The Impact of Fiscal Decentralization on Provision of Quality Education and Education Spending in Tanzania

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Abstract

This article uses panel data from 94 LGAs in Tanzania mainland over the period 2005/06 to 2009/10, to examine the impact of Fiscal Decentralization on education spending and provision of quality education. Using local share of total fiscal expenditure as a proxy for fiscal decentralization, this article concludes that Fiscal Decentralization exerts significant impact on education spending and quality of education in Tanzania.

Keywords: Fiscal decentralization, education, government spending, Tanzania

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1.0 Introduction

This study examines the impact of fiscal decentralization on education spending and provision of quality education in Tanzania by using panel data econometrics for the period between 2004/05 and 2009/10. Fiscal decentralization involves decentralization of local government finances by introducing equitable and transparent revenue and capital development grants from central government to local government authorities. Fiscal decentralization also involves giving local government authorities financial powers to raise appropriate local revenues.

The government of Tanzania has been pursuing unprecedented reforms in local government since 1990s, of which fiscal decentralization constitute an integral part of wider decentralization program. Local government reform, launched in 1998 aimed at transferring resources from central to local government's spending on public services such as education. It also involved devolution of power in an endeavor to create more autonomy at the grassroots level. Despite all these reforms, there is no empirical study that has systematically examined the nexus between fiscal decentralization and quality of education/education spending, see for example, Fjeldstad, (2001), Fjeldstad *et al* (2002), Mbelle (2008).

The discussion on fiscal decentralization and its impact on public spending is not new but up to now there is no consensus on the magnitude and direction of the impact of fiscal decentralization on spending, (Busemeyer, 2007). The impact of fiscal decentralization on public spending varies depending on the distribution of spending across levels of government. Busemeyer (2007) developed a simple model to show that local competition in the provision of local/regional public goods (e.g. education) can result in higher spending. However, when public goods are provided at the national level, fiscal decentralization encourages local policy pre-emption, thus lowering spending, Busemeyer (2007).

This paper contributes to the empirical literature by using panel data econometrics. It exploits dataset from 94 LGAs in Tanzania mainland over the period between 2005/06 and 2009/10. Empirically, panel data econometrics has several appealing features compared with either cross section or time series econometrics. First, panel data contain information on both the inter-temporal dynamics and the individuality of the entities, and therefore it is capable of controlling the effects of unobservable. Second, Hsiao (2005) argues that panel data generates more accurate predictions for individual outcomes by pooling the data rather than generating predictions of individual outcomes using the data on the individual in question.

The econometric results show that Fiscal Decentralization exerts significant impact on education spending and quality of education in Tanzania. The remainder of this article is organized as follows. Section 2 reviews the literature on fiscal decentralization paying particular attention on the link between fiscal decentralization and spending in education. Section 3 presents an econometric model and data analysis. Section 4 concludes.

2.0 Literature Review

The conceptual framework of fiscal decentralization is largely based on contributions by Tiebout (1956), Musgrave (1959) and Oates (1972). Tiebout (1956) argues that fiscal decentralization enhances efficiency in the local public sector with mobility of households providing the disciplining market force. Fiscal decentralization is a powerful channel for matching the provision of public services which are commensurate to the preferences of citizens. Oates (1972) argues that, local governments are best positioned to provide local public services since they can accommodate differences in tastes; local governments have an information advantage on tastes over central government. In an attempt to provide an efficient allocation of local public services means that local governments provide services up to the point where the marginal utility of the last unit of services for which citizens are willing to pay is just equal to its marginal benefits. This implies that local governments are obliged to generate revenues to match citizens' preferences on expenditures.

Indeed, the decentralized system of tax collection would be more likely to make spending decisions at the grass root level more compatible with available resources. The decentralized system of tax collection promotes accountability and responsibility as well as the efficient provision of local public goods. Fiscal decentralization also encourages fiscal autonomy and tax competition among localities. In fact, the literature on fiscal federalism suggests that expenditure assignment should precede tax assignment. The reasons behind is that tax assignment is generally guided by expenditure requirement of different levels of government and these cannot be worked out in advance of expenditure responsibilities. Absence of tax assignment would result in dependence on the federal government by lower levels of government.

2.2 Empirical Literature

Empirical evidence on the effects of decentralized education spending has been mixed, with positive results reported by Barankay and Lockwood (2007) for Switzerland and Skoufias and Shapiro (2006) for Mexico, but negative results obtained by Di Gropello (2002) for Chile, and more broadly for Latin American countries (Glewwe, 2002). Most of the earlier studies report a negative association between fiscal decentralisation and public spending (Nelson 1987; Marlow 1988; Grossmann1989;, but others find no robust effect of fiscal decentralisation on spending (Oates 1985 and Anderson 1998). Akai and Tananta (2007), show that decentralization in education finance have positive effects on students' performance through improvement in the allocation of educational resources. However, it may deteriorate equity in educational resources among districts and result in low educational outcome. The negative effect of decentralization is larger in primary than in secondary education because of large marginal products of education and/or high complementarities among districts in primary education.

Skira, (2006) postulates that expenditure decentralization improves education output by increasing the average years of primary school in the total population, decreasing the percentage of no schooling in the total population, decreasing the dropout rate in primary school, decreasing the repetition rate in primary school, increasing the percentage of primary school attained in the total population and increasing the percentage of secondary school attained in the total

population. The log of expenditure decentralization is significant in all the regressions except when the percentage of primary school attained in the total population is the dependent variable.

Freinkman and Plekhanov (2009) found that fiscal decentralization has no significant impact on key inputs into secondary education, such as computers but has a significant positive impact on examination results in Russian regions. These results remain stable even after controlling for key observable inputs and regional government spending on education. Luo and Chen (2010) examines the relationship between fiscal decentralization and public provision in china and found negative effect of fiscal decentralization on public education provision which was highest in Central and West China.

3.0 Methodology

3.1 Econometric Model for fiscal decentralization and quality of public education

In this paper, we use two econometric models to estimate the impact of fiscal decentralization on the provision of quality education. These models are adopted from Freinkman and Plekhanov (2009). The first model uses school inputs as a proxy for quality education and is specified as follows:

$$INP_{it} = \alpha_1 + \beta_1 EXP_{it} + \gamma_1 DEC_{it} + \lambda X_{it} + \varepsilon_{it} \quad (1)$$

where *INP* are the key physical inputs in district *i* in year *t*, *EXP* is Local government spending in the education per pupil, *DEC* is a measure of fiscal decentralization in the Local Governments broadly defined, *X* is a set of control variables, and ε is the residual. Many empirical studies describe fiscal decentralization as the share local expenditure to total government expenditure, see for examples, Oates, (1985), De Mello (2000); Jin *et al* (2005). Analogously, the local share of total of total government revenue is also applied to measure the degree of fiscal decentralization. We use number of classrooms as a measure of provision of quality of education. The choice of this proxy is dictated by data availability. Unquestionably, data on teaching materials, number of desk and computers would serve as good proxies for the quality of education but these data is not available.

The second specification considers performance indicators as a proxy for provision of quality education. It is specified as follows:

$$PERF_{it} = \alpha_2 + \beta_2 EXP_{it} + \gamma_2 DEC_{it} + \delta INP_{it} + \mu Z_{it} + \eta_{it} \quad (2)$$

Where *PERF* is an indicator of education performance, *Z* is a set of control variables, η is the residual, and other variables are defined as above. The performance indicator in education is the pass rate obtained by primary school candidates in national examinations. The exam pass rates are available for 2005 and 2010 from National Examination Council of Tanzania (NECTA).

3.2 Econometric Model for fiscal decentralization and Spending of Public Education

In measuring the impact of fiscal decentralization on public education spending we used the econometric modeling adopted from Luo and Chen (2010). It is specified as follows:

$$Y_{ijt} = \alpha_0 + \alpha_1 + DEC_{ijt} + \alpha_2 \ln GDPPC_{ijt} + \alpha_3 X\_GDP_{ijt} + \alpha_4 DC_{ijt} + \mu_{ij} + \upsilon_t + \varpi_{ijt} \qquad (3)$$

Y is public education expenditure to GDP ratio. DEC stands for a measure of fiscal decentralization in local government. LnGDPPC denotes per capita GDP to reflect economic development. X_GDP is the Public expenditure-to-GDP in District level. DC stands for Local Government dummy variables, to control idiosyncratic features of each LGA.

3.3 Data

The panel data for this study is composed of 94 rural LGAs all belonging to Tanzania mainland. Urban councils were excluded to reduce greater variability of data by looking at population size and inputs, also the following LGAs were excluded from the study due to absence of data, these are; Longido, Bahi, Chamwino, Ludewa, Kilolo, Siha, Rorya, Nanyumbu, Mkinga, Chato, Arusha rural, Dodoma rural and Misenyi.

Data were taken form the Prime Minister's Office for Regional Administration and Local Government Authorities (PMO-RALG, 2005-2010), as well as logintanzania.net website, Ministry of education and Vocation (MOEVT, 2005-2010), National Bureau of Statistic (NBS, 2005-2010), (2005-2010) and National Examination Council of Tanzania (NECTA, 2005-2010).We use revenue collected by each LGA as a proxy for income and hence GDP. Dividing by the population we get per capita income (GDP) for each jurisdiction.

3.4 Models Estimation and Analysis

This section presents and discusses the empirical results of the models described in earlier. The first part presents the descriptive statistics of the data and the univariate characteristics of the variables. The second part presents the empirical results which include the pooled, fixed and random effects models of the impact of fiscal decentralization on the quality of education and education spending in Tanzania. The last part compares the results with other studies done in various parts of the world.

3.4.1 Descriptive statistics of the data.

A normality test on the variables under study was done, and they were found to be not normally distributed as seen in Table 2.H in appendices two. Hence the variables were transformed to natural logarithms so as to make them normally distributed, since normally distributed variables give better results than variables which are not normally distributed. The descriptive statistics of the transformed data are given in Table 1.1. In general the average statistics of all variables range from -10.5 to 10.23, where by the growth of local government expenditure per person has the

lowest mean statistic while the growth of district government spending on education has the highest mean statistic. All the variables except the growth rate of public expenditure to GDP ratio, are negatively skewed indicating that, most of these values are lying on the left hand side of their average value while the remaining few values are on the right side of the mean.

Table 1.1: Descriptive statistics

	Ln(DEC)	Ln(EXP)	Ln(INP)	Ln(PERF)	Ln(GDPCC)	Ln(XGDP)
Max	-5.40	10.23	5.63	4.56	-4.86	4.28
Min	-7.91	6.99	2.48	2.75	-8.90	0.10
Mean	-6.45	9.21	4.65	3.93	-6.76	2.49
Skewness	-0.47	-1.09	-1.04	-0.55	-0.20	0.09

In order to ensure that the study measures what is intended to measure, a number of test were performed. Hausman test were used to determine the appropriate model to be used. Data were transformed to natural logarithms to make them normally distributed. Breitung and Fischer ADF and LLC test were used to test for presence of unit root in the data.

3.4.2 Unit Root Test

Testing for panel data unit root is quite recent and many researches applying panel data still disregard this crucial step. This study used a battery of tests to test for the presence of unit root in the data. The study used the Levin–Lin–Chu (LLC), Breitung, Fischer and Augmented Dickey Fuller (Fischer-ADF) tests. The LLC and Breitung test assume that the autoregressive parameters are common across cross sections. They use the null hypothesis of a unit root. The Fischer ADF test, however, allows the autoregressive to vary across LGA and also for individual unit root processes. It is computed by combining individual countries' unit root tests to come up with a result that is specific to a panel. The null hypothesis is that all series contain a unit root test and the alternative is that at least one series in the panel contains a unit root. The results presented in Table 1.2 imply that all the tests reject the null of unit root for all variables.

Table 1.2: Panel Unit Root Test

	LLC	Breitung	Fischer-ADF	Order of integration
Ln(DEC)	-15.11	-3.83	49.45	I(0)
Ln(EXP)	-17.60	-3.06	63.67	I(0)
Ln(INP)	-2.54	-5.43	58.11	I(0)
Ln(PERF)	-25.15	9.45	55.93	I(0)
Ln(GDPCC)	-8.36	-10.67	75.60	I(0)
Ln(XGDP)	-8.86	7.69	60.69	I(0)

3.5 Empirical results

3.5.1 The impact of fiscal decentralization on quality of education.

The estimation of the impact of fiscal decentralization on the quality of education provision was done by estimating equation (1) and (2). We estimated a pooled model, fixed effects model and Random equation model for both equations. A pooled model is the most restrictive model among the three, since it does not allow for heterogeneity of the districts, hence it does not estimate district specific effects. The fixed effects model introduces heterogeneity by estimating district specific effects. It is an unrestricted model as it allows the intercept and other parameters to vary across the districts. The F-test statistic was performed to test the ability to pool data and the results in Table 2.A and 2.B in appendix two for equation (1) and (2) respectively, indicate that the null hypothesis of equality of individual effects is rejected. This means that a model with individual effects is better than the pooled model.

Like the fixed effects model, the random effects model also acknowledges heterogeneity in the cross-section. However, it differs from the fixed effects model in the sense that the effects are generated by a specific distribution. Although it assumes that there is heterogeneity in the cross-section, it does not model each effect explicitly. The LM test was performed and the null hypothesis of equality of the individual effects is rejected in favor of random effects specification as seen in Table 2.C and 2.D for equation (1) and (2) respectively.

The Hausman statistic is used to test the null hypothesis that the regressors and individual effects are not correlated in order to distinguish between fixed effects model and random effects model. Failure to reject the null hypothesis implies that the random effects model will be preferred. If the null hypothesis is rejected, the fixed effects model will be appropriate. The results in Table 2.E and 2.F in appendix two show that the Hausman specification test rejects the null hypothesis and this indicates that district specific effects are correlated with regressors for equation (1) and (2) respectively. This suggests that the fixed effects model is preferred for the estimation of both

equation (1) and (2). Since the fixed effects model is the appropriate one for both equations (1) and (2), interpretation of the results will focus on the fixed effects models which are presented in the main text while the results of the random effects models and pooled regressions will be presented in the appendix one for both equations. Estimation results of the fixed effects model for equation (1) are presented in Table 1.3.

The fixed effect model for equation (1) is significant as a whole, with F-statistic of 15.34. Moreover it has adjusted R^2 of 0.59, which is moderately good. The fact that the Corr(U_i, xb)= 0.76, supports the notion that the fixed effects model is appropriate for the estimation of equation (6), since it indicates that the errors are highly correlated with the regressors. Furthermore eighty four percent of the variance in the model is due to differences across the districts as shown by the value of rho which is 0.84. Due to the fact that we are dealing with a micro panel data set the only diagnostic test that were conducted were the test for joint validity of fixed effects, which is produced by default by STATA when you run a fixed effects model.

Table 1.3: Fixed effects model for equation (1)

Dependent Variable: Ln(INP)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Ln(DEC)	0.178	0.451	3.96***	0.000
Ln(EXP)	0.065	0.028	2.36**	0.019
Cons	5.21	0.435	11.96***	0.000
Adjusted R-squared	0.59	F-statistic		15.34
		Prob(F-statistic)		0.000

F-test that all U_i=0: F(94, 378)=17.23 Prob>F=0.0000
Corr(U_i, Xb)=0.7694, rho = 0.84001
Note:*, **, *** presents 10%, 5% and 1% significance level respectively

The F-statistics for the joint validity of fixed effects is statistically significant with a p-value of 0.00, hence rejecting the null hypothesis that the fixed effects are not jointly valid. Other diagnostic tests like testing for serial correlation were not of much interest in this case as we were dealing with a micro panel data set. Nevertheless we tested for the presence of heteroscedasticty in the panel data set, the results are presented in Table 2.G in appendix two. The results indicate that there is no presence of heteroscedasticity.

Local share of government expenditure has a positive sign as expected and is statistically significant at 5% level of signifcance. A percentage increase in local share of government expenditure by a district would lead to a 17% increase in classrooms. Furthermore district government spending in education per pupil was also found to be statistically significant and

with the hypothesized sign. A percentage increase district government spending per pupil would bring a 6% increase in inputs in the education sector.

Estimation results for equation (2) are presented in Table 1.4. The fixed effect model for equation (1) is significant as a whole, with F-statistic of 8.28. Moreover it has adjusted R^2 of 0.69, which is moderately good. The fact that the Corr(U_i, xb)= 0.65, supports the notion that the fixed effects model is appropriate for the estimation of equation (6), since it indicates that the errors are correlated with the regressors. Furthermore seventy five percent of the variance in the model is due to differences across the districts as shown by the value of rho which is 0.75. Due to the fact that we are dealing with a micro panel data set the only diagnostic test that were conducted were the test for joint validity of fixed effects, which is produced by default by STATA when you run a fixed effects model.

The F-statistics for the joint validity of fixed effects is statistically significant with a p-value of 0.00, hence rejecting the null hypothesis that the fixed effects are not jointly valid. Other diagnostic tests like testing for serial correlation were not of much interest in this case as we were dealing with a micro panel data set. Nevertheless we tested for the presence of heteroscedasticty in the panel data set, the results are presented in Table 2.H in appendix two. The results indicate that there is no presence of heteroscedasticity.

All the variables in equation (2) were found to have the hypothesized signs according to the theory. The local share of government expenditure was found to be positive and statistically significant at 5%. A percentage increase in the local share of government expenditure by a district would lead to 18% increase in the pass rate. Moreover district government spending in education per pupil was found to be positive and statistically significant. But it was found to be fairly significant at 10% level of significance. A percentage increase in district government spending would increase the pass rate by 6.8 percent.

Table 1.4: Fixed Effects Model

Dependent Variable: Ln(PERF)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Ln(DEC)	0.184	0.060	3.02**	0.003
Ln(EXP)	0.068	0.037	1.82*	0.069
Ln(INP)	0.063	0.024	2.63**	0.005
St_ratio	-0.562	0.251	-2.23**	0.026
Cons	4.487	0.588	7.63***	0.000
Adjusted R-squared	0.69	F-statistic		8.28
		Prob(F-statistic)		0.003

F-test that all U_i=0 F(94,378)=2.82 Prob>F=0.0000
Corr (U_i, Xb)= 0.6562, rho= 0.7561
Note:*, **, *** presents 10%, 5% and 1% significance level respectively

The student teacher ratio (st_ratio), was found to be statistically significant and negative, a percentage increase in the number of pupils in relation to the teachers available would bring about a 5.6 percent decrease in the pass rate. Nevertheless the number of inputs in the educational sector also was found to be statistically significant and positive. A percentage increase in the number of class rooms would lead to a 6.3% increase in the pass rates.

Looking at the estimation results for equation (1) and (2), we see that both inputs in education and education performance indicators are positively influenced by fiscal decentralization. Hence this implies that fiscal decentralization has positive impact in quality of education.

3.5.2 Impact of fiscal decentralization on education spending

The estimation of the impact of fiscal decentralization on education spending was done by estimating equation (3). We estimated a pooled model, fixed effects model and Random equation model for equation (3). A pooled model is the most restrictive model among the three, since it does not allow for heterogeneity of the districts, hence it does not estimate district specific effects. The fixed effects model introduces heterogeneity by estimating district specific effects. It is an unrestricted model as it allows the intercept and other parameters to vary across the districts. The F-test statistic was performed to test the ability to pool data and the results in Table 1.5 indicate that the null hypothesis of equality of individual effects is not rejected. This was also supported by the LM test which indicated that the pooled model is preferable to the random

effects model. Hence the interpretation of the results will concentrate on the pooled regression results on the second column.

Table 1.5: Estimation results for equation 3

Variable	Pooled Regression	Fixed effects	Random effects
Constant	0.151 (1.85)*	0.221 (3.22)**	0.159 (1.94)*
Ln(DEC)	0.740 (7.40)***	0.938 (6.86)***	0.753 (7.66)***
Ln(GDPPC)	-0.613 (3.59)**	-0.877 (2.98)**	-0.045 (3.73)***
Ln(XGDP)	0.191 (0.08)	0.129 (0.30)	0.134 (1.97)*
DC	1.113 (3.96)***	-	1.072 (2.56)**
Adjusted R^2	0.69	0.72	0.70
Chow test	45.06***		
Hausman test			
LM test	279.456***		

Note:*, **, *** presents 10%, 5% and 1% significance level respectively, the standard errors reported in the brackets are robust standard errors to take care of heteroscedasticity.

From the results in Table 1.5, we see that the rate of growth of local government expenditure per person which has been used as a measure of fiscal decentralization is significant and has a positive effect on public education expenditure to GDP ratio. A percentage increase in local government expenditure per person will lead to 74 percent increase in public education expenditure to GDP ratio. Hence, meaning that Fiscal decentralization brings about an increase in Education spending.

Moreover in control variables, GDP per capita significantly decreases education provision at 5% significance level, a percentage increase in GDP per capita will lead to a 61 percent decrease in education spending, which indicates that, although economic development could enhance education, but to accelerate economic development, local government over-invest in infrastructure, while under-invest in education. Public expenditure-to-GDP ratio is another important control variable, but we do not make detailed analysis here as it was found to be not statistically significant. City council dummy variable significantly reduces education provision, which indicates that "education in capital city is better" is not correct. A district council being a city council reduces education expenditure by 1.1. This may be attributed to the fact that in city councils other development projects have high priority rather than investment in education.

3.5.3 Comparison with other studies

The results obtained in this study are consistent to what Oates (1972), who concluded that fiscal decentralization had a positive effect on the quality of public service provision, including education. Oates (1972) reiterates that this is no surprise by any means since local governments may have superior knowledge of local preferences and needs, thus be able to target public spending better.

Furthermore the results of this study are consistent to what Barankay and Lockwood (2007) for Switzerland and Skoufias and Shapiro (2006) for Mexico, who concluded that fiscal decentralization, has a positive effect on education spending. This is contrary to what Di Gropello (2002) for Chile and more broadly for latin America by Glewwe (2002), who concluded that fiscal decentralization has a negative impact on education spending.

Moreover, the study is also consistent with Freinkman and Plekhanov (2009), who concluded that fiscal decentralization has a significant positive effect on the quality of education spending. They found fiscal decentralization to have a positive effect on average examination results which they used as a performance indicator.

4.0 Concluding Remarks

This study analyzed the impact fiscal decentralization on the quality of education provision and education spending in Tanzania over the period of 2005 to 2009. The study used panel data analysis techniques in the estimation of the data. The data were tested for stationarity using a battery of tests that included Levin, Lin and Chu test, Breitung test and Fischer ADF test, which revealed that the variables were stationary, hence could be estimated using Ordinary least squares.

The equations in this study were estimated using the three common panel data techniques, which are pooled regressions, fixed effects and random effects models. The chow F-statistic, Hausman test and Breusch-Pagan LM test were used to determine modeling techniques. The fixed effects model and pooled regression models were found to be appropriate for the impact of fiscal decentralization on quality of education provision and impact of fiscal decentralization on education spending respectively. The results revealed that fiscal decentralization has a positive effect on the quality of education provision and education spending.

The study revealed that fiscal decentralization has a positive effect on both the quality of education provision and education spending, hence the government may enhance further decentralization in Tanzania. This will lead local governments to have more autonomy on fiscal matters, hence make them more accountable. Fiscal decentralization would reduce district council's dependency on central government. For fiscal decentralization to be successful there must be willingness on the part of the central government to share power with lower tiers of governments.

Indicators of fiscal decentralization are numerous. Zhang and Zou (1998) use the provincial government budget expenditure per person (in-budget and off-budget) over the government's total expenditure per person as proxy for fiscal decentralization. Lin and Liu (2000) use marginal sharing rate of provincial government in budget revenue of the province to measure fiscal decentralization. Further research on fiscal decentralization in Tanzania should take into account these indicators. Furthermore our study could not incorporate other control variables like school resources, organization of schooling, student and family characteristics, the degree of competition across schools when looking at the impact fiscal decentralization on the quality of education provision.

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APPENDICES

Appendix 1: Panel data models

Table 1.A: Random effects model for equation (1)

Dependent Variable: Ln(INP)

Method: Random effects model

Variable	Coefficient	Std. Error	Z-Statistic	Prob.
Ln(DEC)	0.328	0.045	7.59***	0.000
Ln(EXP)	0.035	0.028	1.22	0.224
Cons	6.457	0.430	14.99***	0.000
R-squared	0.51	Wald chi2(2)		67.11
		Prob(Wald chi2)		0.000

Corr(U_i, Xb)=0; rho = 0.7339

Table 1.B: Pooled model for equation (1)

Dependent Variable: Ln(INP)

Method: Pooled model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Ln(EXP)	0.05	0.05	1.14	0.25
Ln(DEC)	0.81	0.45	18.02***	0.00
Cons	6.457	0.430	14.99***	0.000
R-squared	0.55	F-statistic		162.32
		Prob(F-statistic)		0.000

Table 1.C: Pooled model for equation (2)

Dependent Variable: Ln(PERF)
Method: Pooled model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Ln(DEC)	0.026	0.035	0.76	0.450
Ln(EXP)	0.107	0.039	2.76**	0.006
Ln(INP)	0.014	0.006	2.09**	0.021
St_ratio	-0.131	0.028	-4.72***	0.000
Cons	2.779	0.431	6.45***	0.000
R-squared	0.61	F-statistic		172.31
		Prob(F-statistic)		0.000

Table 1.D: Random effects model for equation (2)

Dependent Variable: Ln(PERF)
Method: Random effects model

Variable	Coefficient	Std. Error	Z-Statistic	Prob.
Ln(DEC)	0.134	0.041	0.82	0.412
Ln(EXP)	0.097	0.036	2.73**	0.006
Ln(INP)	0.028	0.017	1.64	
St_ratio	-0.362	0.127	-2.85***	0.001
Cons	3.256	0.452	7.20***	0.000
R-squared	0.62	Wald chi2(2)		8.93
		Prob(Wald chi2)		0.015

Corr(U_i, Xb)= 0; rho= 0.6561

Appendix 2: Diagnostic Tests

Table 2.A: Chow Test for equation (1)

F- test	10% critical value	5% critical value
60.31	1.5065	1.69

Ho: Pooled model is appropriate

Table 2.B: Chow Test for equation (2)

F- test	10% critical value	5% critical value
60.31	1.5065	1.69

Ho: Pooled model is appropriate

Table 2.C: BP LM test for equation (1)

LM test	Probability
388.61	0.0000

Ho: Pooled model is appropriate

Table 2.D: BP LM test for equation (2)

LM test	Probability
55.83	0.0000

Ho: Pooled model is appropriate

Table 2.E: Hausman Test for equation (1)

Hausman	Probability
140.76	0.0000

Ho: Random effects are appropriate

Table 2.F: Hausman Test for equation (2)

Hausman	Probability
11.29	0.0035

Ho: Random effects are appropriate

Table 2.G: Wald test for Heteroscedasticity for equation (1)

Hausman	Probability
11.29	0.0035

Table 2.H: Test for multivariate normality: Doornik Hansen Test

Test statistic(Chi2)	Prob>Chi2
10.150	0.0025

Ho: The variables are normally distributed