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Gender gap in secondary schools in Rwanda: Background paper

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About Laterite and the REAL Centre

Laterite is a data, research and advisory firm dedicated to bringing high-quality research services to the most underserved markets. Based in East Africa, the firm strives to carry out impactful research that helps decision-makers find solutions to complex development problems.

The REAL Centre at the University of Cambridge pioneers research into overcoming barriers to education, such as poverty, gender, ethnicity, language and disability, and promotes education as an engine for inclusive growth and sustainable development.

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The context

Making education more inclusive and narrowing the gender gap are key objectives for the Government of Rwanda and all its international partners. Drawing on Learning Achievements in Rwandan Schools (LARS III)[1] data collected in 2017, a 2018 report by Oxford Policy Management found that boys on average scored slightly higher than girls on both numeracy and literacy assessments both in the last grade of primary school (Primary 6 – P6) and the last grade of lower secondary school (Secondary 3 – S3).[2] The gender gap was larger at S3 than P6 (Burdett & James, 2018).

Drawing from this dataset, this paper builds on the 2018 analysis by providing a detailed description of the gender gap in Rwandan lower secondary education. We provide disaggregated statistics by subject, type of school and area of the country. Further, we examine the role of student characteristics (such as age), and family background characteristics (such as household socio-economic status) in explaining the gender gap in Rwandan Secondary Schools.

This paper aims to inform the policy debate in relation to gender gaps in Rwandan secondary schooling and stimulate additional research in this area. We will carry out further analysis drawing on data as part of our work as learning partners for the Leaders in Teaching initiative, which will enable to us to identify whether the patterns identified in this paper are changing over time.

The study

In this paper we use student assessment data for Rwandan students in Secondary 3 (S3) from a nationally representative learning assessment conducted in 2017 (LARS III[1]), combined with survey information on student background and schools from the same dataset. In this paper, we focus on data from the 6,717 S3 students included in the dataset, and their respective 189 schools. The results presented in this paper are unweighted, which means they are only representative of the 189 schools in the sample (see methodological note for details).

First, we explore the extent and nature of the gender gap in literacy and numeracy across Rwandan secondary schools. We then consider potential explanations of the observed gender gap. We look at the difference in characteristics of boys and girls and whether these differences fully or partially explain the gender gap.

The findings

- Based on 2017 data, the gender gap in literacy and numeracy in Rwandan secondary schools was sizable, with boys outperforming girls in most schools and groups of students.
- The situation varied between rural and urban areas. In rural schools, boys outperformed girls on both assessments. In urban schools, girls outperformed boys in literacy, and there was no significant difference in numeracy. The gender gap was smallest among students from the wealthiest households and largest among the students from the poorest households.
- There was no significant difference in performance between boys and girls in schools of excellence in both literacy and numeracy. Students in schools of excellence also scored significantly higher than their peers in non-schools of excellence by approximately 7 points in literacy and 6 points in numeracy on average (out of a total possible 30 points).
- We observed some differences in student-level characteristics of male and female students: girls performed better than boys in areas typically associated with better learning outcomes, such as being younger (or having correct-age for grade) on average, having low repetition rates and being punctual. However, these differences did not explain the gender gap.
- Further research is needed to understand the root causes of the gender gap.

Introduction

Narrowing the gender gap is a key objective for the Government of Rwanda and all its international partners. The aim of this paper is to contribute to the evidence base on narrowing the gender gap in education in Rwanda to inform the design of effective policies and to stimulate further research in this area. The main source of data is the nationally representative 2017 Learning Achievement in Rwandan Schools (LARS III) data. The LARS III Assessment (Numeracy & Literacy) comprises 30 multiple choice questions increasing in difficulty, each with four answer choices. In this paper, we focus on data from the 6,717 S3 students included in the dataset, and their respective 189 schools (see methodological note for details).

Previous analysis of the 2017 LARS III data by Burdett & James (2018) suggests that in P6 and S3, boys outperform girls on literacy and numeracy assessments in Rwanda. In this paper, we build on these findings by further investigating the extent to which gender disparities persist when school and student-level characteristics, such as family wealth and age, are taken into account.

There are few studies looking at gender differences in secondary education in Rwanda. A recent report by Laterite on dropout and repetition in Rwandan schools found very similar dropout rates between girls and boys at all ages. However, girls were more likely to be out-of-school from ages 16 onwards – the equivalent of S3 and above - especially in rural areas (Laterite, 2017). This may be partly driven by differences in parents' expectations for their sons' and daughters' education and perhaps also related to future opportunities by gender. The analysis indicates that household shocks and the number of younger siblings appear to have a stronger impact on dropout for girls than for boys. This is in line with studies in other related contexts, which indicate that girls often take on more responsibilities in the home, including caring for younger siblings, which is associated with them dropping out (Woldehanna & Hagos, 2012).

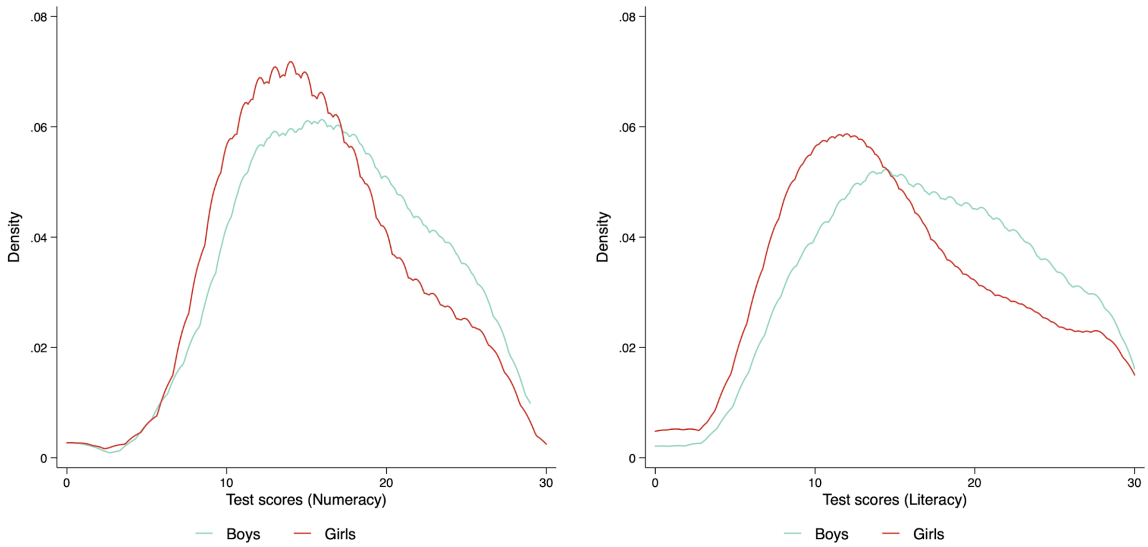
Before delving into the findings, it is important to also consider the limitations of the data and the analysis. One important limitation to consider is that our data are based on the sample of students that were present in class on the day of the survey. This implies that our sample is not representative of the entire population of S3 girls and boys; it is only representative of students that were present on the day that the assessment took place at that school. Absenteeism is associated with low test scores (Richard & Wanga, 2012) and thus the assumption is that the lowest-performing students were most likely absent on the day of the assessment. Another limitation of the data is the lack of school attendance information - both historically and on the day of the assessment and survey. The lack of historic attendance data makes it impossible to assess the impact of missed schooling on the gender gap.

A detailed description of the gender gap in Rwandan secondary schools

The gender gap across students and subjects

In S3, male students' scores were on average 12% higher than female students' scores in literacy and 8% higher in numeracy. In absolute terms, boys outperformed girls by 1.85 points in literacy, and by 1.26 points in numeracy (on a test score scale of 0 to 30 points). Figure 1 shows that the difference in numeracy scores between boys and girls was due to a large proportion of boys scoring between 19 to 26 points out of a total possible 30 points, compared to girls scoring between 8 to 15 points. The distribution for literacy shows a similar pattern.

Figure 1: Distribution of student scores by gender and subject



Note: The graphs visualise the kernel density estimate of test score distribution for numeracy (left) and literacy (right) of S3 students (boys and girls).

The gender gap was not due to girls being more reluctant to "try their luck" when they do not know the answer in the multiple choice questions. Some studies in high-income countries suggest that girls may be more risk-averse in being willing to guess, and so they may also be less likely to pick a random answer (Baldiga, 2014; Griselda, 2021). In our sample, there was a small but significant difference (2%) in the proportion of girls and boys that left at least one question blank (unanswered) out the 30 questions in both numeracy and literacy assessments. 16% of girls left at least one question blank (unanswered) compared to 14% of boys.

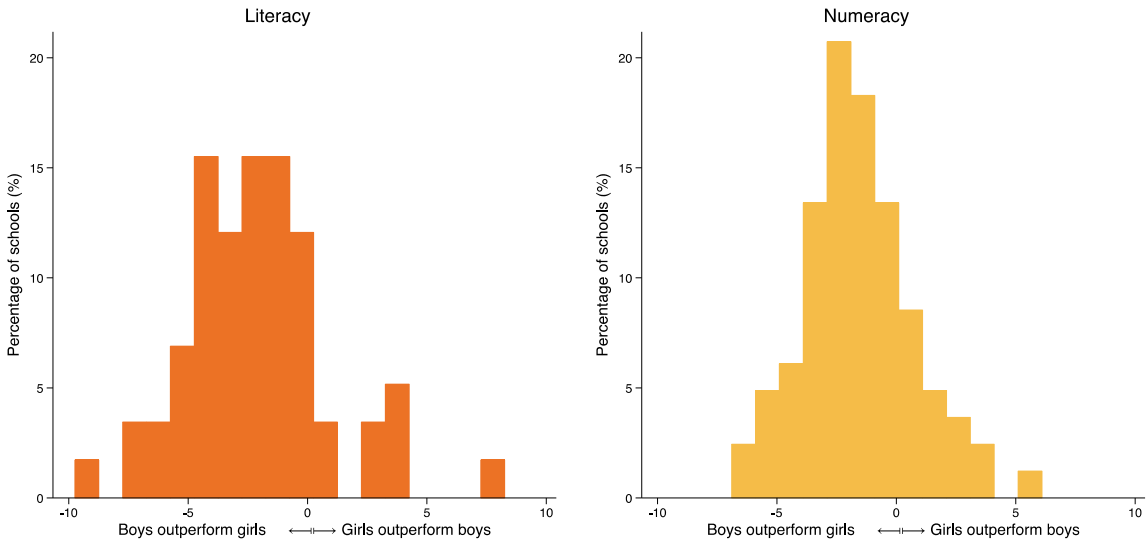
Statistically speaking, randomly picking an answer when the correct one is unknown would result in a higher total score than leaving the answer sheet blank. If missing and wrong answers are both scored as zero in the LARS III assessment, it follows that girls are likely to score lower than boys if they are less willing to guess. To address this, we

calculated the gender gap with an alternative method that produces an equal score for students that leave the answer blank (missing answers are scored 0.25, equal to the probability of guessing the right answer by picking one random answer out of the four options). The magnitude of the gender gap remained unaffected.

The gender gap was observed in a large majority of schools. We calculated the gender gap in all schools in which there was data for at least eight students for each gender and subject. For this reason, the total number of schools for which we carried out this analysis is fewer than 189, as schools with fewer than 8 girls and 8 boys writing an assessment were excluded from the analysis as above.

There was little dispersion in the average gender gap across schools, with the majority of schools having an average gender gap of 1 to 4 points (see Figure 2). The dispersion was smaller for numeracy than for literacy. The average score of girls in literacy was higher than the average score of boys in 24 out of 135 schools, and in 29 out of 141 in numeracy, with little overlap across the two samples. Overall, there were 47 schools out of 146 where girls outperformed boys in either literacy or numeracy. It is interesting to note that 21% of the 47 schools were located in urban areas. In comparison, 18% of the schools in the LARS III sample (schools with S3 only) were in urban areas. 95% of the 47 schools were day schools, and 76% were government-aided schools.

Figure 2: Average gender gap in S3 in Rwandan secondary schools



Note: The histogram shows the difference between average scores for boys and girls in numeracy (right) and literacy (left) in all schools in the sample. The height of the bar represents the proportion of schools with that gender gap.

Boys outperformed girls across all test sections and on all levels of question difficulty. All questions in both numeracy and literacy assessments fell into different key sections that aligned with the content coverage of national exams specified by the new competency-based curriculum.[3] At S3, the LARS III assessments included two sections in the literacy tests (Comprehension and Grammar, and Vocabulary) and five sections in the numeracy tests (Arithmetic, Geometry, Statistics, Fractions, and Algebra). On average boys scored slightly higher than girls on all sections both in numeracy and literacy. The difference ranged from 0.019 points in arithmetic (numeracy) to 0.08 in comprehension (literacy).

We also looked at the difference in performance between girls and boys across the different levels of difficulty of questions in the test.[4] All questions fell into five levels of difficulty: very easy, somewhat easy, easy, hard and very hard. We found that boys scored slightly higher than girls on all levels of difficulty on both assessments. The difference ranged from 0.01 points on the 'very easy' questions in numeracy to 0.11 points on the 'somewhat easy' questions in literacy, however, we did not observe a clear positive relationship between the gender gap and level of difficulty of questions. That is to say, the gender difference did not necessarily increase with the level of difficulty.

Boys outperformed girls only in rural schools. In the full sample, 84% of the schools were located in rural areas. Overall, students in urban schools outperformed their counterparts in rural schools by 2.74 points in numeracy and 4.68 points in literacy. Interestingly, in urban schools, there was no significant difference in performance between boys and girls in numeracy, and girls outperformed boys in literacy by 0.52 points (although not statistically significant). By contrast, a large and significant gender gap in favour of boys was observed in rural schools on both assessments: boys scored higher than girls on average by 2.52 and 1.58 points in literacy and numeracy respectively.

We did not observe a statistically significant gender gap in schools of excellence, however, in the non-schools of excellence, we found a significant gender gap in both numeracy and literacy. Schools of excellence were established by the Ministry of Education in Rwanda to promote sciences with a focus on practical classes, and act as models for other schools (The New Times, 2011). The main distinguishing feature between these schools and other schools is a well- equipped computer and science laboratory, and a library. Schools of excellence are very competitive and are mostly reserved for the highest performing students. Most schools of excellence are boarding schools - approximately 66% of the schools of excellence in our sample are boarding schools. 32 out of 189 schools in our sample are schools of excellence. Students in schools of excellence on average scored significantly higher than their peers in non-schools of excellence by approximately 7 points in literacy and

6 points in numeracy. The gender gap in non-schools of excellence was approximately 2.46 points in literacy and 1.44 points in numeracy in favour of boys. By contrast, there was no significant difference in performance between boys and girls in both literacy and numeracy in schools of excellence.

The gender gap was smallest among students from the wealthiest households and largest among the poorest. To examine nature of the gender gap across students' household socioeconomic status, we divided students into three wealth groups (terciles) based on their household assets[5], and whether they had pumped water into the house, using principal component analysis (PCA) (see methodological note). Among the wealthiest group, we observed a small but significant gender gap of 1.53 points in literacy and weakly significant difference in numeracy of 0.69 points. However, among the poorest and the middle terciles, we found relatively large and significant gender gaps on both assessments. The largest gap in literacy was observed among the poorest tercile, while the largest gap in numeracy was observed among the middle tercile (see Table 1). This implies that the gender gap was apparent amongst poorer households. One potential explanation for this is that, within families with scarce resources, boys are given preference over girls by parents when it comes to informal fees such as transport cost, classroom materials like pens and books (Pro-femmes Twese Hamwe and VSO Rwanda, 2012).

Table 1: Gender gap in literacy and numeracy across wealth terciles

Variable / Model	**Mean difference in literacy (boys – girls)**	**Mean difference in numeracy (boys – girls)**
Wealthiest tercile	1.53***	0.69**
Middle tercile	1.89***	1.80***
Poorest tercile	2.22***	1.52***

*** p<0.01, ** p<0.05, * p<0.1

The role of student and family background characteristics in explaining the gender gap in Rwandan secondary schools

In this section, we investigate whether - and to what extent - differences in student individual and family background characteristics between boys and girls explain the gender gap in numeracy and literacy scores in S3 in Rwandan schools. In theory, the gender gap could be explained by differences in characteristics in the composition of girls and boys in S3 within schools. For example, we know that students being older than expected for their grade on average is negatively correlated with learning achievements in S3 – i.e. younger students perform better on average (see for example Laterite, 2017). In our sample, it might be that the boys we observe are on average younger than girls, leading to boys performing better than girls in student assessments. If age were the reason for the gender gap in assessment scores, in a regression analysis in which we control for both gender and age - keeping everything constant - we would expect to see the gender gap significantly decrease or even disappear.

As our sample confirms, by S3, boys and girls in Rwandan schools had different characteristics. Girls were on average significantly younger than boys – by about six months – which is substantial in the context of education. Girls were also more likely to have attended pre-primary and repeated less frequently than boys. Further, girls were more likely to report being punctual, reading books outside of school (excluding textbooks), and on average spending more time on mathematics homework than boys. By contrast, boys reported spending more time on English homework than girls.

In terms family background characteristics, we didn't observe any statistically significant differences across household socio-economic status and parental literacy (whether father or mother can read and write), suggesting that boys and girls in our sample came from similar households in terms of parental literacy and socio-economic status (refer to Table 4 in the Appendix for more information).

We estimated the gender gap in numeracy and literacy using a regression that assumed fixed effects at the school level. Fixed effects imply that the model assumes that school characteristics (e.g. how equipped the school is, school size and location, gender composition of the school, etc.) affect boys and girls in the same way. The student characteristics and household characteristics discussed above are included in the model as explanatory variables. Table 2 on the next page shows the regression results.

Table 2: Association between scores (literacy and numeracy) and student characteristics, and household characteristics

	Column (1)	Column (2)	Column (3)	Column (4)
Variable	**Literacy**		**Numeracy**	
Male student	2.183***	2.984***	1.513***	1.882***
Student-level characteristics/demographics				
Age		-0.926***		-0.827***
Repeated a grade		-0.890***		-0.181
Attended Nursery		0.208		-0.497**
Family background characteristics				
Household wealth tercile (middle)		-0.830***		-0.507*
Household wealth tercile (richest)		-0.990***		-0.800***
Mother can read and write		0.0992		0.376
Father can read and write		-0.125		0.509
Student schooling behaviors				
Time spent doing Math homework		0.0611		0.623***
Time spent doing English homework		0.119		-0.247**
Late to school in previous week		-0.647***		-0.158
Read books outside school		0.567		-0.262
Constant	14.96***	31.51***	15.52***	29.16***
No. Observations	3,348	2,179	3,369	2,159
School fixed effects	YES	YES	YES	YES
R-squared	0.499	0.592	0.387	0.474
*** p<0.01, ** p<0.05, * p<0.1 Standard errors in parentheses				

In Table 2 above, Columns 1 and 2 report the simplest model which includes only the gender dummy and school fixed effects. Within schools, boys outperformed girls by 2.2 points in literacy and 1.5 points in numeracy, both statistically significant at the 1% level. In columns 3 and 4, we add explanatory variables discussed above to the model to investigate whether correlations between gender and these factors affected the gender gap. In regression analysis where we control for those explanatory variables

(selected student individual characteristics and family background characteristics) and school fixed effects, the gender gap remained and moreover the female disadvantage in literacy and numeracy appeared to slightly increase.

Based on the results of the regression analysis in Table 2, we can conclude that the gender gap was not attributable to differences in observable student individual and family background characteristics between boys and girls in our sample. Moreover, the size of the gender gap within schools appeared to slightly widen when we controlled for student individual characteristics and family background characteristics.

Girls in our sample were more likely to report characteristics which are likely to support better learning outcomes, however, in regression analysis where we controlled for student and family background characteristics and school fixed effects, we observed that boys still outperformed girls in both literacy and numeracy. This potentially suggests that school-level factors affect girls' and boys' learning differently. Further research is needed to understand the differential effects of school-level factors on boys' and girls' literacy and numeracy achievements in Rwandan secondary schools.

Conclusion

The 2017 data show that the gender gap in literacy and numeracy in Rwandan secondary schools was sizable and affected in most schools and groups of students. The gap between girls' and boys' performance – in favour of boys - was greater among poorer students, students in rural areas and students in non-schools of excellence.

Despite girls being more likely to display several characteristics that we expect would be associated with improved performance, boys outperformed girls in numeracy and literacy on average. Within and across schools, the gender gap did not narrow when we controlled for student and family background characteristics such as age, household socio-economic status, and parental literacy. Differences in observable characteristics (at least based on characteristics in the LARS III dataset) between boys and girls did not explain the gender gap in S3 in Rwandan schools.

Further research is needed to understand other factors that may explain the gender gap that were not explored in this analysis. For example, an important limitation to these findings is that we do not have information on the students' history of school absences. It is therefore possible that increased school absences among girls (e.g. due to increased family responsibilities or a need to stay home during menstruation due to a lack of sanitary pads) drove some of the differences between boys' and girls' test results. This is an important area for future research. Moreover, several studies have indicated that girls' educational outcomes are affected adversely by cultural practices and attitudes towards girl educations (see for example, Colclough et al., 2000). This could be explored through qualitative means.

Methodological note

This brief uses data from the third edition of the Learning Assessment in Rwandan Schools (LARS III), collected in 2017. The LARS III dataset includes student assessment data and survey responses from students and headteachers (see Table 3 below). Since the focus of this study is secondary education, we used data from S3 students and headteachers. After this, a total of 6,717 pupils remained in the dataset.

Table 3: Description and number of observations in the datasets used in the analysis

Dataset Description	Number of entries
Unique schools	189
Includes pupil assessments data (test scores)	6,717
Quantitative survey answers data from pupils that took the assessment	6,717
Quantitative survey answers from headteachers	189

Moreover, we also use school-level data collected by Laterite as part of a study on the state of delivery of STEM and ICT education level in Rwanda (Laterite, 2019). The school-level variables used from this dataset include, whether the school is a designated school of excellence and whether the school is in a rural or urban area. We collected this information on 159 schools out of the 189 schools in our original dataset.

Household-level wealth calculation using Principal Component Analysis (PCA). We calculated a wealth index score as a measure of the student's household economic status using a student's household asset information and whether the house had pumped water. Students were asked if they had each of the following assets: a telephone, a bicycle, a motorcycle, a bench or stool, electricity, a radio, a table, a fridge, a TV, a car, a chair, a bed. Student responses to each of the two questions were combined in a PCA and the components that explained most of the variance in the data were used to predict the wealth index score of the student. Students were then split into three groups (terciles), with 'Q1' representing the poorest students, and 'Q3' the wealthiest.

Appendix

Table 4: Key explanatory variables used in the analysis and how they differ between male and female students in our sample

Variable/Question	Sample size (girls)	Mean (girls)	Sample size (boys)	Mean (boys)	Difference (girls – boys)
Student individual characteristics					
Age	3402	16.837	3193	17.305	-0.468***
Number of times repeated a grade	2698	1.712	2637	1.901	-0.190***
Attended Nursery	3465	0.6	3252	0.519	0.080***
Student schooling behaviours					
Late to school in the previous week	3449	0.509	3221	0.55	-0.041***
Time spent doing Math homework in the previous week (hours)	3465	1.934	3252	1.861	0.073**
Time spent doing English homework in the previous week (hours)	3465	1.285	3252	1.359	-0.074**
Reading books (excluding textbooks) outside school	3465	0.913	3252	0.889	0.024***
Family background characteristics					
Poorest tercile	3465	0.327	3252	0.322	0.005
Middle tercile	3465	0.282	3252	0.293	-0.011
Richest tercile	3465	0.391	3252	0.385	0.006
Father can read and write	2471	0.897	2307	0.892	0.005
Mother can read and write	2948	0.819	2751	0.831	-0.012

***<0.001, **<0.01, *<0.05

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Endnotes

[1] Learning Achievement in Rwandan Schools (LARS) is a national educational assessment that aims to study the state of learning in literacy and numeracy in Rwandan schools (P6 and S3 classes).

[2] Basic education in Rwanda comprises of six years of primary education (P1-P6), three years of lower secondary education (S1-S3), and three years of senior secondary education (S4-S6). S3 is the last year in lower secondary and P6 is the final class in Primary education.

[3] A competency-based curriculum takes learning to higher levels by providing challenging and engaging experiences which require deep thinking rather than just memorisation. More information about the competency-based curriculum in Rwanda: https://elearning.reb.rw/pluginfile.php/28040/mod_resource/content/1/CURRICULUM_FRAMEWORK_FINAL.pdf

[4] Estimates of question difficulty used in the analysis were calculated and explained in page 106 of Burdett & James' LARS III report (2018).

[5] Household assets include; telephone, bicycle, motorcycle, bench or stool, electricity, radio, table, fridge, TV, car, chair, and bed.

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