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Applying Empirics from Kenya, Senegal, Tanzania and Uganda

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Service Delivery versus Moonlighting: Applying Empirics from Kenya, Senegal, Tanzania and Uganda

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Abstract

Civil servants such as teachers and doctors allocate their resources into service delivery which benefit society, and moonlighting for alternative means of income. An actor balances service delivery against moonlighting when the moonlighting production function is concave. Then moonlighting decreases if the actor's salary of service delivery increases, or his unit cost of service delivery or the value of moonlighting decreases. As the production efficiency of moonlighting increases above zero, moonlighting initially increases, continues to increase if the efficiency is high, and eventually decreases if the value of service delivery is high. Conversely, with linear or convex moonlighting production, the actor chooses either service delivery or moonlighting. Survey data from Kenya, Uganda, Tanzania, and Senegal is used to show the significance of poor service delivery within education and healthcare services. The policy implications for the paper are that incentive alignment could be achieved through quality monitoring and appropriate and timely compensation.

Keywords: Service delivery, moonlighting, public good, production, resource allocation

Journal of Economic Literature classification numbers: C6, D2, D6

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1 Introduction

Many communities experience low effort or inefficiency in delivering public services to the population at the local level. Examples of reasons are low salaries for service delivery, high unit costs of service delivery relative to alternative efforts generating salary, and easily available alternative ways of generating income. For example, at the individual level, doctors in Tanzania may spend ½ an hour per day with patients because of such reasons and the fact that no one is monitoring them, and teachers in Senegal may teach only about 3 hours a day, which is less than ¾ of the required time.

Examples of professionals providing public goods to their communities are doctors and teachers. In most countries these are more commonly publicly employed than privately employed. In many countries governments also provide salaries which are too low to such professions. Although individuals providing public goods are often idealistic, limits to idealism exist. When such limits are approached or exceeded, doctors and teachers earning too low salaries may be induced or forced to shirk their responsibilities in order to make ends meet. They may increasingly "moonlight" elsewhere to supplement their income. They may even experience delays in receiving their salary payments, as evidence from Kenya, Uganda, Tanzania, and Senegal reveals. They may do something not related to their profession, or something related to their profession through a private arrangement (e.g. private lessons for teachers or private medical services in case of doctors). The extent of such moonlighting depends on the availability and profitability of moonlighting and the extent to which authorities monitor such professionals adequately. In many communities monitoring by the authorities is lacking or absent.

At the level of doctors and teachers, which is the focus of this paper, they face an individual resource allocation problem which can be dysfunctional in the face of poor monitoring. Poor monitoring may be due to poor institutional frameworks, e.g. for a local authority in a rural district in South Africa where multiple monitors compete for power and status. Consequences are that professionals such as teachers and doctors go unmonitored and shift to other activities for extra income. This causes lack of public goods provision from which communities suffer.

The decentralization of government delivery channels creates local government structures and local bureaucracies that fail to deliver the required level of services to the local population. Such local government structures may involve various levels such as the municipal level, district level, council level, and province level. The objectives for decentralization are to transfer real power to the districts and improve accountability at the local level; to bring political power and administrative control over services to the local level; to establish a stronger link between payment of taxes by citizens and provision of services; and to capacitate the local governments in planning, financing and managing the delivery of services to their respective constituencies. Such services include primary health care, education, water and road infrastructure, agricultural extension services, and some elements of security and law and order.

In this paper we capture this phenomenon in a model where each actor has an available resource that can be allocated to service delivery or moonlighting. Both kinds of efforts provide salary according to different logics.

Earlier research on decentralization has been conducted by Collins and Green (1994), Kullenberg and Porter (1999), and Prud'homme (1995). Golola (2001) presents empirical analysis on the impact of decentralization and local bureaucracies on service delivery. The theoretical frameworks for understanding the institutional dynamics at play that impact on service delivery are analyzed by Acemoglu and Robinson (2012). Das and Hammer (2005) consider measurements of doctor quality, Leonard et al. (2007) assess how to get doctors to do their best, Das et al. (2008) assess the quality of medical advice in low-income countries, and Chaudhury et al. (2006) consider teacher and health worker absence in developing countries. Banerjee and Duflo (2005) analyze absence further. Hanushek (2003) provides some evidence on delivery of education services. Besley and Ghatac (2006) consider reforming public service delivery. Some literature has used randomized trials in analyzing the impact of various service delivery initiatives. Amin and Chaudhury (2008) introduce methodologies for measuring service delivery in education. Case and Deaton (1999) show, using a natural experiment in South Africa, that the impact of increasing school resources, as measured by the student-teacher ratio, has the effect of raising academic achievement among black students. Duflo (2001), in her study in Indonesia, finds that a school construction policy was effective in increasing the quantity of education. By using a randomized evaluation in India, Banerjee et al (2004) find that provision of additional teachers in non-formal education centers increases the school participation of girls. However, a series of randomized evaluations in Kenya indicate that the only effect of textbooks on outcomes was among the better students (Glewwe and Kremer, 2006; Glewwe, Kremer and Moulin, 2002). More recent evidence from natural experiments and randomized evaluations also indicates some potential positive effects of school resources on outcomes, but these effects are not uniformly positive (Duflo 2001; Glewwe and Kremer 2006, Björkman, Martina, and Jakob Svensson 2009). Applying case studies for Senegal and Tanzania, Hausken and Ncube (2014) develop a model for service delivery under conditions of tension between monitoring and political contestation.

The policy implication of the paper is that moonlighting should be reduced by improving the quality of monitoring and also paying service-providers on time in order to align incentives.

The rest of the paper is organized as follows. Section 2 presents the model. Section 3 solves the model. Section 4 analyzes the model. Section 5 tests the model empirically. Section 6 supports the model with empirics. Section 7 concludes.

2 The Model

Consider one actor i, e.g. a doctor or a teacher. The actor has a resource r_i which can be considered as the number of hours he can work in a given time period, or work capacity combined with political power and other factors relevant for service delivery and moonlighting. Each actor allocates his resource into service delivery $s_i \geq 0$ and moonlighting $m_i \geq 0$,

$$r_i = p_i s_i + m_i \quad (1)$$

where p_i is the unit cost of service delivery relative to moonlighting. Service delivery s_i generates a public good, but it also generates a basic salary to the actor which we assume is proportional to s_i with proportionality parameter $v_i>0$ valued relative to moonlighting, thus causing utility $s_i v_i$ when the value of moonlighting is 1, without loss of generality. For moonlighting we consider the production function

$$f_i = m_i^{h_i} \quad (2)$$

where $h_i>0$ is a production efficiency parameter. $0<h_i<1$ means concave production reflecting diminishing return on investment and diseconomy of scale, h_i =1 means linear production, and $h_i>1$ means convex production reflecting increasing return on investment and economy of scale. Assuming that service delivery and moonlighting impact utility additively, $u_i=s_i v_i + f_i$, actor i's utility is

$$u_i = (r_i - m_i)w_i + m_i^{h_i} \quad (3)$$

where $w_i = v_i / p_i$ and we have inserted (1) and (2). Thus w_i increases for actor i if his salary if service delivery increases, $\partial w_i / \partial v_i>0$, or his unit cost of service delivery or the value of moonlighting decreases, $\partial w_i / \partial p_i<0$.

3 Solving the Model

The first and second order conditions for m_i are

$$\frac{\partial u_i}{\partial m_i} = h_i m_i^{h_i-1} - w_i = 0, \quad \frac{\partial^2 u_i}{\partial m_i^2} = (h_i - 1)h_i m_i^{h_i-1} < 0 \; when \; 0 < h_i < 1 \quad (4)$$

which are solved to yield

$$m_i = \begin{cases} \left(\frac{h_i}{w_i}\right)^{\frac{1}{1-h_i}} \; when \; 0 < h_i < 1 \\ r_i \; when \; h_i \geq 1 \; and \; w_i < r_i^{h_i-1} \\ 0 \; when \; h_i \geq 1 \; and \; w_i \geq r_i^{h_i-1} \end{cases}, \quad s_i = \begin{cases} \frac{r_i - \left(\frac{h_i}{w_i}\right)^{\frac{1}{1-h_i}}}{p_i} \; when \; 0 < h_i < 1 \\ 0 \; when \; h_i \geq 1 \; and \; w_i < r_i^{h_i-1} \\ \frac{r_i}{p_i} \; when \; h_i \geq 1 \; and \; w_i \geq r_i^{h_i-1} \end{cases} \quad (5)$$

$$u_i = \begin{cases} r_i w_i + (1 - h_i)\left(\frac{h_i}{w_i}\right)^{\frac{h_i}{1-h_i}} \; when \; 0 < h_i < 1 \\ r_i^{h_i} \; when \; h_i \geq 1 \; and \; w_i < r_i^{h_i-1} \\ r_i w_i \; when \; h_i \geq 1 \; and \; w_i \geq r_i^{h_i-1} \end{cases}$$

4 Analyzing the Model

Proposition 1. Assume $0<h_i<1$. $\frac{\partial m_i}{\partial w_i}<0, \frac{\partial^2 m_i}{\partial w_i^2}>0, \frac{\partial m_i}{\partial h_i}>0 \; when \; Ln\left(\frac{h_i}{w_i}\right)>1-\frac{1}{h_i}$,

$\frac{\partial u_i}{\partial w_i}>0 \; when \; r_i w_i > h_i\left(\frac{h_i}{w_i}\right)^{\frac{h_i}{1-h_i}}, \frac{\partial^2 u_i}{\partial w_i^2}>0,$

$\frac{\partial u_i}{\partial h_i}>0 \; when \; 1-h_i+Ln\left(\frac{h_i}{w_i}\right)+h_i\left(\frac{h_i}{w_i}\right)^{\frac{h_i}{1-h_i}}\left(1-h_i+h_i Ln\left(\frac{h_i}{w_i}\right)\right)>0.$

Proof. Appendix A.

Proposition 2. Assume $h_i \geq 1$. $w_i < r_i^{h_i-1}$ causes $m_i = r_i$ and $u_i = r_i^{h_i}$, whereas $w_i \geq r_i^{h_i-1}$ causes $m_i = 0$ and $u_i = r_i w_i$.

Proof. Follows from (5).

Proposition 1 states that with concave moonlighting production $0<h_i<1$, moonlighting intuitively decreases convexly in w_i, that is, if actor i's salary of service delivery increases, or his unit cost of service delivery or the value of moonlighting decreases, $\partial w_i / \partial p_i<0$. As the production efficiency h_i increases above zero, moonlighting initially increases, continues to increase if $h_i>w_i$, and eventually decreases if w_i is large inducing service delivery. Actor i's utility is U shaped in w_i, thus favoring either low service delivery when w_i is low or high service delivery when w_i is high. When w_i is above a minimum above h_i, inducing service delivery, both Ln functions in Proposition 1 are negative causing utility to decrease in h_i.

Conversely, with linear or convex moonlighting production $h_i \geq 1$, Proposition 2 shows that no interior solution exists. Actor *i* chooses either service delivery or moonlighting. With low $w_i < r_i^{h_i-1}$, intuitively, reflecting low salary of service delivery, or high unit cost of service delivery or high value of moonlighting, actor *i* moonlights, but otherwise does not moonlight.

5 Empirical Observations

In this section we present some findings from a survey on service delivery in education and healthcare in four (4) African countries, namely Kenya, Uganda, Tanzania and Senegal, as reported in a study by the World Bank, African Economic Research Consortium and African Development Bank (2015). In Senegal 151 facilities each for healthcare and education were surveyed. In Tanzania, 175 facilities were surveyed in healthcare and 180 in education. In Kenya, 306 primary schools, 2960 teachers, 294 health facilities, and 1859 health providers were

surveyed. In Uganda, 400 primary schools, 3783 teachers, 400 health facilities, and 1507 health providers were surveyed.

5.1 Education

For Kenya, the survey of Service Delivery Indicators related to education was conducted in primary schools during June-July 2012, of which 78%, or 239 schools, were public schools and the remaining 22% either private for-profit or private not-for-profit schools. The survey assessed the knowledge of 1,679 primary school teachers, surveyed 2,960 teachers for an absenteeism study and observed 306 Grade 4 lessons. In addition, learning outcomes were measured for almost 3,000 Grade 4 students. Below, we define the following eight independent variables.

Absence from school: This relates tothe share of a maximum of 10 randomly selected teachers absent from school during an unannounced visit. During the first announced visit, a maximum of 10 teachers are randomly selected from the list of all teachers who are on the school roster. The whereabouts of these 10 teachers are then verified in the second unannounced visit. Teachers found anywhere on the school premises are marked as present.

Absence from classroom: This is the share of teachers who are present in the classroom out of those teachers present at school during scheduled teaching hours as observed during an unannounced visit. The indicator is constructed in the same way as the School Absence Rate indicator, with the exception that the numerator now is the number of teachers who are both at school and in the classroom. The denominator is the number of teachers who is present at the school. A small number of teachers are found teaching outside the classroom, and these are marked as present for the purposes of the indicator.

Time spent teaching (hours and minutes): Amount of time a teacher spends teaching during a school day. This indicator combines data from the Staff Roster Module (used to measure absence rate), the Classroom Observation Module, and reported teaching hours. The teaching time is adjusted for the time teachers are absent from the classroom, on average, and for the time the teacher remains in classrooms based on classroom observations recorded every five minutes in a teaching lesson.

Share of teachers with minimum knowledge: This indicator measures teacher knowledge and is based on mathematics and language tests covering the primary curriculum administered at the school level to all teachers of Grade 4. The share of teachers with minimum content knowledge is calculated on the basis of a custom-designed teacher test administered to the Grade 4 Mathematics and English teachers of the 2011 and 2012 cohort. The objective of the teacher test is to examine whether teachers have the basic reading, writing and arithmetic skills that lower primary students need to have in order to progress further with their education. This is interpreted as the minimum knowledge required for the teacher to be effective and is the basis for the "Share of teachers with minimum knowledge indicator". In addition, the test examines the extent to which teachers

demonstrate mastery of subject content skills that are above the level at which they teach and their mastery of pedagogic skills. Out of courtesy to teachers, the test was designed as a marking exercise, in which teachers had to mark and correct a hypothetical student's exam in one or more of the subjects they teach. The test was validated against the Kenyan primary curriculum as well as 12 other Sub Saharan curricula.

Teaching equipment availability: Unweighted average of the proportion of schools with the following available: functioning blackboard with chalk, pencils and notebooks. Minimum teaching resources is assigned 0-1 capturing availability of (i) whether a Grade 4 classroom has a functioning blackboard with chalk, (ii) the share of students with pencils, and (iii) the share of students with notebooks, giving equal weight to each of the three components.

Infrastructure availability: Unweighted average of the proportion of schools with the following available: functioning electricity and sanitation. Minimum infrastructure resources is assigned 0-1 capturing availability of (i) sufficient light to read the blackboard from the back of the classroom, giving equal weight to each of the two components; and (ii) functioning toilets operationalized as being clean, private, and accessible.

Student- teacher ratio (Grade 4): Average number of Grade 4 pupils per Grade 4 teacher. The indicator of teachers' availability is measured as the number of students per teacher based on the Classroom Observation Module, where the number of students is counted per teacher teaching.

Students per textbook: Number of mathematics and language books used in a Grade 4 classroom divided by the number of students present in the classroom.

Table 1: Kenya: Service Delivery Indicators for Education

	All	Public	Private	Rural	Urban	Urban Public	Rural Public
EFFORT							
Absence from school	15.5%	16.4%	13.7%	16.7%	13.3%	13.7%	17.2%
Absence from classroom	42.2%	47.3%	30.7%	46.6%	33.9%	42.6%	48.8%
Time spent teaching (hours and minutes)	2h 40m	2h 19m	3h 28m	2h 27m	3h 05m	2h 37m	2h 14m
KNOWLEDGE AND ABILITY							
Minimum knowledge	39.4%	35.1%	49.1%	39.1%	40.1%	32.9%	35.8%
AVAILABILITY OF INPUTS							
Teaching equipment availability	95.0%	93.6%	98.2%	94.2%	96.5%	93.7%	93.5%
Infrastructure availability	58.8%	58.5%	59.3%	62.6%	51.6%	58.0%	58.7%
Student-teacher ratio (Grade 4)	32.1	37.1	20.8	33	30.4	40.8	35.9
Students per textbook	3.1	3.5	2.2	3.4	2.4	2.5	3.8

Source: World Bank, African Economic Research Consortium and African Development Bank (2015).

Table 2: Uganda: Service Delivery Indicators for Education

	All	Public	Private	Rural Public	Urban Public
EFFORT					
Absence from school	23.8%	26.9%	14.0%	30.6%	18.7%
Absence from classroom (% teachers)	52.5%	56.5%	40.3%	59.5%	49.8%
Time spent teaching (hours and minutes)	3h 17m	2h 55m	4h 20m	2h 43m	3h 33m
KNOWLEDGE AND ABILITY					
Minimum knowledge	19.5%	19.4%	19.8%	16.9%	25.1%
AVAILABILITY OF INPUTS					
Teaching Equipment Availability	94.6%	94.2%	95.7%	93.5%	95.3%
Infrastructure Availability	55.5%	60.0%	41.7%	56.5%	66.0%
Student-teacher ratio (Grade 4)	unavailable				
Students per text book	14.4	12.4	100.2	16.8	7.1

Source: World Bank, African Economic Research Consortium and African Development Bank (2015).

Table 3: Tanzania: Service Delivery Indicators for Education

	All	Rural	Urban
EFFORT			
Absence from school	23.0%	20.0%	36.0%
Absence from classroom (% teachers)	53.0%	50.0%	68.0%
Time spent teaching (hours and minutes)	2h 04m	2h 11m	1h 24m
KNOWLEDGE AND ABILITY			
Minimum knowledge	42.0%	43.0%	40.0%
AVAILABILITY OF INPUTS			
Teaching equipment availability	not comparable		
Infrastructure availability	3.0%	2.0%	8.0%
Student-teacher ratio (Grade 4)	48.7	50.6	39.1
Students per textbook	not comparable		

Source: World Bank, African Economic Research Consortium and African Development Bank (2015).

Table 4: Senegal: Service Delivery Indicators for Education

	All	Rural	Urban
EFFORT			

Absence from school	18.0%	18.0%	19.0%
Absence from classroom (% teachers)	29.0%	29.0%	28.0%
Time spent teaching (hours and minutes)	3h 15m	3h 17m	3h 08m
KNOWLEDGE AND ABILITY			
Minimum knowledge	52.0%	52.0%	56.0%
AVAILABILITY OF INPUTS			
Teaching equipment availability	not comparable		
Infrastructure availability	17.0%	8.0%	55.0%
Student-teacher ratio (Grade 4)	28.7	28.0	31.9
Students per textbook	not comparable		

Source: World Bank, African Economic Research Consortium and African Development Bank (2015).

Table 5: SUMMARY Education Service Delivery Indicators: Kenya, Senegal, Tanzania, Uganda

Education Service Delivery Indictors	Kenya	Senegal	Tanzania	Uganda
Effort				
Absence from school(%)	15.5	18	23	23.8
Absence from classroom(%)	42.2	29	53	52.5
Time spent teaching(hrs and mins)	2h 40m	3h 15m	2h 04m	3h17m
Knowledge and Ability				
Minimum knowledge(%)	39.4	52	42	19.5
Availability of Inputs				
Teaching equipment availability(%)	95			94.6
Infrastructure availability(%)	58.8	17	3	55.5
Student teacher ratio(Grade 4)	32.1	28.7	48.7	
Students per text book	3.1			14.4
Delays in salary payments(at least 2 months) (%)		0.2	2	

From Tables 1,2,3,4, and 5 above, the highest levels of absence from school by teachers is in Uganda and Tanzania at 23.8% and 23%, respectively. Kenya and Senegal have lower absence rates, with Kenya being the lowest at 15.5%. In both Uganda and Kenya the absence from school rate is higher in public schools compared to private schools. The absence rate from school by teachers is also higher in rural public schools compared to urban public schools, in both Kenya and Uganda. However, for Tanzania and Senegal, teacher absenteeism from school is higher in urban areas compared to rural areas, for all schools.

Looking at absence from the classroom by teachers, Uganda and Tanzania have the highest rates of 52.5% and 53%, respectively. Senegal has the lowest absence rate at 29%. In Kenya and Uganda, the absence rate from the classroom is highest in rural areas, particularly rural public schools compared to urban areas and urban schools. However, for Senegal and Tanzania, the absence rate from the classroom is higher in urban areas compared to rural areas, in general.

In terms of time spent teaching, Senegal and Uganda have similar times of 3 hours 15 minutes and 3 hours 15 minutes respectively. These times spent in the classroom are higher than in Tanzania and Kenya which are at 2 hours 40 minutes and 2 hours 4 minutes respectively.

Switching to knowledge and ability, the most knowledgeable teachers are in Senegal (52%) and Tanzania (42%), while those in Kenya and Uganda are least knowledgeable at 39.4% and 19.5%, respectively. In Kenya, the teachers in private schools display more knowledge than those in public schools, and in Uganda there is no difference.

On infrastructure availability Kenya (58.8%) is more endowed followed by Uganda (55.5%), Senegal (17%), and then Tanzania (3%).

On the student-teacher ratio at Grade 4 level, as a benchmark, Tanzania tops the list at 48.7%, followed by Kenya (32.1%) and then Senegal at 28.7%.

On number of students per textbook, Uganda is at 14.4, while Kenya is at 3.1 students per textbook.

5.2 Health

The indicators for service delivery in the health sector are expressed below with ten independent variables.

Caseload: Number of outpatient visits per clinician per day. The number of outpatient visits recorded in outpatient records in the three months prior to the survey, divided by the number of days the facility was open during the three month period and the number of health workers who conduct patient consultations.

Absence from facility: Average share of staff not in the facilities as observed during one unannounced visit. Numerator: Number of ten randomly sampled workers that are absent from the facility due to any reason other than being off duty (not his/her shift). Denominator: Number of health workers of the randomly sampled that are not off duty from the facility.

Diagnostic Accuracy: Average share of correct diagnoses for each of the following seven case study patients: (i) malaria with anemia; (ii) diarrhea with severe dehydration; (iii) pneumonia; (iv) pulmonary tuberculosis; (v) diabetes; (vi) post-partum hemorrhage; and (vii) neonatal asphyxia. Enumerator assigns a score of one for each correct diagnosis of a case study patient. The sum of the total number of correct diagnoses identified is then divided by the total number of case study patients. Where multiple diagnoses were provided by the clinician, the diagnosis is coded as correct as long as it is mentioned, irrespective of what other diagnoses were given.

Adherence to clinical guidelines: Share of clinicians who adhere to the clinical guidelines for treating patients.

Management of maternal/neonatal complications: Share of clinicians/institutions with successful management of maternal/neonatal complications.

Drug availability: Share of basic drugs, which at the time of the survey, were available in the primary health facilities.

Drug availability (children): Assign score of one if facility reports and enumerator confirms that facility does not have one or more medicines for children ever available; including unavailable on the day of the interview, available but not observed (non-expired) or at least one observed (but expired) or any of the following medicines: Amoxicillin (syrup/suspension), oral rehydration salts (ORS sachets), zinc (tablets), ceftriaxone (powder for injection), artemisinin combination therapy (ACT), artusunate (rectal or injectable), benzylpenicillin (powder for injection), vitamin A (capsules). Because they are listed in the mother and child priority list, two child priority medicines (Gentamicin and ampicillin powder) are removed from the analysis to avoid double counting.

Drug availability (mothers): Assign score of one if facility reports and enumerator confirms that facility does not have one or more medicines for mothers ever available; including unavailable on the day of the interview, available but not observed (non-expired) or at least one observed (but expired) or the following medicines: Oxytocin (injectable), misoprostol (capsule / tablet), sodium chloride (saline solution) (injectable solution), azithromycin (capsule / tablet or oral liquid), calcium gluconate (injectable), cefixime (capsule / tablet), magnesium sulfate (injectable), benzathinebenzylpenicillin powder (for injection), ampicillin powder (for injection), betamethasone or dexamethasone (injectable), gentamicin (injectable) nifedipine (capsule / tablet), metronidazole (injectable), medroxyprogesterone acetate (Depo-Provera) (injectable), iron supplements (capsule / tablet) and folic acid supplements (capsule / tablet).

Equipment availability: Share of providers with thermometer, stethoscope, weighing scale, refrigerator and sterilization equipment.

Infrastructure availability: Share of facilities with electricity, clean water, and improved sanitation.

Table 6: Kenya: Service Delivery Indicators for Health

	All	Public	Private	Rural	Urban	Urban Public	Rural Public
EFFORT							
Caseload	9.0	8.7	10.4	8.8	10.2	8.5	10.3
Absence from facility	27.5%	29.2%	20.9%	26.9%	31.2%	28.3%	37.6%
KNOWLEDGE AND ABILITY							
Diagnostic accuracy	72.2%	71.6%	74.2%	70.8%	77.7%	74.8%	71.1%

Adherence to clinical guidelines	43.7%	42.7%	47.6%	41.7%	52.0%	41.1%	51.2%
Management of maternal/neonatal complications	44.6%	44.2%	45.8%	43.6%	48.3%	43.4%	48.7%
AVAILABILITY OF INPUTS							
Drug availability (all)	54.3%	52.3%	62.1%	54.0%	56.0%	52.7%	48.5%
Drug availability (children)	70.4%	69.2%	75.1%	71.5%	63.8%	70.8%	56.7%
Drug availability (mothers)	43.6%	41.0%	53.5%	42.3%	51.4%	40.6%	43.8%
Equipment availability	77.8%	77.0%	80.4%	76.7%	80.7%	75.8%	81.4%
Infrastructure availability	46.8%	39.3%	74.9%	43.4%	66.9%	36.7%	59.3%

Source: World Bank, African Economic Research Consortium and African Development Bank (2015).

Table 7: Uganda: Service Delivery Indicators for Health

	All	Public	Private	Rural Public	Urban Public
EFFORT					
Caseload	6.1	9.9	2.2	10.4	4.9
Absence from facility	46.0%	51.7%	39.2%	51.7%	51.5%
KNOWLEDGE AND ABILITY					
Diagnostic accuracy	58.1%	56.2%	60.6%	50.3%	70.4%
Adherence to clinical guidelines	49.7%	48.4%	51.5%	43.1%	61%
Management of maternal/neonatal complications	19.3%	18.8%	20%	19.2%	17.6%
AVAILABILITY OF INPUTS					
Drug availability (all)	47.5%	40.3%	54.8%	39.7%	46.4%
Drug availability (children)	unavailable				
Drug availability (mothers)	unavailable				
Equipment availability	81.6%	78.4%	86.7%	77.7%	88%
Infrastructure availability	63.7%	47.9%	79.6%	45.1%	73.5%

Source: World Bank, African Economic Research Consortium and African Development Bank (2015).

Table 8: Tanzania: Service Delivery Indicators for Health

	All	Rural	Urban
EFFORT			
Caseload	unavailable		
Absence from facility	21.0%	17.0%	33.0%
KNOWLEDGE AND ABILITY			

Diagnostic accuracy	57.0%	53.0%	68.0%
Adherence to clinical guidelines	35.0%	31.0%	44.0%
Management of maternal /neonatal complications	unavailable		
AVAILABILITY OF INPUTS			
Drug availability (all)	76.0%	76.0%	77.0%
Drug availability (children)	unavailable		
Drug availability (mothers)	unavailable		
Equipment availability	78.0%	76.0%	83.0%
Infrastructure availability	19.0%	5.0%	60.0%

Source: World Bank, African Economic Research Consortium and African Development Bank (2015).

Table 9: Senegal: Service Delivery Indicators for Health

	All	Rural	Urban
EFFORT			
Caseload	unavailable		
Absence from facility	20.0%	20.0%	20.0%
KNOWLEDGE AND ABILITY			
Diagnostic accuracy	34.0%	30.0%	37.0%
Adherence to clinical guidelines	22.0%	20.0%	29.0%
Management of maternal/neonatal complications	unavailable		
AVAILABILITY OF INPUTS			
Drug availability (all)	78.0%	75.0%	90.0%
Drug availability (children)	unavailable		
Drug availability (mothers)	unavailable		
Equipment availability	53.0%	46.0%	87.0%
Infrastructure availability	39.0%	27.0%	95.0%

Source: World Bank, African Economic Research Consortium and African Development Bank (2015).

Table 10: Summary: Health Service Delivery Indicators: Kenya, Senegal, Tanzania, Uganda

Health Service Delivery Indictors	Kenya	Senegal	Tanzania	Uganda
Effort				
Caseload	9			6.1
Absence from facility(%)	27.5	20	21	46
Time spent with patients(hrs and mins)		39m	29m	
Knowledge and Ability				
Diagnostic Accuracy(%)	72.2	34	57	58.1
Adherence to clinical guidelines(%)	43.7	22	35	49.7
Management of maternal/neonatal				

complications(%)	44.6			19.3
Availability of Inputs				
Drug availability(all)(%)	54.3	78	76	47.5
Drug availability(children)(%)	70.4			
Drug availability(mothers)(%)	43.6			
Equipment availability(%)	77.8		78	
Infrastructure availability(%)	46.8	39	19	63.7
Delays in salary payments(at least 2 months)(%)		5	2	

On caseload, which measures the number of outpatients per clinician per day, Kenya has a higher caseload than Uganda, at 9 and 6.2, respectively.

On the absence of clinicians from health facilities, this rate is highest in Uganda (46%), followed by Kenya (27.5%), and Senegal and Tanzania with similar rates of 20% and 21% respectively. Uganda really stands out with the highest level of absenteeism by clinicians.

On knowledge and ability of clinicians, again we see a varied pattern across countries. In the area of diagnostic accuracy, Kenya has the most competent doctors (72.25%), with Uganda and Tanzania having similar levels of 58.25% and 57% respectively. Senegal has a far lower competence level, with 22% of clinicians being accurate in diagnosing illness.

In Kenya and Uganda, clinicians have the highest adherence to clinical guidelines, while in Senegal and Tanzania, such adherence is low.

On management of maternal/neonatal complications, clinicians in Kenya have a much higher level of competence than in Uganda, at 44.65% and 19.3%, respectively.

Looking at the availability of drugs for all, Senegal and Uganda show a higher level of availability than Kenya and Tanzania. Kenya and Tanzania are showing a similar level of equipment availability.

One of the reasons for poor service delivery by teachers is the delays in their salary payments, as Hausken and Ncube (2014) argued. Such delays, (measured as the proportion of teachers whose salary has been overdue for more than two months), may have an adverse effect on staff morale and therefore on the quality of service. The data is collected directly from teachers at the school, and shown in Table 5. Significant (over two months) delays in salaries do not appear to be a common problem, especially in Senegal. In Tanzania, about 2% of the teaching staff reports more than 2 months' delay in salary, which happens exclusively in rural schools. Data for Kenya and Uganda on salary delays is unavailable.

Just like for teachers, clinicians also experience delayed salary payments. Such delays are likely to impact on the delivery of healthcare services, as Hausken and Ncube (2014) have argued. Data for Kenya and Uganda on salary delays is not available. Table 10 summarizes the results. The delay is measured as the proportion of healthcare workers whose salary is overdue for more than two months. From Table 10, 2% of healthcare workers in Tanzania reported delays in the payment of their salaries, while the figure for Senegal is more than double at 5%. This is likely to impact on the quality of service provision in the healthcare sector.

6 Supporting the model with empirics

Especially interesting is the ratio s_i/r_i of service delivery to resource for actor i. This ratio is present or can be interpreted from four rows in Tables 5 and 10. First, row 3 in Table 5 expresses teachers' absence from school. Calculating 100% minus the absence percentage gives the teachers' presence in school, which expresses s_i/r_i, replicated in row 1 in Table 11. Second, row 5 in Table 5 expresses teachers' time spent teaching which expresses service delivery. Dividing these times for the four countries with scheduled teaching, which is 5hrs 40 mins for Kenya, 7hrs 20 mins for Uganda, 5hrs 12 mins for Tanzania, and 4hrs 36 mins for Senegal, gives the s_i/r_i shown in row 6 in Table 11. Third, row 4 in Table 10 expresses healthcare staff's absence from their facility. Calculating 100% minus the absence percentage gives the healthcare staff's presence at their facility, which expresses s_i/r_i, replicated in row 11 in Table 11. Fourth, row 5 in Table 10 expresses healthcare staff's time spent with patients which expresses service delivery. Dividing these times, available only for Tanzania and Senegal, with scheduled time spent with patients assumed to be eight hours, gives the s_i/r_i shown in row 16 in Table 11.

Table 11: Using service delivery in Tables 5 and 10 to support the model empirically

Table 5,row 3	Kenya:s_i/r_i=0.845	Uganda:s_i/r_i=0.762	Tanzania:s_i/r_i=0.77	Senegal:s_i/r_i=0.72
r_i=p_i=1,h_i=0.5	v_i=1.270	v_i=1.025	v_i=1.043	v_i=0.945
r_i=v_i=1,h_i=0.5	p_i=0.928	p_i=0.990	p_i=0.984	p_i=1.024
p_i=v_i=1,h_i=0.5	r_i=1.613	r_i=1.050	r_i=1.087	r_i=0.893
r_i=p_i=1,v_i=0.65	h_i=0.128	h_i=0.209	h_i=0.201	h_i=0.250
Table 5,row 5	Kenya:s_i/r_i=0.471	Uganda:s_i/r_i=0.448	Tanzania:s_i/r_i=0.397	Senegal:s_i/r_i=0.707
r_i=p_i=1,h_i=0.5	v_i=0.687	v_i=0.673	v_i=0.644	v_i=0.924
r_i=v_i=1,h_i=0.5	p_i=1.269	p_i=1.296	p_i=1.358	p_i=1.035
p_i=v_i=1,h_i=0.5	r_i=0.473	r_i=0.453	r_i=0.415	r_i=0.853
r_i=p_i=1,v_i=0.65	h_i=0.461	h_i=0.476	h_i=0.506	h_i=0.263
Table 10,row 4	Kenya:s_i/r_i=0.725	Uganda:s_i/r_i=0.54	Tanzania:s_i/r_i=0.79	Senegal:s_i/r_i=0.80
r_i=p_i=1,h_i=0.5	v_i=0.953	v_i=0.737	v_i=1.091	v_i=1.118
r_i=v_i=1,h_i=0.5	p_i=1.020	p_i=1.193	p_i=0.969	p_i=0.961
p_i=v_i=1,h_i=0.5	r_i=0.909	r_i=0.543	r_i=1.190	r_i=1.250
r_i=p_i=1,v_i=0.65	h_i=0.245	h_i=0.412	h_i=0.181	h_i=0.171
Table 10,row 5	Kenya:	Uganda:	Tanzania:s_i/r_i=0.06	Senegal:s_i/r_i=0.08

$r_i=p_i=1,h_i=0.5$	Unavailable	Unavailable	$v_i=0.516$	$v_i=0.521$
$r_i=v_i=1,h_i=0.5$			$p_i=1.884$	$p_i=1.846$
$p_i=v_i=1,h_i=0.5$			$r_i=0.266$	$r_i=0.272$
$r_i=p_i=1,v_i=0.65$			$h_i=0.636$	$h_i=0.630$

Combining equations (1) and (5) for concave moonlighting production $0<h_i<1$ gives

$$\frac{s_i}{r_i}=\frac{1}{p_i}\left(1-\frac{1}{r_i}\left(\frac{h_i}{v_i/p_i}\right)^{\frac{1}{1-h_i}}\right)\Leftrightarrow r_i=\left(\frac{h_i}{v_i/p_i}\right)^{\frac{1}{1-h_i}}\Big/\left(1-p_i\frac{s_i}{r_i}\right)\Leftrightarrow$$

$$v_i=\frac{h_i p_i}{\left(r_i\left(1-p_i\frac{s_i}{r_i}\right)\right)^{1-h_i}}\Leftrightarrow h_i=\frac{ProductLog\left(\frac{r_i v_i}{p_i}\left(1-p_i\frac{s_i}{r_i}\right)Ln\left(r_i\left(1-p_i\frac{s_i}{r_i}\right)\right)\right)}{Ln\left(r_i\left(1-p_i\frac{s_i}{r_i}\right)\right)} \quad (6)$$

where the four parameters r_i,p_i,v_i,h_i determine s_i/r_i. For each of the four examples of service delivery in Table 11 we consider four combinations of three of these four parameters, and determine the fourth parameter to generate the ratio s_i/r_i of service delivery to resource specified in Table 11. As our benchmark we consider the unity values $r_i=p_i=v_i=1$ for actor i's resource r_i, unit cost p_i of service delivery relative to moonlighting, and proportionality parameter v_i determining actor *i*'s salary. For the production efficiency parameter for moonlighting we assume the intermediate concavity benchmark $h_i=0.5$. We now proceed to illustrate the mechanics by which low versus high ratios s_i/r_i of service delivery versus moonlighting are generated by the four parameters r_i,p_i,v_i,h_i in the model.

First, $r_i=p_i=1$ and $h_i=0.5$ give the empirically specified s_i/r_i for a variety of different v_i. First, row 1 in Table 11 shows that teachers' presence in school varies from the low $s_i/r_i=0.72$ in Senegal to the high $s_i/r_i=0.845$ in Kenya. The associated v_i's are the low $v_i=0.945$ in Senegal and the high $v_i=1.270$ in Kenya where service delivery relative to moonlighting is valued more highly. Thus higher ratio s_i/r_i of service delivery to resource gives higher proportionality parameter v_i determining actor i's salary. Second, row 6 in Table 11 shows that teachers' time spent teaching, relative to the scheduled time, varies from the low $s_i/r_i=0.397$ in Tanzania to the high $s_i/r_i=0.707$ in Senegal. The associated v_i's are the low $v_i=0.644$ in Tanzania and the high $v_i=0.924$ in Senegal. Hence although teachers in Senegal have low presence in school, they spend more time teaching relative to the scheduled time. Third, row 11 in Table 11 shows that healthcare staff's presence at their facility varies from the low $s_i/r_i=0.54$ in Uganda to the high $s_i/r_i=0.80$ in Senegal, with associated low $v_i=0.737$ in Uganda and high $v_i=1.118$ in Senegal. Fourth, row 16 in Table 11 shows that healthcare staff's time spent with patients is extremely low at $s_i/r_i=0.06$ in Tanzania and the quite similar $s_i/r_i=0.08$ in Senegal, causing extremely low $v_i=0.516$ in Tanzania and $v_i=0.521$ in Senegal. Thus comparing time spent teaching versus time spent with patients, healthcare staff value service delivery relative to moonlighting lower than teachers do, ceteris paribus.

Second, $r_i=v_i=1$ and $h_i=0.5$ give s_i/r_i for various p_i. In row 3 in Table 11 the unit cost p_i of service delivery relative to moonlighting varies from a low $p_i=0.928$ for Kenya to generate high ratio $s_i/r_i=0.845$ of service delivery to resource, to a high $p_i=1.024$ for Senegal which causes a lower $s_i/r_i=0.72$. In row 8 in Table 11 the unit cost p_i varies from a high $p_i=1.269$ for Kenya to a low $p_i=1.035$ for Senegal where the quality of monitoring teachers' time spent teaching relative to the scheduled teaching time is more effective. In Senegal parents are more involved in the schools where their children are pupils, increasing the pressure on teachers to be held accountable for the quality of their services. Higher unit cost of service delivery causes lower service delivery throughout Table 11. In particular, the extremely low service delivery ratios $s_i/r_i=0.06$ and $s_i/r_i=0.08$ for Tanzania and Senegal for healthcare staff's time spent with patients correspond to the extremely high unit costs $p_i=1.884$ and $p_i=1.846$.

Third, $p_i=v_i=1$ and $h_i=0.5$ give s_i/r_i for various r_i. In row 4 in Table 11 actor i's resource to generate teachers' presence in school varies from a low $r_i=0.893$ to generate a low $s_i/r_i=0.72$ in Senegal to a high $r_i=1.613$ in Kenya to generate a high $s_i/r_i=0.845$. In contrast, in row 9 in Table 11 actor i's resource to generate teachers' time spent teaching varies from a high $r_i=0.853$ to a low $r_i=0.415$ in Tanzania. This may be linked to the finding in row 13 in Table 5 where Tanzania also shows a higher level of delays in the payment of salaries for teachers compared to Senegal. More resources r_i causes higher service delivery throughout Table 11. In particular, the extremely low service delivery ratios $s_i/r_i=0.06$ and $s_i/r_i=0.08$ for Tanzania and Senegal in row 16 in Table 11 correspond to the extremely low resource amounts $r_i=0.266$ and $r_i=0.272$.

Fourth, $r_i=p_i=1$ and $v_i=0.65$ give s_i/r_i for various h_i. In row 5 in Table 11 the production efficiency parameter for moonlighting varies from a high $h_i=0.2$50 to generate a low $s_i/r_i=0.72$ in Senegal to a low $h_i=0.128$ in Kenya to generate a high $s_i/r_i=0.845$. Higher production efficiency parameter h_i for moonlighting causes low service delivery throughout Table 11. In particular, the extremely low service delivery ratios $s_i/r_i=0.06$ and $s_i/r_i=0.08$ for Tanzania and Senegal in row 16 in Table 11 correspond to the high $h_i=0.636$ and $h_i=0.630$.

7 Conclusion

We develop a model where an actor allocates his resources into service delivery and moonlighting, i.e. supplementing one's income with alternatives. This applies for example to teachers or doctors, or members of a council, with a strong political character, in various rural districts. Service delivery consists in providing a service which may be a public good, e.g. caring for sick people or educating a community, or supervising civil servants such as doctors and teachers. Moonlighting means supplementing one's income by exerting efforts elsewhere such as in a private market. Service delivery benefits society at large and the recipients of the service, and generates a salary for the actor which is commonly low. Actors may thus seek income elsewhere. This causes communities to suffer decreased provision of public goods and other services. We determine how actors strike a balance between service delivery and moonlighting.

We find that an actor strikes an interior equilibrium balance between service delivery and moonlighting when the production function for moonlighting is concave, thus diminishing return on investment in moonlighting. Then

moonlighting decreases if the actor's salary of service delivery increases, or his unit cost of service delivery or the value of moonlighting decreases. As the production efficiency of moonlighting increases above zero, moonlighting initially increases, continues to increase if the efficiency is high, and eventually decreases if the value of service delivery is high.

Conversely, with linear or convex moonlighting production, no interior solution exists and the actor chooses either service delivery or moonlighting. With low salary of service delivery, or high unit cost of service delivery or high value of moonlighting, the actor moonlights exclusively, which may mean leaving his job, instead of focusing loyally and exclusively on service delivery.

One implication of the model is that moonlighting cannot be eradicated, but its role can be reduced if one is aware of the logic of which factors impact how actors allocate their resources between service delivery and moonlighting.

We have used data from the education and healthcare sectors in the African countries Kenya, Uganda, Tanzania and Senegal to highlight deficient and poor service delivery. In both sectors, education and healthcare, and for all four countries, teachers spend far less than the designated time teaching students, and clinicians spend very little time with patients per day.

The policy implication of the paper is that moonlighting, which reduces service-delivery, should be reduced by improving the quality of monitoring. It can also be reduced by paying an economic wage timeously, so as to align incentives.

Appendix A Proposition 1

The first and second order conditions for m_i and u_i are

$$\frac{\partial m_i}{\partial w_i} = \frac{-\left(\frac{h_i}{w_i}\right)^{\frac{1}{1-h_i}}}{(1-h_i)w_i}, \frac{\partial^2 m_i}{\partial w_i^2} = \frac{(2-h_i)\left(\frac{h_i}{w_i}\right)^{\frac{1}{1-h_i}}}{(1-h_i)^2 w_i^2},$$

$$\frac{\partial m_i}{\partial h_i} = \frac{\left(\frac{h_i}{w_i}\right)^{\frac{1}{1-h_i}}\left(1+h_i\left(Ln\left(\frac{h_i}{w_i}\right)-1\right)\right)}{(1-h_i)^2 h_i}, \frac{\partial^2 m_i}{\partial h_i^2} = \frac{\left(\frac{h_i}{w_i}\right)^{\frac{1}{1-h_i}}\left(3(1-h_i)^2 + Ln\left(\frac{h_i}{w_i}\right)\left(2-2h_i^2+h_i Ln\left(\frac{h_i}{w_i}\right)\right)\right)}{(1-h_i)^4 h_i},$$

$$\frac{\partial u_i}{\partial w_i} = (1-h_i)\frac{r_i w_i - h_i\left(\frac{h_i}{w_i}\right)^{\frac{h_i}{1-h_i}}}{(1-h_i)w_i}, \frac{\partial^2 u_i}{\partial w_i^2} = \frac{h_i(1-h_i)\left(\frac{h_i}{w_i}\right)^{\frac{h_i}{1-h_i}}}{(1-h_i)^2 w_i^2},$$

$$\frac{\partial u_i}{\partial h_i} = \frac{h_i\left(\frac{h_i}{w_i}\right)^{\frac{h_i}{1-h_i}}\left(1-h_i+Ln\left(\frac{h_i}{w_i}\right)+h_i\left(\frac{h_i}{w_i}\right)^{\frac{h_i}{1-h_i}}\left(1-h_i\left(1-Ln\left(\frac{h_i}{w_i}\right)\right)\right)\right)}{(1-h_i)^2 h_i}$$

(A1)

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