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Modelling the Effects of Teacher Demand Factors on Teacher Understaffing in Public Secondary Schools in Kenya

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Abstract

The secondary school teacher labour market faces many challenges including, escalating teacher wage bill, teacher shortages that occur alongside teacher surpluses, inadequate teacher distribution and inefficient teacher utilization. There is the need therefore to understand the effects of the factors determining demand for secondary school teachers and determine the incidence of risk on teacher under staffing caused by different demand factors. The study adopted cross-sectional research design using time series data for the period from 1990 to 2010. The dependent and independent variables in this study were subjected to Poison Regression to establish the extent to which the set of independent variables explained variance in the dependent variable. Results of the Poisson Regression showed that the significant factors determining secondary school teacher demand in Kenya included: number teachers on duty, secondary school enrolment, class size and number of teachers employed. There was evidence to prove that Pupil Teacher Ratio (PTR), number of classes, number of streams, teacher workload and Government policy affected secondary school teacher demand collectively although they did not have significant effect of teacher demand independently. The results of the Poisson Regression model with random effect illustrated the Incidence Relative Risk (IRR) on teacher understaffing. The study concluded that, changing the levels in student enrolment, PTR, number of classes, number of teachers employed and teacher without relevant policy controls and interventions measures would increase the risk of teacher shortage. Thus there is the need for the policy makers to control the effects of secondary school teacher demand factors to avoid critical teacher shortages in the future.

Key Words: Modelling, Teacher demand, public secondary school

1.0 Introduction

Teachers constitute the core of the education system and their importance in student performance has been widely confirmed by many studies (Rivkin, Stephen, Ertik & John, 2000). Thus teachers are an important resource in the teaching/learning process and their training and utilization therefore requires critical consideration (Ministry of Education Science and Technology (MOEST), 2005a). In recent years an increasing number of studies have expressed concern about current and prospective teacher shortages in many countries. According to Santiago (2002) severe shortages currently exist, and there is a gap between demand and supply of teachers needed to ensure effective teaching in many countries.

Qualified teachers in both the developed and developing world are quickly becoming the hardest segment of the teaching profession to attract and retain and are the most expensive to educate (World Bank, 2005). Literature suggests that there have been few, if any, interventions to improve recruitment, retention and retraining of secondary school teachers that have yielded dramatic, positive results (Lewin, 2002; World Bank, 2005).

In Kenya, since June 2003, the Teachers Service Commission (TSC) has been carrying out a balancing exercise to move teachers from overstaffed areas to understaffed areas but this exercise has faced major resistance (MOEST, 2005a). Thus, hardship and remote areas continue to suffer teacher shortages. Alternative modes of deployment for appropriate utilization of teachers, therefore, need to be explored and implemented. Some scholars have recommended that the monopoly given to the TSC be dismantled and allow the formation of efficient and independent employment boards to deal with teachers recruitment, promotion and terms of service (Institute of Policy Analysis and Research (IPAR), 2008). Such a move would make teaching profession more efficient and responsive to the demands of the dynamic education system.

Teacher shortages are frequently viewed as impacting negatively on quality of teaching and learning, and an understanding of the factors influencing these shortages is absolutely crucial to educational planners and policy

makers. The situation is similar in Kenya where teacher recruitment has been minimal despite the increase in supply of teachers graduating from universities and other teacher training colleges; and the ever spiralling need for secondary school teachers occasioned by increasing enrolment levels. Major shortages in 1995 were experienced in science subjects including Chemistry, Physics and Mathematics while there was teacher surplus in other subjects especially in social sciences including geography, history and CRE (MOEST, 2005b; Delloitte & Touche, 1995). However, by 2003, teacher surpluses indicated in geography, history and CRE had disappeared and in their place came shortages in these subjects (TSC, 2005).

One of the major challenges facing the education system in Kenya is the need for more teachers against a constrained budget. By 2005, the teacher wage bill absorbed eighty four per cent of the MOEST budget (MOEST, 2005b). This has led to calls for containment or reduction of the wage bill so that savings can be made and used in funding other essential educational inputs. This factor had earlier led to the freeze of employment of teachers by the TSC between 1998 and 2000. Prior to 1998 the TSC had been recruiting teachers from the universities and other colleges and posting them to various schools in the country. However the Government changed this practice of automatic recruitment of all graduate teachers with effect from 1st July 1998. This was done in line with the civil service reform programme, which aimed at staff reduction in the civil and the teaching services (Government of Kenya (GoK), 1999). Teacher rationalization programme is part of this wider programme of reforms. From 2001, the Government implemented changes in the teacher recruitment policy, where teachers in secondary schools are recruited on the basis of vacancies in various secondary schools and the ability of the Government to pay.

The current staffing norm in secondary schools in Kenya was brought about by a major policy reform implemented in 1984 leading to the use of Curriculum Based Establishment (CBE) which specified a minimum teaching load of 27 lessons per week (MOEST, 2005b; TSC, 2007). The current norm however does not specify a minimum or a maximum class size and is not sensitive to regional variations. Furthermore, the CBE does not take into account the Arid and Semi-Arid (ASAL) regions. Relying strictly on the CBE may lead to small class sizes and low student-teacher ratio, hence under utilization of teachers (MOEST, 2005b; Wamukuru & Muthaa, 2010). Despite the norm, on average teachers handle a teaching load of 22 lessons, an indication that they are underutilized. Based on the CBE, there was a teacher shortage of 10,287 teachers in 2007 (TSC, 2007). Based on the staffing norm, there was an estimated teacher shortage of about 6,226 teachers in 2005 (MOEST, 2005b). In the year 2009 teacher shortage in secondary schools had reached 23,291. Major shortages in 1995 were experienced in science subjects including Chemistry, Physics and Mathematics while there was teacher surplus in other subjects especially in social sciences including geography, history and CRE (MOEST, 2005b; Delloittee & Touche, 1995).

The introduction of Free Primary Education (FPE) in 2003 and Free Day Secondary Education in 2008 required that the education system train and retain sufficient number of well qualified teachers, not only at the primary level but in secondary school level as well (Nilsson, 2003: Wamukuru & Muthaa, 2010). This indicates the need for a framework of projecting teacher demand in order to avoid crisis as the output of FPE enter secondary while FSE attract more enrolments in this level.

A clear teacher demand framework will be necessary not only to rationalize teacher utilization but also to guide in meeting the targets for MDGs in education and Kenya's Vision 2030. The vision for the education sector for 2030 is "to have globally competitive quality education, training and research for sustainable development"(Republic of Kenya, 2007).

1.1. Objectives of the Study

Specifically the study sought to:

i. Determine the effects of selected factors on secondary school teachers understaffing in Kenya
ii. Develop a model for teacher demand projection

1.2. Methodology

The research design adopted in this study was cross-sectional research design using time series data. Data on selected factors and demand for secondary school teachers were collected for the period 1990 to 2010. The population of this study included all the 4236 public secondary schools in Kenya in 2010, all graduate and

diploma teachers who have been teaching in secondary schools in Kenya between 1990 and 2010 and sixteen Teacher Service Commission (TSC) provincial staffing officers. The study also targeted the TSC for records of all secondary schools in Kenya between 1990 and 2010. Simple random sampling was used to select 351 secondary schools from the total of 4236 public secondary schools in Kenya. Saturated sampling was used to select eight provincial staffing officers at the TSC Headquarters. Data needed for this study was collected by use of two data analysis profoma and one Interview Schedule.
Data summary and classification were done using descriptive statistics and presented using tables and graphs. In order to answer specific research questions, statistical procedures were used, including trend analysis and Poisson Regression. Diagnostic tests to check the suitability of the Poisson Regression were done using Dagostino Pearson test and Shapilo-wilk W test for normal data. The secondary school teacher demand model was developed based on Poisson Regression.

The dependent and independent variables in this study were subjected to Poison Regression to establish the extent to which the set of independent variables explained a proportion of variance in the dependent variable. Poisson regression was appropriate in this study since the dependent variable was a count variable. The events were independent in the sense that there is independence among schools in terms of teacher demand, meaning that computation of the teacher demand in one school was not influenced by findings (teacher demand) from other schools. The distribution of independent (teacher demand factors) and dependent variable (teacher demand) data was not normal an indication that use of Poisson Regression was appropriate.

2.0. Results and Discussions

2.1 Effects of the Selected Factors on Teacher demand

The dependent and the independent variables for this study including number of teachers on duty, student enrolment, PTR, class size, number of teachers employed and teacher workload were subjected to Dagostino Pearson Test and Shapiro-Wilk W Test for normal data to determine the suitability for Poisson regression which was used in this study. Understaffing was used as an indicator of teacher demand and therefore it was the dependent variable in this study. Results from Dagostino Pearson Test and Shapiro-Wilk W Test for normal data indicated that the data for understaffed was not normal. The p-value from the Dagostino Pearson test was less than 0.05 (P-value = $1.343e\text{-}^{08}$) while the P-Value for Shapiro-Wilk W Test was 0.0. The P-value for both tests was therefore clearly significant at 0.05 significance level which rejects the null hypothesis that the data were from a normal distribution.

Table 1: Diagnostic Results for Dagostino Pearson Tests of the Variables

Variable	Observations	P-Value
Understaffing	351	$1.343e\text{-}^{08}$
Number Employed	351	2.2e-16
Numbers of Teachers on Duty	351	3.933e-16
PTR	351	2.2e-16
Average Teacher Workload	351	0.0004594
Average Class Size	351	2.2e-16

Table 2: Diagnostic Results for Shapiro-Wilk W Test for Normal Data

Variable	Observations	W	V	z	Prob>z
Understaffing	351	0.96638	8.235	4.986	0.00000
Number Employed	351	0.97205	6.830	4.543	0.00000
Numbers of Teachers on Duty	351	0.90290	23.786	7.495	0.00000
PTR	351	0.83959	39.294	8.682	0.00000
Average Teacher Workload	351	0.98335	4.078	3.324	0.00000
Average Class Size	351	0.88686	27.715	7.856	0.00000

The selected factors were subjected to Poisson regression to determine their effect on teacher demand. The results of the Poisson regression are presented in the model.

Table 3: Secondary School Teacher Demand Model

Understaffing	Coefficient	Standard Error	P>|z|
Number of Teachers on Duty	-0.0350	0.0142	0.0140
Student Enrolment	0.0021	0.0008	0.0110
PTR	0.0025	0.0053	0.6420
Number of Classes	0.0103	0.0550	0.8520
Number of Streams	-0.1070	0.2381	0.6530
Average Class Size	-0.0160	0.0063	0.0110
Number of Teachers Employed	0.2396	0.0835	0.0040
Teacher Workload	0.0024	0.0104	0.8190
Policy	0.0359	0.1293	0.7810
Constant	1.1094	0.3341	0.0010

The results showed that the model on secondary school teacher demand was fitting (P-value = 0.00, R^2 =0.50). Thus the conclusion was that the independent variables influence the change in dependent variable was significant. Results of the Poisson Regression showed that the significant factors determining secondary school teacher demand in Kenya included: number teachers on duty (P-value = 0.014), secondary school enrolment (P-value = 0.011), class size (P-value = 0.011) and number of teachers employed (P-value = 0.004). The data collected provided evidence to prove that the following factors did affect secondary school teacher demand collectively although they did not have significant effect of teacher demand independently; PTR , number of classes, number of streams, teacher workload and Government policy. The factors were subject to further analysis to establish whether the inclusion of interaction terms was significant. The inclusion of interaction term into the model yielded the results in Table 4. From the Poisson regression results it was clear that inclusion of the interaction terms into the model was insignificance (Prob > chi2 = 0.1798).

Table 4: Teacher Demand Model with Interaction of the Selected Factors

Understaffing	Coefficient	Std Error	P>|z|
Number of Teachers on Duty	-0.0635	0.0368	0.0840
Student Enrolment	0.0021	0.0017	0.2300
PTR	0.0056	0.0056	0.3170
Number of Classes	0.0050	0.0564	0.9290
Number of Streams	0.0030	0.2707	0.9910
Average Class Size	-0.0226	0.0095	0.0180
Number of Teachers Employed	-0.0596	0.2616	0.8200
Teacher Workload	0.0007	0.0104	0.9430
Policy	0.0504	0.1529	0.7410
Teachers on Duty x Student Enrolment	0.0000	0.0000	0.7510
Teachers on duty x number of teachers employed	0.0001	0.0010	0.8930
Average class size x number of teachers employed	0.0355	0.0126	0.0050
Student enrolment x number of teachers employed	0.0047	0.0068	0.4890
Student enrolment x average class size	-0.0013	0.0006	0.0370
Constant	0.0000	0.0000	0.4530

2.2 Effects of Number of Teachers on Duty on Teacher Demand

This study established that the number of teachers on duty was a significant factor (P-value = 0.014 at 0.05 significant level) determining secondary school teacher demand. However the number of teachers on duty had a negative influence on teacher demand. Thus the more the number of teachers on duty, the lower the teacher demand. The freezing of teacher employment in 1998 and the change in teacher recruitment policy in 2001 had a large effect on teacher demand. Teacher shortages in public secondary schools are likely to have a negative impact of quality of education and delay the attainment of the Vision 2030 goal in education of providing high quality education to the citizens.

2.3 Effects of Secondary School Student Enrolment on Teacher Demand

This study established that student enrolment at secondary school level had a significant effect on teacher demand (P-value = 0.011). The effect of student enrolment on teacher demand was in the positive direction indicating that an increase in enrolment results to an increase in teacher demand. The number of secondary school students increased from 618,500 in 1990 to 1,180,300 in 2007, an increase of 90.8%.

2.4 Effects of Class Size on Teacher Demand

This study established that class size had a significant influence (P-value = 0.011) on teacher demand. The average class size had a negative effect on teacher demand indicating that an increase in class size resulted to a reduction in teacher demand. The findings established that the average class size in public secondary school in Kenya was 37 which was below the optimum class size of 40 and Ministry of Education recommended 45 students per class.

2.5 Effects of Number of Secondary School Teachers Employed on Teacher Demand

The findings of this study indicated that number of teachers employed had a significant effect (P-value = 0.004) on teacher demand. The study established that on average 4470 new secondary school teachers are employed every year at the national level during the study period. However, the recruitment of new teachers was not steady and seemed to be done in an unplanned manner without a clear framework. The number of teachers employed in Kenya was influenced by various factors some of which were beyond the control of the Ministry of Education and the TSC.

2.6 Effects of Number of streams on Teacher Demand

This study established that number of streams in a school had a negative effect on teacher demand when combined with other factors. On average, most of the public secondary schools had two streams in 2010. The findings of this indicated that increasing the number of streams at the school level would reduce teacher demand. A study by Olel and Othuon (2005) recommended that public secondary schools should strive to attain a minimum of three streams as a way of increasing enrolment and improve the utilization of resources at the school level while benefiting from economies of scale.

2.7 Effects of Secondary School Teacher work load on Teacher Demand

The findings of these study indicated that teacher workload had a positive effect on teacher demand when combined with other factors. Evidence from this study indicated that secondary school teachers on average teach 22 lessons per week which is lower than the recommended 27 lessons per week. Earlier studies had shown that the actual and recommended contact hours in Kenya were lower than contact hours in other African countries. For instance, the average teaching hours in Ghana and Mozambique are 25 and 24 respectively. Comparing Kenya with Asia and European countries show that the actual and recommended teaching load for Kenyan teachers was lower (Siniscalco, 2002). Thus secondary school teachers in Kenya were underutilized.

2.8 Effects of Government Policy on Teacher Demand

The findings of this study established that Government policy had a positive effect on teacher demand. Thus the Government policy changes had profound effect on teacher demand in Kenya secondary schools. For instance,

the decision the Government in 1987/1988 to convert Harambee secondary schools to public secondary schools and that these schools be provided with full employment of teachers caused the Teachers Service Commission (TSC) to absorb all the teachers who had hitherto been under the Board of Governors. One of the effects of these move was that Mathematics, Science and Languages teachers who were in short supply , and who had been posted to Government maintained schools had now to be shared among the former harambee schools which had become public leading to teacher shortage in these subjects (Kang'ali, 1994). The decision by the TSC in 1996 to pay extra allowances to attract teachers in some subjects namely; mathematics and sciences (chemistry, biology and physics) resulted in more teacher trainees enrolling in these subjects. In 1997 languages (English and Kiswahili) were included but the humanities were left out and as a result fewer teacher trainees were undertaking humanities as their subjects of choice.

The decision by the Government to freeze employment of civil servants, including those of teachers in 1998 increased secondary school teacher demand since no teachers were employed in public secondary schools from 1998 to 2000. The change in teacher recruitment policy from supply driven to demand driven approach in 2001 also affected teacher demand at the secondary school level. Since 2001, teacher recruitment in public secondary schools is done at the school level based on the new policy.

2.9 Model for secondary school teacher demand projection

The study therefore concluded that the simple linear model:

$$Ln(y) = a + bx_1 + cx_2 + dx_3 + ... + \varepsilon \quad \text{Equation } \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3$$

was the most appropriate model for projecting secondary school teachers demand in Kenya.

where: y = teacher demand

a = Constant

x_1= Number of teachers on duty

x_2 = Student enrolment

x_3 = PTR

x_4 = Number of Classes

x_5 = Average class size

x_6 = Number of streams

x_7 = Number of teachers employed

x_8 = Average teacher workload

X_9 = Government policy

3.0 Conclusions and Recommendations

3.1 Conclusions

The study concluded that the factors determining secondary school teacher demand in Kenya include: number teachers on duty, secondary school enrolment, class size and number of newly employed teachers each year.

The study developed the following model for projecting secondary school teacher demand in Kenya as presented by equation:

$$Ln(y) = a + bx_1 + cx_2 + dx_3 + ... + \varepsilon \quad \text{Equation } \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3$$

The study also concluded that, changing the levels in student enrolment, PTR, number of classes, number of teachers employed and teacher without relevant policy controls and interventions measures would increase the risk of teacher shortage.

3.2 Recommendations

This study lays out two sets of recommendations including options for addressing current and future teacher shortages and areas for further investigations.

3.2.1 Recommendations Addressing Teacher Shortages

i. The BOGs and the school administrators at the school level should work out ways to ensure that their schools have optimum class sizes and the teachers are efficiently utilized.

ii. The Government should provide incentives to the private sector to play a greater role in the provision of secondary education in the country so as to relieve the pressure on public schools and the resultant teacher demand.

3.2.2 Recommendations for Further Studies

Although the study explored a lot of factors affecting teacher demand at the secondary school level, a comprehensive understanding of the interplay between the factors, teacher demand trends and other secondary school education issues would require investigations into the following:

i. The effects of Teacher Shortages on quality of education in secondary schools in Kenya.

ii. The effects of teacher shortages on teachers motivation

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