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INTERREGIONAL VARIATIONS AND EXPLANATION OF STUDENT ACHIEVEMENT IN ETHIOPIA

Mekete Belachew*

ABSTRACT. The study after providing an overview of the research literature, discusses the nature and magnitude of interregional variations in student achievement. The occurrence of such variations has been proved statistically. It has also tentatively indicated that financial, urbanization, learning conditions, teacher's sex and teaching materials variables appeared to explain most of the spatial variations of the dependent variable. Nevetheless, as the study essentially reflects the quality of secondary education, which is very complex indeed, the present findings ought to be viewed as being tentative pending further research into this problem in the future.

1. INTRODUCTION

The question of the quality of education is an issue which has been attracting the attention of schools, parents, governments and many others which are directly and indirectly involved in the progress of education in any country. The phrase quality of education as pertains to this study "... refers to pupil performance or standards of attainment in different school subjects. According to this usage, which is by far the most prevalent, the complaint about decline in the quality of education means that standards of attainment have fallen or that the average level of attainment at different levels, as established through examination results or test scores or other norms of scholastic achievement, has gone down steadily [21. p. 61].

*Associate Professor, Department of Geography, Addis Ababa University.

In the less developed countries (LCDs) like Ethiopia the declining level of student achievement has of late created a more-than-usual concern from all quarters. This phenomenon may have resulted from the huge quantitative growth of student population at the expense of tangible qualitative improvement. The demand for more education is based on a small existing school system and limited resources. Under such circumstances, there is a tendency for satisfying social and political aspirations which are not warranted by the available resources. The end result has been declining quality in education leading, of course, to poor student performance.

Several grim consequences have emerged from this development. In the case of Ethiopia, the most outstanding problem in this regard is the problem of several thousands of school leavers who fail to obtain admission into any type of higher education owing to their relatively lower academic performance. This problem, looked at from a broader perspective, has very serious implications which are outside the scope of this study.

This study does not wish to go into the broader dimension of the problem and propose solutions for it. Instead, it attempts to deliberate upon the background of this issue. It consists of a number of parts or sections. First, a brief overview of the literature is provided in order to take stock of the existing knowledge regarding the problem under investigation. Secondly, the study focuses on the investigation of interregional or inter-Administrative Region variations in student achievement discovered above. In addition to this Introduction the study entails other Sections, namely: Objectives where the aims of the study are fully stated, Hypotheses, Methodology and Nature of Data and Conclusions.

2. OBJECTIVES

This study focusses on two main objectives:

2.1 To investigate the nature and magnitude of interregional (spatial) variations in student achievement or academic performance.

2.2 To make a preliminary effort towards the explanation of interregional variations in student achievement. This writer clearly appreciates the fact that the measurement of student achievement is too complex, especially in a country like Ethiopia where this problem is hardly touched on, to be treated single handedly. Therefore, in this respect the aim is to make a very modest beginning along the line of exploratory research.

3. HYPOTHESES

3.1 There exist significant interregional (spatial) variations or differences in student achieverment.

3.2 Interregional variations in student achievement are largely a function of fifteen variables, namely: Total number of teachers, Number of male teachers, Number of female teachers, Number of teachers with first and second degrees (Teachers Variables); Budget for teaching materials, Number of equipped secondary schools (Teaching Materials variables designed to serve as surrogate or proxy variables for the availability of textbooks); Number of senior secondary schools, Per cent of all senior secondary schools, Number of classrooms per 10,000 population (School-Space Variables); Size of enrollment, Staff-student ratio (Enrollment Variables); Allocated recurrent budget, Recurrent budget per

student, Size of Salary (Financial Variables); and Degree of Urbanization (Urbanization Variables).

4. METHODOLOGY AND NATURE OF DATA

Statistical analysis has been performed on data of the results of the Ethiopian School Leaving Certificate Examinations (ESLCE) collected and computed from the files of the Office of the ESLCE. The remaining data were obtained from the various Divisions and Sections of the Ministry of Education. As all the data were drawn from authoritative sources they have a high degree of reliability.

5. REVIEW OF THE LITERATURE

The review of the literature essentially summarizes the present state of knowledge as regards the effects of a number of group variables on student achievement or performance particularly in the less developed countries. All the variables utilized in this study are covered in the literature either directly or indirectly.

Researches on the factors affecting student performance in the less developed countries are scanty. However, there are a few important studies which provide some preliminary conclusions on this issue. In this respect the World Bank's contributions are quite important. One such contribution or study deserves special mention. This study critically assesses all available researches concerning teacher training and student achievement

in the less developed countries. Nevertheless, only those teacher variables that have direct bearing on this study are included here. Accordingly, teacher sex, teacher credentials and certification or level of training, teacher salary and school-teacher block variables are discussed briefly.

The available overall evidence concerning teacher sex seems to slightly support the notion that male teachers are more effective than female teachers [22, p. 15]. Overall, one can conclude from the evidence of the 32 studies covered by this report that at least some teacher variables have emerged as very important in explaining variations in student achievement in the LDCs. By far the most important evidence focusses on variables linked with teacher qualifications and credentials. Contrary to the arguments presented elsewhere, the evidence here suggests that trained teachers do make a difference [22, p. 42]. Some studies have indicated the existence of positive relationship between teacher salary and student achievement [22, p. 29]. In addition there are the School-Teacher Block Variables which are reported in the survey undertaken by the International Association for Evaluation of Educational Achievement (IEA). These include four blocks representing Home and Student Back-ground, Type of School or Course, Learning Conditions and Kindred Variables [22, p. 69]. These variables, at least in the LDCs, are found to be important in accounting for variations in student achievement [22, p. 39]. The available sources make no direct mention of the Urbanization Variable which has been utilized in this study. However, as this variable reflects the general urban environment in which the learning process is being carried out it can fall under the block-variables mentioned above. In addition Lerner [13] argues that urbanization is one of the 'basic' variables that animates the modernization process. Therefore, it is plausible to suppose that those schools that are located in the more urbanized areas tend to perform better than those located in the less urbanized areas.

In another similar study, again commissioned by the World Bank the influence of the availability of textbooks on student achievement is specifically treated. From the evidence so far obtained the availability of textbooks appears to be the most consistent factor in predicting academic achievement. It is positive in 15 of the 18 statistics (83%). This is, for example, more favourable than the 13 of 24 (54%) reported recently for teacher training [23, p. 1]. This does not mean, however, that we know all the reasons why. Textbooks do not have necessarily uniform impact everywhere. What does mean is that compared to other commonly measured characteristics such as teacher training, class size, teacher salaries, boarding facilities, grade repetition etc. the availability of textbooks appears so consistently associated with higher achievement levels that as an instrument for affecting learning they represent a reasonable choice. In short they are worthy of more experimentation and close scrutiny [23, p. 3].

In still another World Bank sponsored study [9] expenditure variables are not found to be important predictions of student achievement.

One important study, which draws some examples from Ethiopia's educational experiences, has attempted to bring together information about educational outcomes, including types of measures, the role and use of measurement and national policy consequences of measurements [11, p. 9].

An exploratory work on the quality of education in Ethiopia has attempted to explain variations in academic performance in a manner very much related to the ones discussed above. In this study a number of categories in the total environment in which learning takes place have been suggested. Those categories that are relevant to this study are outlined briefly below.

The General Environment Conditions Category embraces a wide range including the broad framework of political change, climatic conditions, traditional cultures, technologies and the like. The Home/Community Environment Conditions Category comprises the specific impact of general environmental conditions and may vary from community to community, but they also include the specific conditions of social unit: socio-economic status impact of mother/father siblings etc., distance from school, physical conditions in the home etc. The Teacher Inputs Category is part of the following Category. But it is obvious that although self-instruction is possible, the formal school system assumes the presence of a teacher. Of all inputs to school the teacher — his experience, training, attitude, motivation etc., is probably the most significant variable in the learning process. The other School Inputs Category includes the provisions for the educational process: buildings, land, furniture, equipment, curriculum, textbooks, paper, pencils, recurrent budget etc. [12, pp. 6-7].

The review of the literature summarized above clearly demonstrates the complexity of the problem and hence the difficulty in selecting the more relevant variables that may explain the interregional variations in student achievement.

6. INTERREGIONAL VARIATIONS IN STUDENT ACHIEVEMENT

This section of the paper or study has two-fold objectives. First, it examines the nature of interregional (spatial) or inter-Administrative Region variations in student achievement as measured by the size of percentage passes in the Ethiopian School Leaving Certificate Examination. Secondly, the hypothesis that there exist significant interregional variations in student achievement is tested statistically.

Table 1 and Fig. 1 demonstrate the interregional variations in academic achievement on the basis of percentage passes. Both of them indicate the existence of interregional differences in academic performance over the past nineteen years. Eritrea (30), Addis Ababa (26) and Harer (27) excelled all others in having the largest percentage passes while Gojjam (12), Gamo Gofa (14) and Wello (14) came under the lowest ranks. Note that the figures in parentheses are percentage passes.

The second objective of this Section deals with hypothesis testing. It was hypothesized earlier that there exist significant interregional variations in student achievement. The Single Classification or One Way Classification Analysis of Variance is utilized in testing this hypothesis. This is a very useful and powerful technique for making comparisons among any number of sets of data at once. In other words, through this method the researcher will be able to test the significance of mean differences between more than two groups simultaneously [17, p. 152]. In this study as per the assumption of the technique all of the samples are drawn from normal universes. Ten random samples are taken from the percentage passes of each administrative Region and the city of Addis Ababa. These samples are given in Table 2 below.

Table 1. PERCENTAGE PASSES BY ADMINISTRATIVE REGIONS

Administrative Region	Percentage Pass By Years and Administrative Regions																		Average (%)
	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1977	1978	1979	1980	1981	1982	1983	
Addis Ababa	38	25	23	25	23	28	27	25	24	27	33	27	41	27	18	20	15	21	23	26
Arssi	56	12	15	0	31	37	35	25	14	21	18	25	20	14	20	20	13	17	24	22
Bale	—	—	0	—	—	—	5	8	19	15	11	33	46	31	21	21	20	19	32	20
Eritrea	63	11	26	37	23	25	27	9	15	14	17	29	52	78	36	31	23	27	32	30
Gamo Gofa	20	0	—	—	0	5	22	6	6	17	6	20	26	20	21	17	10	18	20	14
Gojjam	13	6	0	3	6	7	8	9	13	12	10	12	11	7	9	12	10	25	27	12
Gonder	50	13	12	3	8	7	7	16	9	24	19	23	17	6	6	8	12	22	27	15
Harer	55	23	11	13	21	17	8	11	22	29	27	50	40	17	36	30	23	43	44	27
Illubabor	100	20	17	6	0	0	0	7	9	36	12	25	18	9	21	13	5	9	13	17
Keffa	24	0	0	7	20	6	8	5	14	38	15	19	38	23	22	17	10	14	17	16
Shewa	22	16	19	28	24	13	13	13	12	13	12	21	38	24	18	21	12	24	24	19
Sidamo	25	—	11	20	10	16	7	7	11	17	20	16	24	15	15	11	9	14	16	15
Tigray	13	0	3	6	14	15	24	8	15	18	15	14	41	29	19	20	14	31	34	18
Wellega	33	0	13	38	7	4	33	21	27	27	13	17	25	21	19	17	9	14	19	19
Wello	57	9	2	8	22	19	8	10	7	10	15	15	15	19	16	6	6	15	16	14

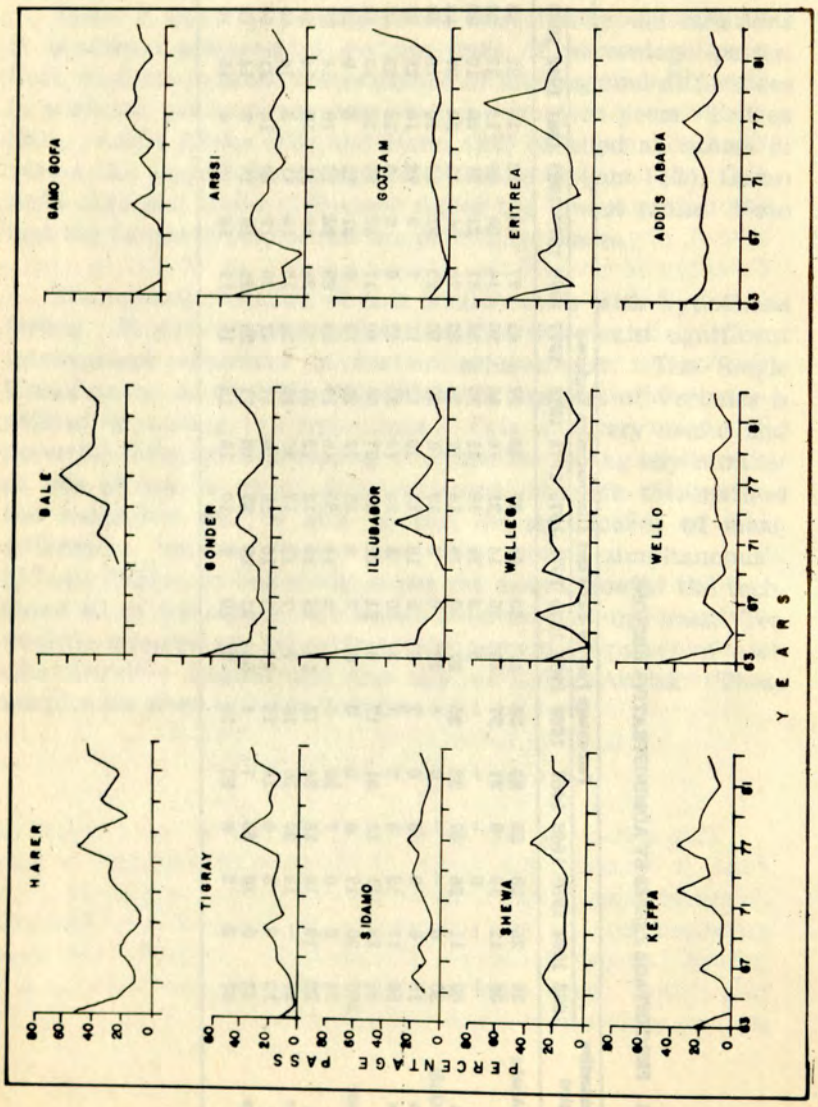

FIG. 1 GRAPHS INDICATING INTER-REGIONAL VARIATIONS IN ACADEMIC ACHIEVEMENT

Table 2. SIZE OF PERCENTAGE PASSES IN THE SELECTED RANDOM SAMPLES

Addis Ababa	Arssi	Bale	Eritrea	Gamo Gofa	Gojjam	Gonder	Harer	Illubabor	Keffa	Shewa	Sidamo	Tigray	Wellega	Wello
41	31	0	36	20	3	22	40	100	24	24	25	13	33	16
25	15	8	31	5	0	13	50	6	0	22	20	3	0	9
15	35	19	11	6	6	9	55	0	20	19	16	14	38	8
28	35	11	37	17	8	7	23	7	8	24	9	24	4	19
38	25	46	23	6	9	7	13	9	5	13	11	8	33	8
23	14	31	27	26	12	9	17	12	38	13	20	18	27	7
33	21	21	9	20	10	24	17	25	[illegible]	12	16	15	27	10
27	18	20	15	21	12	19	36	18	19	13	24	14	13	15
27	25	19	14	17	11	23	23	9	38	12	15	41	17	15
18	14	32	29	18	9	6	43	13	22	38	11	19	21	19

A Single Classification Analysis of Variance was performed on the above samples using the following formulae [17, pp. 169—170].

$$\text{TOTAL SUM OF SQUARES (TOTAL SS)} = \Sigma x^2 - \frac{(\Sigma x)^2}{n} \quad (1)$$

$$\text{BETWEEN SS} = \Sigma \frac{(\Sigma x)^2}{ng} - \frac{(\Sigma x)^2}{n} \quad \text{----------} (2)$$

Where:

$\Sigma \frac{(\Sigma x)^2}{ng}$ = the total of each group's sum of raw scores and then divided by the number of subjects in the group (ng).

$(\Sigma x)^2/n$ = the sum of all raw scores squared and divided by the total number of subjects (n).

$$\text{WITHIN SS} = \Sigma \Sigma x^2 \frac{(\Sigma x)^2}{n} \quad \text{----------} (3)$$

The results of the analysis are provided in Table 3 hereunder.

Table 3: ANALYSIS OF VARIANCE TABLE

Source of Variation	Sum of Squares	Degrees of Freedom	Estimated Variance	F
Between Samples	5,035.37	14	359.67	2.28
Within Samples	21,254.50	135	157.44	-
Total	38,951.49	149		

The results indicate the "F" value is significant at 0.01 level. This means that the hypothesis under investigation has been validated proving that there do exist significant inter-regional differences in student achievement.

7. EXPLANATION OF INTERREGIONAL VARIATIONS IN STUDENT ACHIEVEMENT

Earlier a convincing statistical evidence has been established for the inter-administrative regional variations in student achievement or academic performance. The study now proceeds further to ascertain possible reasons why such variations occur.

As indicated above under 3.2 fifteen ($X_1 - X_{15}$) independent variables are intended to explain the dependent variable (Y). The fifteen independent or explanatory variables and the dependent variable together with their respective values are provided in Table 4 below. It is true that the number of observations should have been greater than the number of independent variables. Since it is not possible to increase the number of observations owing to the lack of data the number of independent variables has been reduced. The procedure selected for this purpose is the Stepwise Linear Regression. Refer to the Appendix as regards the zero order linear correlation coefficients. According to this procedure the independent variables are entered one at a time. The independent variable which has the highest simple correlation with the dependent variable is entered first. Next the independent variable, which accounts for most of the remaining variance, will be entered and so on. Accordingly, five independent variables have been identified. These include: Allocated Recurrent Budget (X_{12}); Degree of Urbanization (X_{15}); Number of Senior Secondary School per 10,000 population (X_7). Number of Female Teachers (X_3); and Number of Equipped Secondary Schools (X_6). In other words the variables that are related to finance, learning conditions or environments indicated by the degree of urbanization and number of senior secondary schools per 10,000 population; sex of teachers and teaching materials appeared to be the most important ones in explaining the spatial variations of student achievement.

Table 4. AVERAGE PERCENTAGE PASSES IN THE ETHIOPIAN SCHOOL LEAVING EXAMINATIONS AND VARIABLES FOR MEASURING STUDENT ACHIEVEMENT IN SENIOR SECONDARY SCHOOLS BY ADMINISTRATIVE REGIONS FOR 1982 AND 1983.

		Teacher Variables				Teaching Materials Variables	
Administrative Region	Average Percentage Passes	Total No. of Teachers	No. of Male Teachers	No. of Female Teachers	No. of Teachers with 1st & 2nd Degrees	Budget for Teaching Materials (in Birr)	No. of Equipped Senior Secondary Schools
	(y)	(x_1)	(x_2)	(x_3)	(x_4)	(x_5)	(x_6)
Arssi	21	253	226	27	15	83,730	3
Bale	26	144	126	18	26	58,144	3
Eritrea	30	395	353	42	53	319,759	6
Gamo Gofa	19	148	135	13	5	62,770	4
Gojjam	41	376	345	31	19	101,150	7
Gonder	25	331	290	41	18	107,348	6
Harer	44	340	289	51	22	120,988	8
Illubabor	11	153	143	10	11	65,334	5
Keffa	16	248	218	30	26	90,157	4
Shewa	24	948	819	129	67	239,995	20
Sidamo	15	485	428	57	20	114,257	7
Tigray	33	332	297	35	11	113,051	5
Wellega	17	472	434	25	51	106,789	6
Wello	16	434	388	46	35	126,451	10
Addis Ababa	22	1303	1154	149	217	352,528	14

Table 4 (Continued)

Administrative Region	Average Percentage Passes (y)	School-Space Variables: No. of Senior Secondary Schools per 10,000 Population (x_7)	School-Space Variables: % of all Senior Secondary Schools (x_8)	School-Space Variables: No. of Classrooms per 10,000 Population (x_9)	Enrollment Variables: Size of Enrollment (x_{10})	Enrollment Variables: Staff Student Ratio (x_{11})
Arssi	21	.074	4.7	0.68	10,080	40
Bale	26	.032	1.6	0.16	4,750	33
Eritrea	30	.066	8.3	0.26	13,541	34
Gamo Gofa	19	.047	2.6	0.49	4,556	31
Gojjam	41	.047	5.2	0.47	12,748	34
Gonder	25	.055	6.2	0.55	12,070	36
Harer	44	.036	6.2	0.43	10,654	31
Illubabor	11	.129	5.7	0.79	5,286	35
Keffa	16	.035	3.1	0.60	8,355	34
Shewa	24	.074	20.2	0.83	44,027	46
Sidamo	15	.034	5.2	0.40	20,235	42
Tigray	33	.044	5.2	0.59	6,226	19
Wellega	17	.065	7.2	0.69	19,990	45
Wello	16	.051	7.2	0.58	15,246	34
Addis Ababa	22	.148	10.9	3.64	69,331	53

Table 4 (Continued)

Administrative Region	Average Percentage Passes (y)	Enrollment Variables: Allocated Recurrent Budget (in Birr) (x_{12})	Enrollment Variables: Recurrent Budget per Student (in Birr) (x_{13})	Urbanization Variables: Size of Salary (in Birr) (x_{14})	Urbanization Variables: Degrees of Urbanization (% urban) (x_{15})
Arssi	21	2,091,142	207	1,945,117	9.2
Bale	26	791,982	167	693,816	5.7
Eritrea	30	2,880,140	213	2,282,800	29.2
Gamo Gofa	19	1,480,687	325	1,371,298	4.7
Gojjam	41	2,415,440	189	2,209,619	9.3
Gonder	25	2,049,853	170	1,844,640	7.9
Harer	44	2,854,416	268	2,638,021	8.7
Illubabor	11	1,440,152	272	1,318,446	6.7
Keffa	16	1,599,700	191	1,454,244	8.2
Shewa	24	6,548,553	149	6,117,844	30.0
Sidamo	15	1,929,504	305	1,722,349	7.6
Tigray	33	1,898,566	113	1,692,678	8.9
Wellega	17	2,257,522	177	2,076,475	5.9
Wello	16	2,704,175	114	2,409,173	10.0
Addis Ababa	22	7,935,278	95	7,372,988	100.0

The importance of an independent variables has been determined on the basis of the beta coefficient which is defined as follows:

$$Bi = bi \frac{SY}{SX_i} \quad \text{---------- (1)}$$

Where: bi = Ordinary Least Square

SY = Standard Deviation of the Dependent Variable

SX_1 = Standard Deviation of the Variable X_i

The Multiple Regression Analysis using the above mentioned five independent variables produced a value of R = 0.98 which is the adjusted Coefficient of Determination. This indicates the fact that about 98 per cent of the dependent variables is explained by the overall effect of the independent variables. The ordinary regression equation along with the standard error of regression coefficients is provided hereunder.

$$\text{Ordinary Y} = -81.782 + \underset{(.000)}{.002X_{12}} + \underset{(4.670)}{4.752X_{15}}$$
$$\underset{(308.899)}{626.977X_7} + \underset{(3.442)}{6.456X_3} - \underset{(27.374)}{42.283X_6} \text{ -- (2)}$$

$$R^2 = 0.978$$

$$\text{Beta Y} = .641X_{12} + .194X_{15} + .110X_7 + .432X_3 \text{ ——— } .322X_6 \text{ ----- (3)}$$

The linear correlation matrix shows a high degree of multicollinearity among the explanatory variables. For instance there exists high correlation between X_{12} (Allocated Recurrent Budget which is included in the regression equation) and variables X_1 (Total Number of Teachers) and X_2 (Number of Male Teachers) and so on. As a result the Stepwise Regression has reduced the explanatory variables to five and the study concentrates on these.

8. CONCLUSION

The study has clearly identified and proved the occurrence of spatial variations in student achievement. It has also tentatively pointed out, albeit in an exploratory manner, certain variables as being responsible for the spatial variations in student achievement. These include financial, urbanization, learning conditions, teachers's sex and teaching materials variables.

Nevertheless, no conclusive statements can be made as regards the causes of the spatial variations in student achievement. This is due to the fact that this aspect of the study is too complex to be dealt with in a short investigation such a this one. In consequence, the findings indicated above may be considered as tentative conclusions until such time when it is possible to undertake further research into the question of the quality of education in Ethiopia and its impact on student achievement or performance.

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APPENDIX

ZERO ORDER LINEAR CORRELATION COEFFICIENTS BETWEEN THE DEPENDENT AND INDEPENDENT VARIABLES

Variables	VARIABLES														
	Y	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}
Y															
X_1	.95														
X_2	.95	.999													
X_3	.93	.96	.96												
X_4	.92	.90	.90	.82											
X_5	.85	.81	.81	.79	.81										
X_6	.76	.85	.84	.89	.60	.65									
X_7	.22	.14	.15	.05	.11	.06	.11								
X_8	.68	.77	.76	.80	.50	.67	.93	.04							
X_9	.85	.81	.82	.73	.93	.62	.49	.16	.37						
X_{10}	.94	.99	.99	.95	.93	.78	.81	.13	.72	.86					
X_{11}	.62	.73	.73	.65	.70	.50	.56	.10	.54	.62	.79				
X_{12}	.96	.97	.96	.97	.86	.83	.88	.15	.82	.79	.96	.67			
X_{13}	-.50	-.50	-.51	-.45	-.50	-.40	-.40	-.10	-.37	-.43	-.46	-.14	-.50		
X_{14}	.95	.96	.96	.97	.86	.80	.89	.16	.82	.79	.96	.68	.998	-.46	
X_{15}	.94	.88	.88	.83	.97	.85	.59	.15	.50	.93	.90	.62	.87	-.45	.87

Note that Y stands for the dependent variable.