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Research Article

Factors Affecting Academicians' Research Engagement in Woldia University

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Abstract

Teaching, Research and community service are activities expected from current academicians in the university. Research engagement refers to both "engagement in research (i.e. by doing it) as well as engagement with research (i.e. by reading and using it)". The involvement of academicians' in research activities is very rare in Woldia University. This study is aimed at identifying factors that affect academicians' research engagement using count regression models. To meet the objectives, Stratified sampling technique is used to select a sample of 275 academicians. Poisson, zero inflated Poisson and zero inflated negative binomial regression models were used for data analysis considering the number of research conducted as the response variable. The analysis revealed that ZIP model was a better fit to the data than the other count models. Descriptive statistics results show that 72.4% of the academicians didn't conduct any research in their stay at Woldia University. The results of the ZIP regression model revealed that for a year increases in teaching experience the number of conducted researches are increased by 1.17%. Providing research based trainings for female academicians, creating forums for experience sharing, minimizing funding burecracy, and providing mentorship in research activities are some of the interventions that help to increase the engagement of academicians in research activities.

Keywords

Research Engagement, Zero Inflated Poisson, Woldia University

1. Introduction

Teaching, Research and community service are activities expected from current academicians in the university. Being an academician not only entails teaching, getting involved in students' affair and activities, but also conducting research, creating and innovating, providing professional services and up to this juncture, entrepreneurship.

Sakaran defined research as a process for finding a solution to a problem after making a deep analysis and conducting studies of relevant factors [1]. Research is conducted to identify problems or to find answers to 'uncertainties'. Research is also important for the generation of knowledge useful for policy-making, planning and strategic action, all of which are critical to development.

Research is not only done to obtain a degree, in fact it has become a task that is obligatory. It is an undeniable fact that excellence in research and production of high quality publications are able to enhance the reputation of an institution of higher learning.

According to Borg, research engagement refers to both "engagement in research (i.e. by doing it) as well as

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engagement with research (i.e. by reading and using it)" [2]. In broadened view, research engagement refers to academics' involvement in various research-related activities including, among others, initiation of research ideas and projects, conduct of research, writing of research reports, and dissemination of research findings [3].

The fact that African research accounts for a fraction of international research output is regularly observed. Africa produces less than 1% of global research output. [4] Meanwhile, African countries face some of the toughest challenges worldwide, most of which can only be tackled through robust and efficient research. In sub-Saharan Africa the issue of research and publication is even worst.

According to Alebachew, about 73.9 percent of the instructors employed by public universities in Ethiopia have been affected by a lack of scholarly publications [5]. The academic staffs are expected to be scholars who produce knowledge mainly through research. However, quite often, academic staffs focus on teaching and sometimes on community service. The involvement of academicians' in research activities is very rare in Woldia University.

Addressing the barriers to conduct research is a step towards improving research capacity and output. Therefore, this study aims to identify possible personal and institutional factors affecting academicians' research engagement in Woldia University.

2. Data and Methodology

2.1. Data

The data were collected from academicians in Woldia University (main campus and mersa campus). Random samples of 275 academicians were selected from a total of 905 academicians using a stratified sampling technique. In doing this the 8 colleges in Woldia University were considered as a stratum.

2.2. Methodology

In this study, the variable of interest (the number of research conducted by the academicians in Woldia university) is a count variable. When the data in the response variable is countable with non-negative integer values, non-linear models are appropriate based on non-normal distribution to describe the relationship between the outcome variable and a set of explanatory variables.

2.2.1. Poisson Regression Model (PRM)

One of the count regression models that provide a standard framework for the analysis of count data is Poisson regression model. According to Shin, the apparent simplicity of Poisson model is due to two restrictive assumptions [6]. First, equivalence of mean and variance of count variable. Second, the events are independence.

Suppose we have an independent sample of n pairs of observations (y_i, x_i) i ε1,2,…, n where y_i denotes the number of conducted research and x_i is the value of the explanatory variables for the i^{th} subject. Assume $y_i \sim$ Poisson(μ), then the probability density function(PDF) of Poisson random variables, y_i, is given by

$$p(y_i/\mu) = \frac{e^{-\mu}\mu^{yi}}{yi!}$$

where μ > 0, represents the expected number of research conducted in Woldia university in a fixed period of time.

Let x be an n × (p+1) covariate matrix**.** The relationship between y_i and i^{th} row vector of x, is given by the Poisson log-linear model

$$\ln(\mu_i) = x_i^T\beta$$

where, $x_i = (1, x_{i1}, x_{i2},\ldots, x_{ip})^T$ is the vector of explanatory variables and $\beta = (\beta_0, \beta_1,\ldots, \beta_p)^T$ is the vector of unknown regression parameters.

By the equidispersion property of the Poisson, $E(y_i) = var(y_i) = \mu$. In practice, it is often found that the data exhibit overdispersion. The over dispersion could be checked by the Deviance and Pearson chi-square test. If the model fits the data well, both statistics divided by the degrees of freedom are approximately equal to one. If the values greater than one, the variance is an over dispersion. The Negative Binomial model is preferred in this case.

2.2.2. Negative Binomial Regression Model (NBRM)

When the variance exceeds the mean the NBRM is used. Generally, heterogeneity of the population and excess of zeroes are the two sources of overdispersion. In NBRM, introducing a random component into the conditional mean addresses the issue of over-dispersion. However, if there is excess number of zeros in the data, it results in a poor fit to the data. Therefore, before developing a Negative Binomial Regression Model checking the proportion of zero counts is necessary. In this study the likelihood ratio test is used to determine the more appropriate model between the Poisson Regression and Negative Binomial Regression.

The PDF of Negative Binomial random variable is given by

$$p\ (yi;\ \mu,\ \alpha) = \frac{\Gamma(yi+\frac{1}{\alpha})}{yi!\Gamma(\frac{1}{\alpha})}(1+\alpha\mu)^{-1/\alpha}\left(1+\frac{1}{\alpha\mu}\right)^{-y_i}$$

Where $y_i \geq 0$ and α > 0, and Γ(.) is the gamma function.

α is called the dispersion parameter, that shows the level of overdispersion, and assumed not to depend on a covariate. NBRM will reduce to Poisson Regression Model when the dispersion parameter tends to zero. The NBRM is used when the variance is greater than the mean.

2.2.3. Zero-Inflated Poisson (ZIP) Regression Model

For count data with excessive number of zero observations ZIP regression model is appropriate. Further theory suggested that a separate process from the count values generate the excess zeros and the excess zeros can be modeled and analyzed. Hence, the zero inflated Poisson (ZIP) model has two parts, i.e. the usual Poisson count model and the logit model which is used to predict excess zeros in the count dataset.

Suppose μ be the mean of the underlying Poisson distribution and ω_i the probability of an observation being drawn from the constant distribution that always generates zeros and is often called the zero inflation probability [7]. The pdf of a zero inflated Poisson random variable Y is given by

$$p(y_i) = \begin{cases} \omega i + (1-\omega i)e^{\mu i}, yi = 0 \\ (1-\omega i)\frac{e^{\mu i}\mu i^{yi}}{y_i!}, y_i = 1,2,3,\ldots \end{cases}$$

$E(y_i) = \mu_i\ (1-\ \omega_i)$ and $var(y_i) = \mu_i\ (1-\ \omega_i)(1-\ \omega_i\ \mu_i)$ are mean and variance of ZIP respectively. In addition to the excess zeros there are also other sources of over-dispersion that must be considered. Biased standard errors will occur due to a model misspecification when excess zeros are not considered. In ZIP Models, the underlying assumption is that variance is equal to the distribution's mean. If this is an invalid assumption, the data exhibit over-dispersion (or under-dispersion). The Zero-inflated negative Binomial (ZINB) Regression Model often provides an adequate alternative if over dispersion is detected.

2.2.4. Zero-Inflated Negative Binomial Regression Model

ZINB Regression is for modeling over-dispersed count outcome variables and count variables with excessive zeros. Furthermore, theory suggests that the excess zeros are generated by a separate process from the count values and that the excess zeros can be modeled independently. The PDF of ZINB random variable Y is given by

$$P(y_i/w, \alpha, \mu) = \begin{cases} \omega_i + (1+\omega_i)(1+\alpha\mu_i)^{-\frac{1}{\alpha}}, y_i = 0 \\ (1+\omega_i)\frac{\Gamma(y_i+\frac{1}{\alpha})(1+\alpha\mu_i)^{-\frac{1}{\alpha}}(1+\frac{1}{\alpha\mu_i})^{-y_i}}{y_i!\Gamma(\frac{1}{\alpha})}, y_i = 1,2,\ldots \end{cases}$$

Where, μ_i is the mean of negative binomial distribution, the over dispersion parameter $\alpha > 0$ and $0 \leq \omega_i \leq 1$ depend on vectors of covariates x_i and z_i respectively [7]. The formulations for μ_i and ω_i are the same as those used in the ZIP regression model. Here, the mean and variance of the response variable are

$$E(y_i) = (1-\omega_i)\ \mu_i$$

and

$$var(y_i) = \mu_i\ (1-\omega_i)(1+\omega_i\ \mu_i + \alpha\ \mu_i)$$

The Newton Raphson method can be used to obtain the parameter estimates of ZINB regression models,

2.3. Goodness of Fit Tests

Likelihood-ratio test (LRT)

The LRT test is used to assess the adequacy of two or more nested models. This study used significance of LRT and dispersion parameter as criterions to compare negative binomial with Poisson regression models and also ZIP with ZINB regression models. The statistic of LRT is given by

$$LRT_\alpha = -2(LL_1 - LL_2)$$

$LRT_\alpha \sim$ chisq(1) and LL is log-likelihood. If the statistic is greater than the critical value then, the model 2 is better than the model 1.

Akaike and Bayesian information criterions

For model selection this study used AIC and BIC as a goodness of fit criteria. The model with smallest value of AIC or BIC is preferable [8, 9]. The statistics are given by

$$AIC = -2\log(LL) + 2k \text{ and } BIC = -2\ LL + k\ln(n)$$

Where, k and n are number of parameters and observations respectively.

Test for individual predictors

To test the equivalence of a parameter with assumed value wald test is used. It is also important to test the dispersed parameter α. The Wald statistic is given by:

$$Z = \frac{\beta_i}{S.E(\beta_i)},\ i=1,2,3,\ldots,\ p$$

Where, β_i is the coefficient of the i^{th} variable.

$$Z \sim norm(0,\ 1) \text{ and } Z^2 \sim chisq(1).$$

3. Results and discussion

3.1. Statistical Data Analysis and Model Comparison

The variable of interest in this study is the number research conducted by academicians' in their stay on Woldia university. Such data can be well fitted by count data models rather than standard linear regression models. Different count data models are considered in this study.

At the initial stage, a Poisson model is fitted to identify the risk factors of academicians' research engagement. The likelihood ratio-based chi-square test results indicated that

the Poisson model is a good fit to the data. The deviance result (value/df = 0.684) indicated that there is no overdispersion in the data. This result also confirmed by the insignificance of the dispersion parameter (α) in the negative Binomial model. Therefore, the standard negative binomial regression model is inappropriate.

The response variable, number of research data were characterized by excess zero counts of about 199 (72.4%). This brings the zero-inflated models into the picture. Finally, zero inflated negative binomial model is fitted and compared with the standard Poisson and ZIP using the information criteria.

The test results indicated that zero inflated Poisson model is a best fit to the data compared to Poisson and ZINB models. Moreover, the Pearson's chi square test result indicated that the zero inflated Poisson model is a good fit to the data.

3.2. Interpretation and Discussion of Results

Table 1 presents the result of zero inflated poison model for predicting the mean response (λ). The factors administrative position, work load, gender, experience, academic rank, senior expert for mentoring, and funding burecracy were found to be statistically significant predictors of the outcome variable.

The result of this study shows that female academicians are less engaged in research activities than male academicians. The engagement of female academicians in research activities is 65% lower than male academicians.

The findings of this study revealed that academicians who are in the higher professional ranks have more number of researches than lower ones. The number of conducted researches for lecturers and assistant professors were 17.7 and 38.4 percent higher than technical assistances, respectively. This result is in line with the findings of [10].

The other factor that has a significant association with the number of conducted researches is the average semester work load. The number of researches conducted in Woldia University is increased by 1.1% for an additional credit hour. This is a negative result.

The results also indicate that those academicians that assumed administrative position at the university have 61% higher chance of engaging in the research activities compared to an academician that doesn't assumed an administrative position ever, keeping all others covariates constant. This finding is inconsistent with [5].

The findings of this study revealed that academicians that know senior experts for mentorship conduct more researches in the university than other academicians. This result is in line with the findings of [11]. The number of conducted researches was about 59% lower for an academician that doesn't know senior experts for mentorship compared to the other counterparts.

The findings of the study show that more experienced academicians are highly engaged in research activities compared to those academicians with less experience in teaching. For a year increases in teaching experience the number of conducted researches are increased by 1.17%. A study by [5] also reports a positive relationship between the number of conducted research and years of experience in teaching.

The other factor that has a significant effect on research engagement is funding burecracy. Academicians that are highly and moderately satisfied on funding burecracy are conducted 4.7 and 6 times more research than highly dis satisfied academicians, respectively. This fining is inconsistent with [12].

Table 1. *Results of the fitted ZIP model.*

Covariates	β	SE	Z	Sig.	Exp(β)	95% CI of β	
						Lower	Upper
Gender (male)							
female	-1.032	.481	-2.14	0.032	0.356	-1.97	-.087
Age (<30)							
30-39	-.829	.371	-2.24	0.025	0.436	-1.55	-.102
40-49	-.892	.821	-1.09	0.277	0.409	-2.50	.71
≥ 50	-15.948	1107.03	-0.01	0.989	1.1e -07	-2185.6	2153
Motivation (yes)							
no	-.0705	.234	-0.30	0.763	0.931	-.529	.388
Position (yes)							

Covariates	β	SE	Z	Sig.	Exp(β)	95% CI of β	
						Lower	Upper
no	-.944	.2459	-3.84	0.000	0.388	-1.426	-.462
Load	.0509	.021	2.41	0.016	1.052	.009	.092
Experience	.1560	.055	2.83	0.005	1.168	.0481	.264
No. of staffs	-.002	.035	-0.05	0.961	0.998	-.071	.068
Rank (technical assistance)							
Graduate assistance	-30.215	2.3e+07	-0.00	1.000	7.5e -14	-4.5e+07	4.5e+07
Ass. Lecturer	1.044	1.370	0.76	0.446	2.841	-1.642	3.731
Lecturer	2.871	1.249	2.30	0.022	17.660	.423	5.319
Ass. professor	3.647	1.342	2.72	0.007	38.370	1.015	6.279
Senior expert(yes)							
no	-.911	.238	-3.83	0.000	0.401	1.379	-.444
Internet (dis satisfied.)							
moderate	-.178	.291	-0.61	0.539	0.836	-.749	.391
satisfied	.263	.301	0.88	0.382	1.302	-.327	.855
Research Funding (dis sat)							
moderate	-.287	.419	-0.69	0.493	0.750	-1.110	.534
satisfied	-.739	.447	-1.65	0.098	0.477	-1.616	.136
Fund burecracy (dis sat.)							
moderate	1.541	.458	3.36	0.001	4.670	.642	2.439
satisfied	1.787	.637	2.80	0.005	5.975	.537	3.037
Colleague contrn. (dis sat.)							
moderate	.250	.246	1.02	0.310	1.284	-.233	.734
satisfied	.660	.3042	2.17	0.030	1.935	.063	1.256
intercept	-3.960	1.277	-3.10	0.002	0.019	-6.464	-1.457
Reference categories are in parenthesis							

4. Conclusions and Recommendations

4.1. Conclusions

The study has empirically investigated and identified the factors that are associated with academicians' research engagement in Woldia University. A stratified sampling technique is used to select 275 academicians. Among the count data models considered, the zero-inflated Poisson model was a better-fit to the data which is characterized by excess zeros. From the ZIP model, administrative position, work load, academic rank, senior expert for mentoring, gender, teaching experience, and funding burecracy were found to be significant determinates of academicians' research engagement in Woldia University.

4.2. Recommendations

In recent decades, Ethiopia opened universities. However, academicians are mainly focus on teaching activities as a result their engagement on research activities is very rare. The findings presented in this study have the following research and policy implication:

1) The engagement of female academicians is much lower than male academicians. Thus, research based trainings should be given to female academicians.

2) Forums should be created, where senior academicians can share their experiences with the juniors.
3) The study revealed that highly satisfied academicians on funding burecracy are more engaged in research activities. Thus, to improve the satisfaction of academicians funding burecracy should be decreased.
4) The research and community service department should provide counseling service for academicians who need mentorship on research activities.

Abbreviations

AIC	Akaike Information Criteria
BIC	Bayesian Information Criteria
LL	Log Likelihood
LRT	Likelihood Ratio Test
NBRM	Negative Binomial Regression Model
PDF	Probability Density Function
PRM	Poisson Regression Model
ZIP	Zero Inflated Poisson
ZINB	Zero Inflated Negative Binomial

Author Contributions

Ermyas Kefelegn is the sole author. The author read and approved the final manuscript.

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Conflicts of Interest

The author declares no conflicts of interest.

References

[1] Sakaran, U. 2000. *Research Method for Business: A Skill Building Approach.* 3rd Edition. Singapore: John Wiley & Sons.

[2] Borg, S. (2010). Language teacher research engagement. *Language Teaching*, 43(4), 391-429.

[3] Kimkong, M. Obaidul, H. and Asaduzzaman, K. Factors influencing academics' research engagement and productivity: A developing countries perspective. *Issues in Educational Research, 30(3), 2020.*

[4] Chu KM, Jayaraman S, Kyamanywa P, Ntakiyiruta G. Building Research Capacity in Africa: Equity and Global Health Collaborations. PLOS Med. 2014; *journal. pmed. 1001612.*

[5] Alebachew, A. Modeling of Instructors Publication Factors in Ethiopia Public Universities: Advanced Count Regression Models. *Journal of Scientific Research & Reports 24(6), 1-11, 2019.*

[6] Shin, J. C. & Cummings, W. K. (2010). Multilevel analysis of academic publishing across disciplines: Research preference, collaboration, and time on research. *Scientometrics.*

[7] Bland, J., Center, A., Finstad, A., Risbey, R. & Staples, G. (2005). A theoretical, practical, predictive model of faculty research productivity. *Academic Medicine*, 80(3), 225-237.

[8] Akaike H. Information theory and an extension of the maximum likelihood principle. Proc. 2nd Inter Symposium Information Theory. 1973; 267-81.

[9] Blackburn, T., Behymer, E. and Hall, E. (1978). "Research Notes. Correlates of Faculty Publications. Sociology of Education 51: 132-141.

[10] Dessi, Y., & Mesfin, F. Researchers' challenges: findings from in-depth interview among academicians in Haramaya University, Ethiopia. *Herald Journal of Education and General Studies*, 2(2), 069–071. 2013.

[11] Njuguna, F., & Itegi, F. (2013*). Research in institutions of higher education in Africa: challenges and prospects:* vol. 1 ISSN: 1857–7881.

[12] Teodorescu, D. (2000). Correlates of faculty publication productivity: A cross-national analysis. *Higher Education*, 39(2), 201-222.