# Private Tutoring in Mauritius*

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**Abstract**

Private tutoring is widespread in Mauritius where it is considered to divert resources away from public schooling. Students use private tutoring as a mechanism to catch-up with and/or overtake other students when skilled labor positions are attributed to those with the highest human capital. We assess the merits of the proposed solutions of raising public teachers' wages and changing their selection mechanism to curb private tutoring and show that both are counter-productive.

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# 1 Introduction

> "Private tutoring unfortunately has been institutionalized and has become a destabilizing feature. It is the source of lack of interest for class work, unruly conduct at school, outright truancy and induced absenteeism because of frustration and tiredness." (Ministry of Education, 1997)

The jury is out on the education system in Mauritius where the government sees private tutoring as the worm eating away at it. It is an understatement to say that private tutoring is indeed a major player in the Mauritian school system.[1] According to Foondun (1992) more than 90% of secondary school students take after-school private tutoring, and it will be hard to find a primary school pupil who does not take private tutoring. Among a series of measures launched by the Mauritian government to improve the efficiency of the school system, the most significant ones are abolishing ranking-based promotion from the primary to the secondary level, and improving the remuneration package of teachers.

In this paper we ask whether these measures will effectively reduce private tutoring. We show that private tutoring arises endogenously because of the expected rewards obtained by skilled workers, and the use of human capital as a selection device for these positions. Pupils use private tutoring to complement the education they receive in public schools, and to increase the likelihood of winning the best-paid position. If human capital is used as a discriminating hiring device, an increase in the wage of skilled workers will not reduce

[1] See Marimuthu et al. (1991) for a critical view of private tutoring in general. Private tutoring is also pervasive in developed education systems, such as the US (Duke, 1986; Gordon and Gordon, 1986), and Japan (White, 1987).

private tutoring. In fact, more pupils will demand private tutoring because the relative wage of skilled labor has increased, and teachers have all incentives to supply private tutoring.

We do not raise the normative issue of the desirability of tutoring in this paper, but start instead from the postulate that tutoring should be eliminated. However, private tutoring can be an efficient complement to formal schooling for those experiencing difficulties (Glass, 1984). Moreover, tutoring can be thought of as a convexifying mechanism when there are indivisibilities associated with public schooling (Boldrin, 1992; Epple and Romano, 1998), and in that sense is similar to private education. We abstract completely from these issues in this research.

The rest of the paper is organized as follows. We provide a brief description of the Mauritian education system and the incentives that prompt students to take private tutoring in section 2. Section 3 presents the model, and section 4 derives the necessary and sufficient conditions for the existence of private tutoring. Section 5 concludes the paper. All proofs are given in the appendix.

## 2 The Education System in Mauritius

The school system in Mauritius consists of six years of primary school, followed by at most seven years in the secondary school. In 1996, there were 269 primary schools with a total enrollment of almost 120,000 students, and 127 secondary schools with over 90,000 students. The enrollment rate in primary schools was of 107% in 1996, but of only 52% at the secondary

level.[2] Although some schools are privately owned, both primary and secondary education are completely free. Students pay no tuition fee, and the overwhelming majority of privately-owned schools receive transfers from the government which cover all their expenses. In fact there is no significant difference between the quality of government or privately-owned schools, although at the secondary level the best schools are government-owned.[3]

At the end of six years of primary school, students sit for an island-wide exam, the Certificate of Primary Education (CPE), where they are ranked. These rankings matter considerably for the choice, and type of secondary school which the students can attend. There is a two-tier secondary school system in Mauritius. On the one hand, those who fail the CPE exam have the choice between joining the labor market or attending basic secondary schools where they can acquire technical skills. On the other hand, those who succeed the CPE can attend one of the regular secondary schools where they sit for the School Certificate after five years. If they pass that exam, they take two more years of schooling, sit for the Higher School Certificate (HSC) where there is an island-wide ranking.

Those students who are ranked first at the HSC obtain full scholarships to study in universities of their choice around the world. Such a scholarship represents a considerable amount of money because of the relatively high cost of living and tuition fees at those

[2]These numbers include continuing education. The loss of such a high number of students from the primary to secondary level is viewed by the government as a serious problem.

[3]In 1998, out of the 127 secondary schools, 104 were privately-owned and 96 of them were entirely funded by transfers from the government. The *French Lycée* is one such private school which receives no government transfers but where students follow the French curricular which differs completely from what is taught in the other schools where classes are conducted in English and the curriculum dates from British rule. Many secondary schools are gender specific, and those which consistently have the best success rates are the *Queen Elizabeth's College* for girls, and the two *Royal Colleges* for boys.

universities once they are converted in domestic currency. Given that the same secondary schools consistently rank their students first in the HSC, competition to win a seat in those institutions is fierce. As the choice of the secondary school to attend is based on the pupil's rank in the CPE, being highly ranked in the exam is seen as a necessary condition to have stand chance in winning a good scholarship to attend a university and secure a well-paid position. Private tutoring is widely regarded as a mean of improving a student's results at both the CPE and the HSC exams.

In Mauritius, primary school teachers are selected amongst a pool of candidates who have at least a School Certificate. Those with top scores stand a better chance to be recruited for the two-year program at the teacher's training college which eventually allows them to become primary school teachers. As for secondary school teachers, they must at least hold a HSC and either a teacher's diploma from the Mauritius Institute of Education or a university degree. Being a teacher is highly regarded upon because of its social prestige, and of the good stipend. For instance the starting salary for a primary school teacher is 5,675 rupees and reaches a maximum of 10,470 rupees, while a secondary school teacher makes between 6,275 rupees and 14,470 rupees. By comparison, an unskilled employee working for the government, such as a laborer or a cleaner, makes a minimum of 3,590 rupees and a maximum of 5,375 rupees.

In addition to their wages, teachers rationally anticipate that they can easily double their income by giving private tutoring. The latter rarely takes the form of one-to-one coaching. The teacher lectures a group of students after school hours. At the primary level these

groups can be composed of 20 students but at the secondary level it is somewhat smaller. A primary school teacher can currently charge as much as 400 rupees per student, and in some instances will be giving private tutoring to three groups of students. The next section incorporates these institutional elements into a general-equilibrium model which formalizes private tutoring.

# 3 The Model

Consider an economy where individuals live one period as young agents and one period as old agents. In all periods, two generations of agents are alive. Young agents spend their one unit of time endowment either receiving education or working in a consumption good sector. Old agents spend their one unit of time endowment either working or providing education to young agents. The size of each generation is normalized to one. Young agents are also endowed with agent-specific human capital, $\eta$, drawn from a uniform distribution with support [0,1]. Agents derive lifetime utility from consumption of the nondurable numeraire good in each of the periods of their life-cycle. For tractability we assume that a young agent's lifetime utility is:[4]

$$U = c + \beta c' \tag{1}$$

[4]Considering risk-averse individuals would preclude us from obtaining closed-form equilibrium prices as can be seen in the Appendix.

where $c$ denotes consumption, primed variables ($'$) are next-period variables, and $\beta$ is a time preference discount factor satisfying $0 < \beta < 1$. Hereafter, a young agent endowed with $\eta$ units of human capital shall simply be referred to as agent $\eta$.

Education is compulsory up to a level $g \in (0, 1)$, measured in units of young agents' time, and is provided free of charge by an infinitely-lived government. For simplicity, assume this legislation is fully enforceable. Since education is compulsory, a young agent who attends public school may allocate her remaining time, $1 - g$, either to working in the consumption good sector, or to receiving human capital-enhancing private tutoring for $e$ units of time. As for the adult, she can participate in the market for unskilled laborers where she receives a unit wage of $w$, or she can be hired to work as a public school teacher for $g$ units of time.[5]

To capture the main features of the teachers' hiring mechanism in Mauritius, we make the following assumptions. An agent's initial endowment, her public school-acquired knowledge, and her private tutoring-acquired knowledge, combine additively to determine her next-period human capital, which we denote as $h'$:

$$h' = \eta + \theta_g g + \theta_e e \tag{2}$$

where $\theta_g$ and $\theta_e$ are efficiency parameters. Note that human capital does not depreciate, it is agent specific, and it is finite with a natural upper bound $h_{\max} \equiv 1 + \theta_g g + \theta_e(1 - g)$. We also assume that teachers are recruited on the basis of their score in a selection test which

[5]Young agents' labor market participation should not be seen as "child labor", since in our model, labor force participation does not trade off mandatory education. It can be viewed as off-school labor activities such as helping parents on the farm, baby-sitting, ..., which do not necessary take from schooling time.

is open only to adults. Given the distribution of the test scores, the government selects an arbitrarily small measure $\lambda$ of the best scores. Should there be a tie between two or more candidates, selection will be done randomly among those candidates. Finally an agent's test score equals her accumulated human capital. Since the range of test scores is always bounded, to allow for leap-frogging among heterogeneous agents we assume that the upper bound of this range, $\overline{h}$, is strictly less than $h_{\max}$. To justify this assumption, suppose this were not the case and $\overline{h} = h_{\max}$. In this case, in equilibrium, only agent $\eta = 1$ will attain a score of $\overline{h}$, and the upper tail of the ex-post distribution of scores would be identical to the distribution of human capital endowments. No agent would be able to catch up with the others in the race for a teacher's position. We assume in the rest of the paper that $\overline{h} = 1 + \theta_g g$. This guarantees that everyone, except those with $\eta = 1$, need private tutoring to obtain the maximum score.[6]

Given her preferences, and since the consumption good is non-storable, the young agent's first-period budget constraint is:

$$c + pe = (1 - g - e)w \tag{3}$$

where $p$ is the unit cost of private tutoring. In the second period of her life, the agent can be in either one of two positions. She may not have been recruited as a school teacher in which case she supplies her time endowment inelastically on the unskilled labor market, pays $t$ as

[6]An alternative interpretation is that we approximate a monotone increasing and concave test score technology by a piecewise linear function.

lump-sum taxes, and consumes all her net income. Her budget constraint is:

$$c' = w' - t \tag{4}$$

If on the other hand she is recruited as a public school teacher, she receives a salary $gs$, where $s$ is the hourly wage. She is left with $(1-g)$ units of time of which she supplies $v'$ units giving private tutoring, and supplies the remainder, $(1-g-v')$ on the unskilled labor market. In this case, her budget constraint is:

$$c' = gs + v'p' + (1-g-v')w' - t \equiv w_s - t \tag{5}$$

where $w_s$ is the teacher's gross income and is explicitly defined. If $v' = (1-g)$, we say that the teacher specializes completely in education.

We assume that aggregate human capital, $H$, is a positive externality in the production of the numeraire commodity. Let $L$ denote aggregate unskilled labor, total output $Y$ is:

$$Y = HL \tag{6}$$

The production function (6), known as the AK technology (Barro and Sala-i-Martin, 1995), has the convenient property that it allows for analytical expressions for equilibrium prices. More flexible technologies will not necessarily add much to our conclusions and would force

us to use numerical methods. Under the assumption that both the input and the output market are perfectly competitive, unskilled labor is paid its marginal product $H$.

In deciding whether or not to demand private tutoring, an agent forms her expectations about the likelihood that she will be hired as a public school teacher if she allocates an additional unit of time to private tutoring. Since we are not interested in the exact identity those who are selected as teachers for the next period, we focus exclusively on the cut-off agent who, given prices and wages, is indifferent between demanding or not private tutoring. Denote this cut-off agent by $\eta^*$, and let her probability belief about the event of being hired as a teacher be denoted by $q^* \in [0,1]$. We show in the appendix that $q^* = \lambda(1-\eta^*)^{-1}$ (see the proof of Claim 1 in the proof of Proposition 1). The intuition behind this result is that since all agents have rational expectations, in equilibrium, given that human capital endowment is uniformly distributed, only those who are endowed with at least as much human capital as the cut-off agent purchase private tutoring. In doing so, all young agents choose $\overline{h}$ as their desired test score. Since only those agents with the highest test scores are recruited as teachers, choosing less than $\overline{h}$ would result in a zero probability of being hired. As there is a maximum score in the test, it is pointless for any agent to accumulate more that $\overline{h}$ units of human capital. Indeed, any human capital over and above $\overline{h}$ still yields the maximum score, and does not increase the probability of being recruited as a teacher. Hence, of the $(1-\eta^*)$ who reach $\overline{h}$, only $\lambda$ are chosen at random to become teachers.

Having established the likelihood that an agent will be recruited as a teacher, we now consider the cut-off agent's problem. Substituting the budget constraints given by equations

(3) and (5) into the agent's preferences, equation (1), allows us to write the optimization schedule of $\eta^*$ as:

$$V(\eta^*) = \max_{\{e,\nu'\}} \{w(1-g-e) - pe + \beta\left[q^* w'_s + (1-q^*)w' - t\right]\}, \tag{7}$$

subject to equation (2). A rational expectations competitive equilibrium is a specification of the price system $\{w, p\}$, the time allocation set $\{e, \nu\}$; the production plan $\{H, L, Y\}$; and the cut-off agent's subjective probability belief $q^*$, such that agents' choices are optimal given the price system, expectations are rational and all markets clear:

$$H = \int_0^1 \eta \, d\eta \; + \; \int_0^1 h(\eta) \, d\eta; \tag{8}$$

$$\int_0^1 e(\eta) d\eta = \lambda\nu; \tag{9}$$

$$L = \int_0^1 (1-g-e(\eta)) d\eta + (1-\lambda) + \lambda(1-g-\nu). \tag{10}$$

From equation (8), aggregate human capital is the sum of the young and adult endowments, and any other human capital acquired through public education and private tutoring. If the government does not hire teachers from those having the best scores at the selection exam, an agent who acquires human capital above compulsory public schooling loses unskilled labor income, does not increase her chances of obtaining the top-paying job, and only marginally increases overall productivity (see equation (8)). Agents have measure zero and do not internalize this positive externality. The right-hand side of equation (9) is the

aggregate supply of private tutoring. It follows from the fact that teachers are identical ex-post. The right-hand side of equation (10) is the aggregate supply of unskilled labor which is made up of young agents' after-school time net of private tutoring, adults who are not teachers, and time left to teachers after they have taught in the public school and given private courses.

# 4 Existence of Private Tutoring

This section derives conditions under which private tutoring is supported in a de-centralized competitive equilibrium. Since there is no population growth and human capital is individual-specific in our model, when an equilibrium exists it is a steady-state one. Henceforth, we restrict our attention on the steady-state equilibrium. For reasons discussed earlier we first focus on the cut-off agent $\eta^*$ and characterize her optimal time allocation. Next, we derive aggregate private tutoring demand and supply, and compute the equilibrium prices.

Given her preferences, her budget constraint, equation (5), and that her reservation income is the unskilled labor wage, a teacher allocates no time to private tutoring if the wage is higher than the price of private tutoring. She splits her time between labor and private tutoring if both activities yield the same hourly revenue, and specializes in private tutoring if $p > w$. Hence, a teacher's supply of private tutoring is:

$$\nu \quad \begin{cases} = 1 - g, & \text{if } p > w; \\ \in [0, 1 - g], & \text{if } p = w; \\ = 0, & \text{if } p < w, \end{cases} \tag{11}$$

Consequently, a representative teacher's gross income is:

$$w_s = \begin{cases} gs + (1-g)p, & \text{if } p > w; \\ \\ gs + (1-g)w, & \text{if } p \leq w. \end{cases} \tag{12}$$

Given her income as a teacher or as an unskilled laborer, we can calculate the amount of private tutoring, $e^*$, demanded by $\eta^*$ as that which makes her indifferent between the two options of demanding or not private tutoring. Equating indirect utilities under each scenario yields:

$$e^* = \beta q^*[w_s - w](p+w)^{-1}. \tag{13}$$

Equation (13) implies that no young agent demands private tutoring unless the teacher's income exceeds the unskilled labor wage. This result arises because a teacher's income is the sum of her fixed salary and private tutoring income. If the teacher's salary is equal to the unskilled laborer's wage, all adults make the same total income. However, taking private tutoring costs $pe$, and income $we$ is foregone for the time not spent on the labor market. Hence a teacher's lifetime income must compensate for this loss.

The aggregate supply of private tutoring is obtained by integrating equation (11) over the population of teachers, and the aggregate demand for tutoring involves integrating all young agents' individual demand for private tutoring – see equation (25) in the appendix. We show in the appendix (see Claim 2 in the Proof of Proposition 1) that the private tutoring and unskilled labor markets are characterized by a tri-variate system in $(\nu, w, p)$ which solves

equations (11),

$$w = 1 + \theta_g g + \theta_e \lambda \nu, \tag{14}$$

and

$$\beta[g(s-w) + \nu(p-w)] = 2\nu(w+p). \tag{15}$$

As $0 \leq \nu \leq (1-g)$, then equation (14) leads us to conclude that $w$ must also be bounded. If the government were not to choose those agents who have the top scores in the selection test as teachers, no one would have any incentives to accumulate human capital. In this case aggregate human capital, and wages, would reach a minimum $\underline{w} \equiv 1 + \theta_g g$. The upper bound on wages, $\overline{w}$, is reached when teachers allocate all their after-school time to private tutoring. In this case, $\overline{w} \equiv 1 + \theta_g g + \theta_e \lambda (1-g)$. We now make use of those results to derive our first proposition.

**Proposition 1** *Private tutoring is a competitive equilibrium if and only if the teacher's wage is sufficiently high ($s > \underline{w}$ ).*

The necessary and sufficient condition for private tutoring to exist is supported by the empirical evidence provided in Section 2. Indeed, teachers in Mauritius earn more than the average unskilled wage. We now turn to the main policy question of whether increasing teachers' wages will eliminate private tutoring. We subsequently discuss the intuition behind our results.

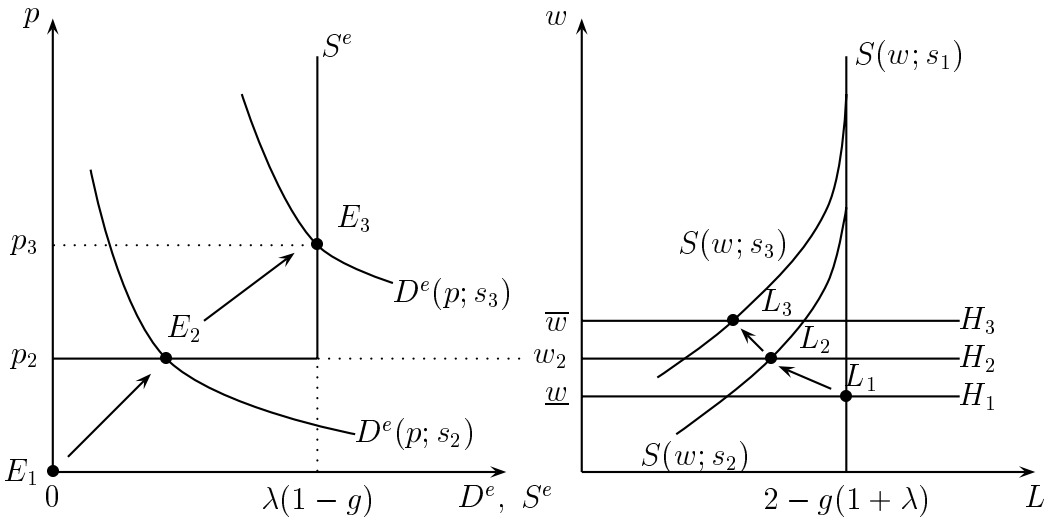
**Proposition 2** *Increasing the teacher's wages does not reduce the incidence of private tutoring. Within the range* $\underline{w} < s < \overline{s}$*, where* $\overline{s} \equiv \overline{w}[1 + 4(1-g)(\beta g)^{-1}]$*, increasing teacher's wages increases the incidence of private tutoring.*

Figure 1 provides the intuition behind Propositions 1 and 2. The inverse aggregate demand $D^e$ for private tuition is downward sloping (see equation (25) in the Appendix) because the greater cost of private tutoring outweighs the higher expected future income as a teacher. The aggregate supply of private tutoring $S^e$ (equation (11)) is kinked because of the constraint on the number and time of teachers. On the market for unskilled labor, demand is perfectly elastic and given by aggregate human capital, $H$ (see equation (23) in the Appendix). The supply of unskilled labor, $S(w; s)$, can be elastic or perfectly inelastic depending on teachers' wages. Indeed, labor supply is maximum when all teachers and students spend their after public school time on the labor market. This scenario corresponds to a perfectly inelastic labor supply schedule. When teachers' wages are sufficiently high, i.e. Proposition 1 holds, a market for private tutoring emerges. In this case, labor supply is elastic: an increase in labor wages raises the opportunity cost of tutoring for both teachers' and young agents. They react by allocating less time to private tutoring.

When the teachers' wages are low, $s_1 = \underline{w}$, there are no incentives to demand private tutoring to enhance one's chances of becoming a teacher.[7] A competitive market with tutoring does not exist, and we have a degenerate equilibrium $E_1$ on the private tutoring market.

[7] Clearly when $s < \underline{w}$ one would have to force adults to be teachers as they would loose money by doing so. We abstract from that case as it is not relevant for the Mauritian experience where a teaching position is very sought after.

Figure 1: Tutoring and Labor Markets Equilibria




Note: The supply of private tutoring is denoted $S^e$; the aggregate demand for private tutoring is $D^e$; $p$ is the price of private tutoring; $s$ is public school teacher's wage, with $\underline{s} = s_1 < s_2 < s_3$, and $s_3 > \overline{s}$; $H$ is labor demand given by aggregate human capital; and $S(w; s)$ is the supply of unskilled labor.

Furthermore, labor supply is at its maximum: $(1-g)$ for children, $(1-\lambda)$ for workers, and $\lambda(1-g)$ for teachers, because all non-public school time is spent working on the labor market. The corresponding equilibrium on the market for labor, $L_1$, is characterized by low wages $\underline{w}$, and aggregate human capital. When teachers' wages rise to $s_2 \in (\underline{w}, \overline{s})$, a demand for tutoring emerges and intersects the supply curve in its perfectly elastic range yielding an equilibrium $E_2$ on the private tutoring market. Teachers specialize partially in education, and spend some non-teaching time as unskilled laborers. More human capital is accumulated than when the equilibrium is $E_1$, unskilled labor is more productive and wages rise to $w_2 > \underline{w}$. A new equilibrium is reached on the market for unskilled labor at $L_2$ where

the equilibrium wage $w_2$ equals the tutoring price $p_2$. Finally, increasing teachers' wages to $s_3 > \overline{s}$ makes a teaching position so attractive that it exhausts all the available supply of tutoring. The incentives to acquire additional human capital are so important now that the inverse demand curve intersects the supply curve in its perfectly inelastic range and the new equilibrium is given by $E_3$. However human capital cannot be increased any further because of the teachers' time and number constraints. Consequently, at the new equilibrium $L_3$, wages reach their upper bound $\overline{w}$ and unskilled labor is at its minimum.

The policy implications of our results are straightforward. Proposition 1 implies that, given the teachers' selection mechanism, tutoring can only be eliminated by reducing the teachers' wage to a threshold level. This reduces however aggregate labor productivity as less human capital is accumulated. Moreover, our second result shows that, contrary to its desired objective, the proposed policy of increasing teachers' wages will in fact increase private tutoring up to an upper bound after which only redistributive effects occur. Alternatively, instead of lowering teachers' wages one could hire teachers either randomly out of the population of adults or based on measured endowments of human capital of young agents before they enter the education system. In these cases private tutoring would be useless to improve one's chances of becoming a teacher. The strong downside of both policies is that they result in the lowest possible wage for all agents.

# 5 Conclusion

This paper showed that private tutoring exists in Mauritius because the gap between skilled and unskilled labor wages is relatively high, and that increasing public school teacher's wages may not reduce its incidence. Indeed when there exists a limited number of well-paid skilled positions which are filled through an exam, agents will seek to maximize their scores if those who achieve the best scores are recruited. When scores are positively related to human capital, agents take private tutoring to increase the latter and thus engage in a rat race to win those positions. Consequently, increasing teachers' wages gives more incentives to students to take private tutoring in our model. Private tutoring would fall, and even disappear, if the government reduced teachers' wages or recruited them randomly. Assuming that such policies are politically feasible, the end result would be lower wages for everyone in our model.

In this paper we did not raise the normative question of why it is optimal to curb private tutoring. This may be the case if human capital accumulated through private tutoring is only test-specific and has no effect on an agent's productivity. If on the other hand private tutoring helps pupils with difficulties and has positive spillovers on the quality of public schools, then it should be promoted.

Our two-sector analysis identified a skilled position with a public school teacher. In Mauritius, doctors and lawyers, among other professions, also carry high wages and are limited in number. Our model could be adapted to take this explicitly into account by making skilled wages endogenous. However, our conclusions would still hold and be based

on the wage gap between skilled and unskilled labor. Further research should consider a fully dynamic model and investigate the impact of private tutoring on the existence of one or more balanced growth path(s) in Mauritius.

# A Proofs

## A.1 Proof of Proposition 1

The proof of Proposition 1 is in three steps. First, we characterize the probability that the cut-off agent is hired as a teacher. Second, we derive some intermediate equilibrium results which are used to prove the proposition.

**Claim 1** *Let $\eta^*$ denote the cut-off agent's human capital endowment. Her (rational expectations) probability of being hired as a public school teacher is:*

$$q^* = \lambda(1-\eta^*)^{-1}. \tag{16}$$

**Proof**.

The proof is in two parts. First we show that the threshold $\overline{h}$ is reached in equilibrium. We then prove that $q^*$ is as in equation (16).

Assume a threshold $\check{h} < \overline{h}$ is obtained in equilibrium. From the definition of a rational expectations equilibrium (i) agents $\eta \in [0, \eta^*)$ purchase no private tutoring; (ii) agent $\eta^*$ is indifferent between purchasing and not purchasing private tutoring; and (iii) agents $\eta \in (\eta^*, 1]$ cannot improve their probability of being hired as a teacher by purchasing additional tutoring. However, the *ex-post* distribution associated with $\check{h}$ is:

$$\check{q} = \begin{cases} 0 & \text{if } h < \check{h}; \\ \frac{f(\check{h})}{F(\check{h})-F(h^*)} & \text{if } h = \check{h}; \\ 1 & \text{if } h > \check{h}. \end{cases} \tag{17}$$

Hence, for all $\check{h} < \overline{h}$, an agent $\eta \in (\eta^*, \check{h} - \theta_g g]$ can achieve a probability of one of being hired by purchasing an arbitrarily small additional amount of private tutoring. This is a contradiction and $\check{h}$ cannot be an equilibrium threshold. Therefore, no interior threshold exists. Since test scores are bounded, targeting above $\overline{h}$ is useless. Hence $\overline{h}$ is the equilibrium threshold.

Second, as all agents target $\overline{h}$ as the relevant threshold, the *ex-post* distribution for an interior cut-off $\eta^*$ is:

$$q^* = \begin{cases} 0 & \text{if } h < \overline{h}; \\ \frac{\lambda}{1-F(h^*)} & \text{if } h = \overline{h}. \end{cases} \tag{18}$$

Since the human capital accumulation technology is linear, and $\eta$ is uniformly distributed, $F(h^*) = \eta^*$.

∎

**Claim 2** *The equilibrium triplet* $(\nu, w, p)$ *which satisfies* (11) *also satisfies:*

$$w = 1 + \theta_g g + \theta_e \lambda \nu \tag{19}$$

$$\beta[g(s-w) + \nu(p-w)] = 2\nu(w+p) \tag{20}$$

**Proof**.

First, using the human capital accumulation technology (2) and the assumption that $\overline{h} = 1 + \theta_g g$ implies that:

$$\begin{aligned} \eta^* &= \overline{h} - \theta_g g - \theta_e e^* \\ &= 1 - \theta_e e^*. \end{aligned} \tag{21}$$

Substitute (21) into (16), and use the resulting expression for $q^*$ in (13). Solving for $e^*$ yields:

$$e^* = \sqrt{\frac{\beta\lambda(w_s - w)}{\theta_e(w+p)}}. \tag{22}$$

Next, an agent $\eta \in [0, \eta^*)$ demands no private tutoring, and agents $\eta \in [\eta^*, 1]$ attain $\overline{h}$. From the equilibrium in the labor market, it follows that:

$$\begin{aligned} w &= H \\ &= \int_0^1 \eta d\eta + \int_0^1 h(\eta) d\eta \\ &= 1/2 + \int_0^{\eta^*} (\eta + \theta_g g) d\eta + \int_{\eta^*}^1 \overline{h} d\eta \\ &= 1/2 + 1/2(\eta^*)^2 + 1 - \eta^* + \theta_g g \\ &= 1 + 1/2(\theta_e e^*)^2 + \theta_g g. \end{aligned} \tag{23}$$

Finally, aggregate demand for private tutoring is obtained by observing that:

$$e(\eta) = \begin{cases} 0 & \text{if } \eta < \eta^* \\ \frac{\overline{h} - \eta - \theta_g g}{\theta_e} & \text{otherwise} \end{cases} \tag{24}$$

Integrate equation (24) over all young agents to obtain:

$$\begin{aligned} \int_0^1 e(\eta) d\eta &= \int_{\eta^*}^1 \left(\tfrac{1-\eta}{\theta_e}\right) d\eta \\ &= \tfrac{\theta_e (e^*)^2}{2} \\ &= \tfrac{\beta(w_s - w)}{2(w+p)} \end{aligned} \tag{25}$$

which equals $\lambda\nu$ by equilibrium. Substitute the second line of (25) in (23) to obtain (19), while equating the third line to $\lambda\nu$ simplifies to (20).

∎

**Claim 3** *There exists a price $p > 0$, such that $e^* > 0$ and $\nu > 0$ if and only if $s > 1 + \theta_g g$ holds.*

**Proof**.

The proof involves two steps:

**Step 1: ("If").** Let $s > 1 + \theta_g g$, and suppose there does not exist $p > 0$ such that $e^* > 0$ or $\nu > 0$. This implies that for all $p \geq 0$ either $e^* = 0$ or $\nu = 0$. From (22), $e^* = 0$ implies $w_s = w$. Substituting this into (12) yields

$$w = \begin{cases} gs + (1-g)p, & \text{if } p > w; \\ gs + (1-g)w, & \text{if } p \leq w. \end{cases} \tag{26}$$

**case 1:** $p > w$ Then, $w = gs + (1-g)p$, which, using (19) implies that:

$$\begin{aligned} gs &= 1 + \theta_g g + (1-g)(\lambda\theta_e - p) \\ &< 1 + \theta_g g + (1-g)(\lambda\theta_e - w) \end{aligned} \tag{27}$$

since $p > w$. This in turn implies that

$$s < 1 + \theta_g g - \lambda\theta_e(1-g). \tag{28}$$

Contradiction.

**case 2:** $p \leq w$ Then $s = w$, which from (19) implies that $s = 1 + \theta_g g + \theta_e \lambda\nu$. If $\nu = 0$, then clearly this is a contradiction. If $\nu > 0$, then from (20) $s = w$ implies

$$\beta(p - w) = 2(w + p) \tag{29}$$

which is impossible since $0 < \beta < 1$, implying that $s \neq w$. Contradiction.

**Step 2: ("Only if").** Let there exist a $p > 0$ such that $e^* > 0$ or $\nu > 0$, and suppose that $s \leq 1 + \theta_g g$. Then, from (19) and (20):

$$2(w + p) < \beta(p - w) \tag{30}$$

which contradicts $p > 0$, since $0 < \beta < 1$, and $w \geq 0$.

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## A.2 Proof of Proposition 2

The proof consists of two steps. First note that since an equilibrium with private tutoring does not exist for $p < w$, we only need to consider the cases $p = w$ and $p > w$.

**Case 1:** $p = w$**.** Then, $\nu \in [0, 1-g]$, and from (20), $p = w$ implies that

$$4\nu w + \beta g w - \beta g s \equiv 0. \tag{31}$$

Next, observe that by the implicit function theorem

$$\frac{\partial \nu}{\partial s} = \frac{\beta g}{4w + 4\theta_e \lambda \nu + \beta g \theta_e \nu} > 0 \tag{32}$$

implying that, in equilibrium, a rise in the teachers' wages increases the incidence of private tutoring.

**Case 2:** $p > w$**.** Then, from (11), $\nu = 1 - g$. Substitute in (19) to obtain

$$\begin{array}{rl} w & = 1 + \theta_g g + \theta_e \lambda (1-g) \\ & \equiv \overline{w}, \end{array} \tag{33}$$

which is independent of $s$. Substitute optimal tutoring supply and $w = \overline{w}$ in (20) and solve for prices as:

$$\begin{array}{rl} p & = \frac{\beta g s - \overline{w}[\beta + 2(1-g)]}{(1-g)(2-\beta)} > \overline{w}, \quad \text{if,} \\ s & > \overline{w}[1 + 4(1-g)(\beta g)^{-1}] \equiv \overline{s}. \end{array} \tag{34}$$

Hence, for $s > \overline{s}$, a rise in the teachers' wages has no effect on the incidence of private tutoring, as illustrated in Figure 1.

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