Weekly Payment | 11.50* | 11 |
| | (0.69) | (0.15) |
| Total Payment (Before ownership) | No limit | 687 |
| | - | (232) |
| Observations | 159 | 260 |

Standard errors in parenthesis. Test of comparison of means: ***, **, * means that the difference is statistically significant a the 1% level, respectively 5%, and 10%

**Table 29.** Key characteristics per contract

| | I | II | III | IV | V | VI | VII |
|---|---|---|---|---|---|---|---|
| Trust | 0.30*** | 0.36*** | 0.35*** | 0.27*** | 0.27*** | 0.31*** | 0.24** |
| | (0.07) | (0.08) | (0.08) | (0.09) | (0.09) | 0.09 | 0.10 |
| Owner's education | - | -0.07*** | -0.06** | -0.04 | -0.04 | -0.04 | 0.01 |
| | | (0.03) | (0.03) | (0.03) | (0.03) | 0.03 | 0.04 |
| Owner's nber of motorcy. | - | - | -0.18*** | -0.13** | -0.13** | -0.13** | -0.14** |
| | | | (0.05) | (0.05) | (0.05) | 0.05 | 0.05 |
| Price of the motorcycle | - | - | - | 0.001* | 0.001* | -0.001** | -0.001 |
| | | | | (-0.0001) | (-0.0001) | 0.0001 | 0.0001 |
| Owner has other revenues | - | - | - | - | -0.21 | -0.21 | -0.21 |
| | | | | | (0.35) | 0.35 | 0.37 |
| Age rider | - | - | - | - | -0.21 | -0.03* | 0.04* |
| | | | | | (0.35) | 0.02 | 0.02 |
| Country Dummy | - | - | - | - | - | - | Yes |
| Year Dummy | - | - | - | - | - | - | Yes |
| Constant | -0.32*** | -0.10 | 0.22*** | 0.56* | 0.82* | 1.67** | 1.70** |
| | (0.07) | (0.10) | ()0.14 | (0.31) | (0.45) | (0.67) | (0.71) |
| Pseudo R2 | 0.04 | 0.07 | 0.11 | 0.10 | 0.10 | 0.11 | 0.18 |
| Obs | 342 | 300 | 278 | 215 | 211 | 211 | 211 |

***, **, * means that the difference is statistically significant a the 1% level, respectively 5%, and 10%. Standard errors in parenthesis. The main independent variable is the variable "Trust", that is constructed through factor analysis.

**Table 30.** Probit estimates. Dependent variable is the contract.

| | I | II | III | IV | V | VI |
|---|---|---|---|---|---|---|
| Trust (Ethnicity) | 0.36*** | 0.43*** | 0.38*** | 0.29* | 0.27* | 0.41** |
| | (0.13) | (0.14) | (0.14) | (0.15) | (0.09) | (0.19) |
| Owner's education | - | -0.08*** | - | -0.04 | -0.04 | 0.02 |
| | | (0.02) | (0.02) | - | (0.03) | 0.04 |
| Owner's nber of motorc. | - | - | -0.15*** | -0.13** | -0.13** | -0.15*** |
| | | | (0.05) | (0.05) | (0.05) | (0.05) |
| Price of the motorcycle | - | - | - | 0.001** | 0.002*** | -0.001 |
| | | | | (-0.0001) | (-0.0001) | 0.0001 |
| Owner has other revenues | - | - | - | - | -0.8 | -0.16 |
| | | | | | (0.35) | (0.30) |
| Age rider | - | - | - | - | -0.0.01 | 0.02 |
| | | | | | (0.02) | (0.02) |
| Country dummy | - | - | - | - | - | Yes |
| Year dummy | - | - | - | - | - | Yes |
| Constant | -0.50*** | -0.32*** | 0.05 | 0.56* | 0.82* | -0.24 |
| | (0.09) | (0.08) | (0.16) | (0.31) | (0.45) | (0.69) |
| Pseudo R2 | 0.01 | 0.05 | 0.08 | 0.10 | 0.10 | 0.18 |
| Obs | 419 | 336 | 297 | 297 | 251 | 251 |

***, **, * means that the difference is statistically significant a the 1% level, respectively 5%, and 10%. Standard errors in parenthesis. The main independent variable is the variable "Trust", that is measured as sharing the same ethnic group

**Table 31.** Probit estimates. Dependent variable is the contract.

| | *L* | *LO* | Total |
|---|---|---|---|
| Higher speed than normal (%) | 0.47** | 0.35 | 0.40 |
| | (0.04) | (0.03) | (0.02) |
| Accidents & Mishaps (% last week) | 0.44 | 0.38 | 0.41 |
| | (0.04) | (0.03) | (0.03) |
| Take breaks (Other than lunch) | 0.77 | 0.86** | 0.83 |
| | (0.03) | (0.02) | (0.02) |
| Revenues yesterday | 7.26*** | 5.60 | 6.17 |
| | (0.34) | (0.22) | (0.19) |
| Revenues maximum | 11.05*** | 9.49 | 10.08 |
| | (0.30) | (0.26) | (0.20) |
| Revenues minimum | 2.48 | 2.48 | 2.48 |
| | (0.10) | (0.10) | (0.07) |
| Turnover (Number of past owners) | 2.40*** | 1.74 | 1.94 |
| | (0.18) | (0.08) | (0.08) |
| Observations[@] | 159 | 263 | 422 |

***, **, * means that the difference is statistically significant a the 1% level, respectively 5%, and 10%. Standard errors in parenthesis. [@] The number of observations varies across variables due to missing data.

**Table 32.** Riders' behavior and risk taking per type of contract

| | I | II | III | IV | V | VI |
|---|---|---|---|---|---|---|
| Contract | 0.28*** | 0.31*** | 0.31*** | 0.30** | 0.31*** | 0.26** |
| | (0.10) | (0.11) | (0.12) | (0.12) | (0.12) | (0.12) |
| Trust | - | 0.08 | 0.08 | 0.08 | 0.06 | 0.06 |
| | - | (0.06) | (0.06) | (0.06) | (0.06) | (0.06) |
| Rider has children | - | - | - | - | - | -0.15*** |
| | - | - | - | - | - | (0.05) |
| Age of the Rider | No | No | Yes | Yes | Yes | Yes |
| Rider' years of schooling | No | No | No | Yes | Yes | Yes |
| Constant | -0.11* | 0.42** | 0.72*** | -0.14 | -0.03 | -0.33 |
| | (0.06) | (0.29) | (0.30) | (0.30) | (0.31) | (0.32) |
| R-square | 0.02 | 0.03 | 0.03 | 0.04 | 0.04 | 0.06 |
| Obs | 398 | 327 | 327 | 322 | 321 | 318 |

***, **, * means that the difference is statistically significant a the 1% level, respectively 5%, and 10%. Standard errors in parenthesis. The dependent variable is a measure of behavior and risk taking on the road.

**Table 33.** Effect of the contract's incentive versus trust.

| **Trust ( 1 Factor retained)** | | | |
|---|---|---|---|
| Factor | Eigenvalue | Variables | Rotated Factor Loading |
| 1 | 1.38 | Duration relation | 0.79 |
| 2 | 1.09 | Past Prof. relation =1 | 0.44 |
| 3 | 1.01 | Same Ethic Group=1 | 0.69 |
| **Behavior at the workplace** | | | |
| Factor | Eigenvalue | Variables | Rotated Factor Loading |
| 1 | 1.41 | Speed | 0.00 |
| 2 | 1.24 | Breaks | 0.72 |
| 3 | 0.88 | Accidents & Mishaps | 0.58 |
| 4 | 0.46 | Revenue | 0.72 |

**Table 34.** Factor Analysis

# Appendix C2: Figures for chapter 3

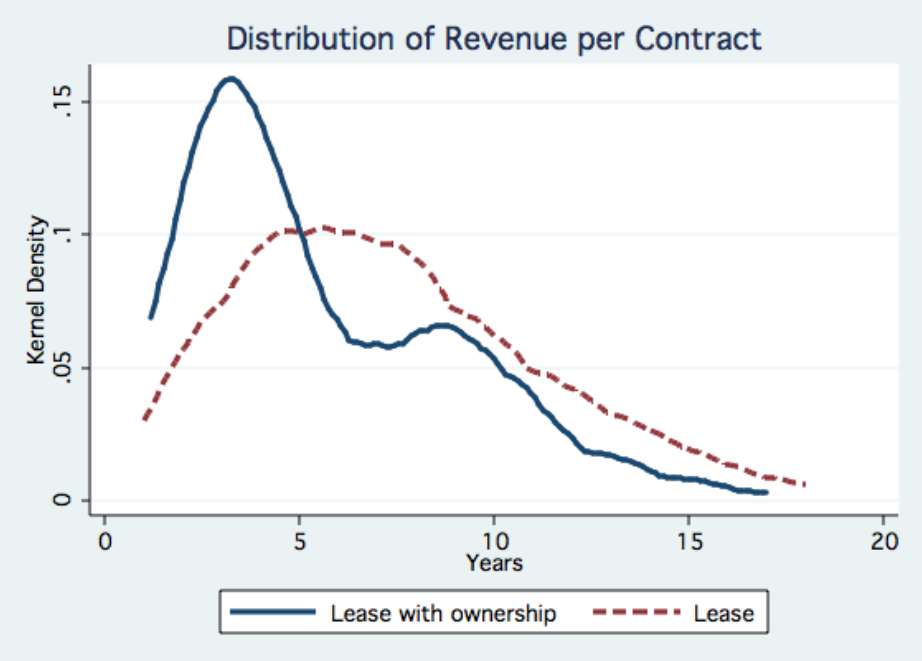


**Figure 21.** Revenue per type of contract


**Figure 22.** Distribution of riders' age by type of contract

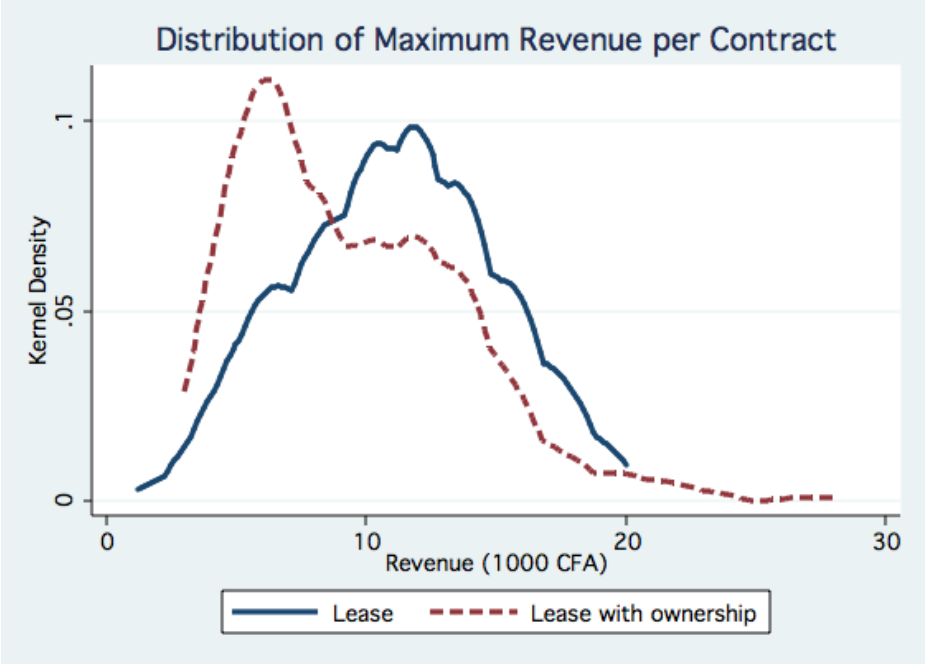


**Figure 23.** Distribution of daily maximum revenue ever made.

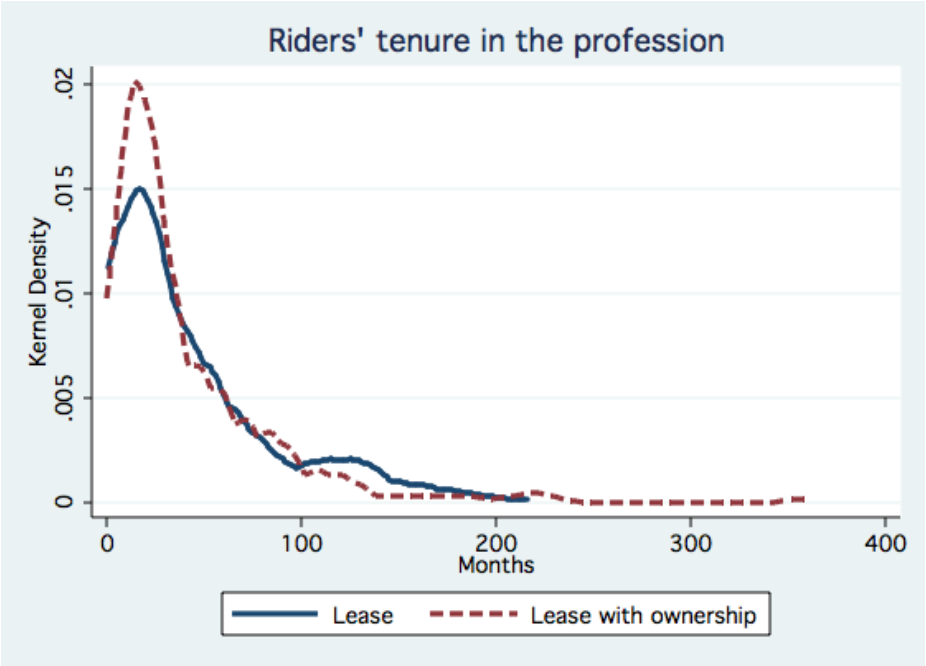


**Figure 24.** Riders' tenure in the profession of Zemidjan

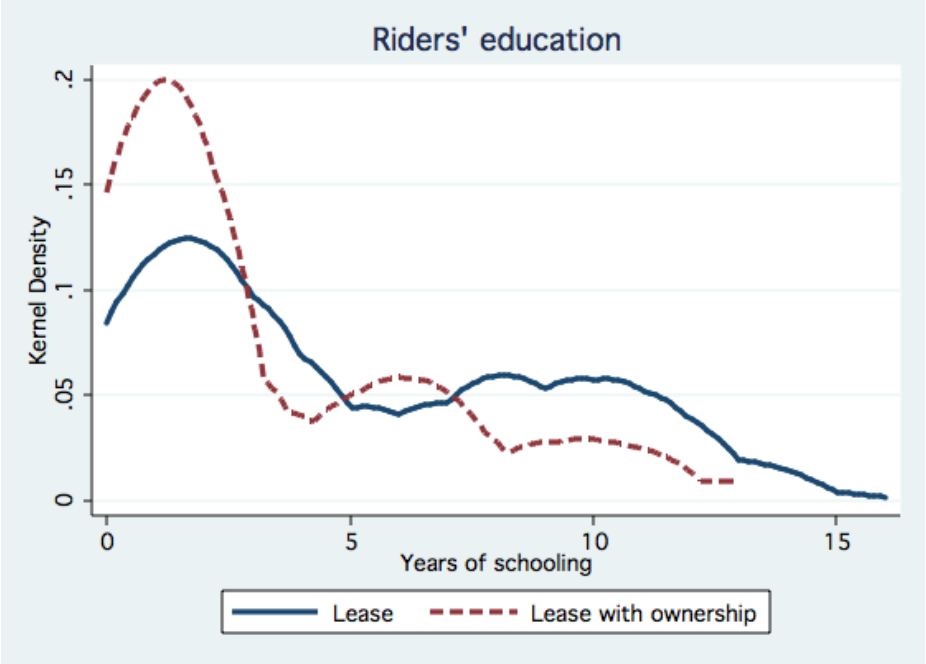


**Figure 25.** Riders' Education

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