

Trade-offs in children's time allocation: Mixed support for embodied capital models of the demographic transition in Tanzania

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ABSTRACT

Embodied capital theory (ECT) argues that socioeconomic 'modernization' leads to high-cost, high-return parental investments in education, in turn incentivizing demographic transitions to low fertility. However, few studies have directly investigated the proposed opportunity costs of schooling in contemporary developing populations undergoing socioeconomic change. We present a study of children's time use in two communities in Mwanza, Tanzania, representing either end of a local rural-urban gradient. Consistent with ECT, town compared to village residence was associated with increased schooling at the expense of time allocation to children's work. However, these patterns apply primarily to boys, for whom herding work is relatively incompatible with schooling. Girls more readily combine domestic chores with school attendance, a pattern which may account for unexpectedly high female school enrolment in this population. Furthermore, the strongest time allocation trade-offs were not between school and work, but between school and leisure time, suggesting overall low

opportunity costs to education. Mixed support for ECT may partially explain why fertility decline has stalled in many low-income countries, despite education uptake. Finally, we advocate that international development programs consider the wellbeing implications of reduced leisure time accompanying education uptake, particularly for girls maintaining a 'double-shift' of school and domestic work.

KEYWORDS

Education; children's work; time allocation; embodied capital; modernization

1 INTRODUCTION

2 Embodied capital is defined as the skills, knowledge, experience, physical growth and strength
3 acquired during childhood and adolescence, which increase adult social and reproductive
4 success. Embodied capital theory (ECT), developed by evolutionary anthropologists, predicts
5 that children's time allocation favors activities that improve long-term social and reproductive
6 success, but that there may be trade-offs between activities with long-term returns which are
7 not immediately productive, and activities with short-term returns (Gurven & Kaplan, 2006).
8 Processes involved in economic 'modernization', including urbanization, declining mortality
9 and market integration, lead to greater payoffs to investment in embodied capital gained
10 through formal education (Mattison & Sear, 2016). Schooling enables children to gain
11 practical and social skills that will be beneficial in the long-term. But attending school is costly,
12 both directly, and through opportunity costs arising from time allocation away from
13 productive activities. Children therefore become more costly, leading parents to invest more
14 in fewer children. These 'quantity-quality trade-offs' are hypothesized to have driven the
15 global decline in fertility over the past two centuries (Kaplan, 1996; Kaplan, Bock, & Hooper,
16 2015).

17 Support for the importance of quantity-quality trade-offs in causing fertility decline primarily
18 focuses on data from historical European demographic trends and variation in fertility within
19 modern affluent populations (Lee, 2003). However, the primacy of Europe in influencing
20 demographic transition theories is problematic because the process of modernization in
21 contemporary developing populations may be distinct (Thornton, 2001). Embodied capital
22 models of the demographic transition posit that parents incur costs, but that these are offset
23 by increased payoffs for their children in adult life. Thus, education is presented as beneficial,

24 but this may not always be the case in contemporary rural low-income settings. Poor
25 education quality, a lack of employment prospects, and reliance on subsistence livelihoods,
26 make the payoffs to education uncertain (Nieuwenhuys, 1993). There are also concerns that
27 the widely-assumed trade-off between children's work and school attendance (i.e. the
28 opportunity costs of educating children) is exaggerated in both current theory and policy
29 discourse, with few studies demonstrating a direct trade-off between time spent in work
30 versus education (Beegle et al., 2008; Pörtner, 2016). Indeed, work and school may often be
31 complementary; for example, children may earn money for school expenses through part-
32 time work (Nieuwenhuys, 1993).

33 ECT also anticipates that parents will invest according to the specific returns expected for
34 different children, based on socioecological context, household factors, and individual-level
35 factors such as child gender (Bock, 2002; Gurven & Kaplan, 2006). In a patrilocal, patrilineal
36 context, such as we study here, sons remain nearby as adults, meaning parents may anticipate
37 greater returns to educating boys. Furthermore, when men earn higher wages than women
38 and are more likely to have a job requiring formal education, parents are anticipated to favor
39 educating sons. However, non-economic outcomes, including maternal and child health,
40 social status, and marriage opportunities, are also improved by education and may lead to
41 greater payoffs to girls' education in some contexts (Bedasso, 2008).

42 With long-term benefits to education uncertain, and potentially limited or absent altogether,
43 differential opportunity costs of schooling may be pivotal for parental investment decisions
44 in many rural low-income populations. Typically, girls do more domestic chores and childcare,
45 while boys are more involved in work outside the household (Murdock & Provost, 1973).
46 Anthropologists have highlighted the importance of girls' childcare in underwriting the costs

47 of high fertility in pre-transition societies (Kramer, 2002). Other studies emphasize the
48 importance of boys' labor in contributing to household subsistence (Cain, 1977). However,
49 existing data on children's work and time allocation in contemporary low-income settings
50 likely underestimates the amount of work done by children, particularly girls, due to the focus
51 on market-based work done for cash income (Assaad, Levison, & Zibani, 2010; Esquivel et al.,
52 2008). Household work is often overlooked, yet these duties may be time- and energy-
53 consuming, essential to household functioning, and disruptive of schooling (Ilahi, 2000).
54 Additionally, few studies have considered the impacts of schooling and work on children's
55 leisure time (Bacolod and Ranjan, 2008).

56 We present a novel study of children's time allocation in two communities in northwestern
57 Tanzania, representing either end of a local rural-urban gradient. Departing from much of the
58 prior literature, we take a holistic perspective on children's time allocation throughout a
59 complete day, including contributions to domestic and farm work, and leisure time. Defining
60 work more broadly and collecting data on leisure activities, rather than focusing solely on
61 school or market work, allows a more nuanced investigation of predictions derived from ECT.
62 We outline five hypotheses regarding the impacts of modernization and gender on (i) school
63 enrollment, (ii) patterns of children's work, and (iii) the trade-offs between these activities.

64 *Social context and hypotheses*

65 Fieldwork was conducted in the Mwanza region of north-western Tanzania, a context in which
66 social, economic, and demographic transitions are occurring. Primary school enrolment in
67 Tanzania increased dramatically following the universal education movement in the 1970s,
68 but declined in the 1980s (Beegle et al., 2008). Less than 60% of children progress to
69 secondary school, and there are concerns over the low quality of schooling available (Hivos,

70 2014). Many households are still involved in subsistence agropastoralism, with children also
71 working on household farms (ILO, 2013; USDoL, 2013). In the Mwanza region, under-5
72 mortality has declined substantially over the past decade, but fertility remains high at 6.4
73 children per woman on average (Kishamawe et al., 2015; DHS, 2016). Within this context, we
74 use residence in a neighbouring village and town as a proxy for degree of modernization, in
75 order to test hypotheses derived from ECT. While we acknowledge that modernization is a
76 multi-faceted process which cannot be fully captured by a two-way comparison (Kirk, 1996),
77 there are clear differences between the village and town in the anticipated payoffs to
78 children's work and education.

79 The village and town are both within the Magu Health and Demographic Surveillance Site
80 (HDSS), approximately 20km east of Mwanza city (Figure 1). Most residents are part of the
81 Sukuma ethnic group, the largest in Tanzania, representing about 17% of the nation (Malipula,
82 2015). Traditionally, the Sukuma lived in large, dispersed homesteads and maintained large
83 herds. Now cattle keeping is declining, as land holdings decrease in size and consumer goods
84 become a more important indicator of wealth (Wijsen & Tanner, 2002). In the village, 83% of
85 households are reliant on agropastoralism, with 45% of households selling surplus crops or
86 animal products, and 38% being subsistence farmers. In the town, more households rely on
87 petty trading or laboring (20%), or small businesses and skilled work as, for example,
88 mechanics or tailors (53%). The opportunities for paid employment and entrepreneurship are
89 much greater in the town, which has a central market, and is linked by public transport to
90 large markets in Mwanza city and its surrounding suburbs. Near the town are large businesses
91 including a textile factory and a Coca-Cola depot, which require a secondary school certificate
92 for employment. By contrast, in the village knowledge and skills associated with traditional

93 livelihoods, particularly cattle herding, remain important, and are best acquired through
94 practical experience. The village generally retains a stronger Sukuma identity, with many
95 families continuing to speak Sukuma, and 42% practicing traditional religious beliefs. In the
96 town, most speak Swahili, the national language in which primary school is taught, and the
97 majority of households identify either as Christian (92%) or Muslim (5%).

98 While predictions are drawn from ECT, our analyses are somewhat exploratory, given the
99 unpredictability of returns to investment in a transitioning context. Our first two hypotheses
100 concern parental decisions to enroll children in school. In the town, we anticipate higher
101 returns to investment in skills acquired through school, due to the greater potential for formal
102 employment (Kaplan, 1996; Mattison & Neill, 2013). Our first hypothesis therefore is that (1)
103 *modernization* (proxied here by town residence) *will be associated with greater school*
104 *enrolment*. Given the patrilocal, patrilineal context, and the typically higher earnings of men
105 (FAO, 2014), we expect boys to receive more education. Thus, we anticipate that (2) *girls will*
106 *be less likely to be enrolled in school than boys*. We also take the opportunity to consider
107 potential interactions between gender and village/town residence in predicting education
108 outcomes.

109 Our third and fourth hypotheses concern children's work. Agricultural and particularly
110 pastoralist livelihoods are associated with high labor demands, traditionally met partly
111 through children's labor (Kramer, 2002; Sellen, 2003). Modernization is associated with
112 lowered reliance on agriculture and reduced livestock ownership, and so is expected to be
113 associated with lower returns to children's agricultural work. Additionally, better access to
114 water and smaller household size (i.e. fewer household members) in the town is expected to
115 reduce the returns to children's household chores. This leads to our third hypothesis, that (3)

116 *modernization will be associated with less work overall for children, particularly farm work.*

117 Gendered division of labor is observed across societies, and children are socialized to fulfil

118 these gendered roles as adults. Among the Sukuma, farm work and cattle herding are boys'

119 tasks, while household chores are girls' tasks (Varkevisser, 1973). Our fourth hypothesis is

120 therefore that (4) *boys will do more farm work and girls will do more household chores.*

121 Finally, we examine the trade-off between work and education suggested by ECT. As time is

122 a limited resource, school attendance is expected to reduce time spent in other activities.

123 Furthermore, as the returns to children's work are expected to be lower, and the returns to

124 school attendance higher in the town, the opportunity costs of school are expected to be

125 lower. Thus, we hypothesize that (5) *there will be a trade-off between work and education,*

126 *but that modernization will reduce the magnitude of this trade-off.*

127 METHODS

128 We conducted a study of children and young adults aged 7-19. The HDSS provided a sampling

129 frame of all households with members aged 7-19, from which we randomly sampled 550

130 households. Surveys collected information about household membership, education and

131 occupation, and household assets, land and livestock ownership, business involvement, and

132 food security, based on the Household Food Insecurity and Access Scale (Coates, Swindale, &

133 Bilinsky, 2007). Food security is used as a proxy for household wealth in our analyses. We

134 believe this is an effective measure of household wealth in the context of a food insecure

135 population and avoids comparability issues in alternative wealth measures (e.g. comparing

136 land or cattle ownership) in the face of marked livelihood variation between town and village.

137 Children's time allocation on the previous school-day was recorded through a time allocation
138 interview (Figure 2). 1,278 children were followed-up out of a total of 1,387 eligible children
139 (92.1%). Children were shown a diagram representing the day, and were asked to remember
140 everything they did on the previous weekday, from when they woke up until they went to
141 sleep. A diagram was shaded to indicate the time and duration of the activities (time diagram
142 example shown in Supplementary Material; Figure S1). The advantage of these data is that
143 they provide a 'child's eye' view of children's contributions to their households. There are
144 some limitations, however, including possible biases in self-report, for example previous
145 studies have suggested children may overestimate their work hours (Janzen, 2015); as a
146 snapshot of a single day, these data cannot account for seasonal variation, nor all potential
147 strategies families may employ to ameliorate the trade-off between work and school, such as
148 working on weekends or during school holidays; we also collected data only on the primary
149 activity and did not ask about concurrent activities, which we acknowledge may
150 underestimate time in activities potentially combined with others, e.g. childcare.

151 We used logistic regression models to test hypotheses 1 and 2, regarding the effect of town
152 residence (our proxy for modernization) and gender on schooling. We constructed three
153 binary outcome variables relating to schooling: *schooled*, where 1 indicates the child has ever
154 been enrolled in school; *enrolled*, where 1 indicates the child is currently enrolled in school;
155 and *progressed*, for those aged 14-19 only, where 1 indicates the child has attended
156 secondary school. The clustering of children (Level 1, n=1,367) within households (Level 2, n=
157 456) was accounted for using mixed effect models, including a random effect for household
158 in *schooled* and *enrolled* models. *Progressed* models did not include a random effect because
159 the clusters are more sparsely populated, which may overestimate fixed and random effects

160 (Clarke, 2008). All models adjust for child age and food security as a proxy for household
161 wealth. An interaction between gender and residence was included to investigate whether
162 gender differences were reduced in the town.

163 Hypotheses 3 and 4, regarding children's time spent in work, were tested using linear
164 regression models. Activities from the time allocation interview were coded into one of five
165 categories; leisure / personal (hereafter referred to as 'leisure'), education, household chores,
166 farm work or herding (hereafter referred to as 'farm work'), and market work (full details
167 given in SM; Table S1). Total time spent in each activity category was calculated and divided
168 by the number of hours covered by the interview (5am-10pm; 17 hours) to give the
169 proportion of time spent in each activity category. Separate regression models were run for
170 each activity, as well as a new activity variable, productive work, which was calculated as the
171 total number of hours spent in chores, farm, and market work. The outcome variable for each
172 regression model was hours spent in that activity, with gender and place of residence being
173 the key predictor variables. An interaction between residence and gender was included to
174 investigate whether gender differences exist between the town and village. Analyses were
175 stratified by school attendance (attended on the previous school day or not) and age group
176 (7-13 and 14-19), as work patterns change with age, and differ between those who attended
177 and did not attend school. Models were adjusted for age and household food security, and
178 school enrolment for those who did not attend school.

179 Fractional multinomial logistic regression (Buis, 2017) was used to investigate hypothesis 5,
180 the trade-off between education and other activities. This method accounts for
181 autocorrelation between time uses, as time spent in one activity automatically reduces the
182 time available for other activities. The outcome variables are the proportions of time spent in

183 education, leisure activities, household chores, farm work, and market work, adding up to 1
184 for each child. The key predictor variables were gender, residence, and school attendance.
185 These models were stratified by age group, and adjusted for age, household food security and
186 school enrolment. Models give predicted proportions of time in the five categories,
187 subsequently converted back into hours. All analyses were carried out in Stata version 14.

188 RESULTS

189 *Descriptive statistics*

190 Town households are smaller; more likely to have an educated household head; less likely to
191 own land, grow crops, or own cattle; more likely to have a formal business or salaried
192 member; and have greater access to public services such as electricity and water (Table 1).

193 These data support our assumption that town residence is a proxy for modernization. Food
194 insecurity is high and similar across the village and town, suggesting that, despite livelihood
195 variation, both locations face similar socioeconomic challenges in provisioning their families.

196 Only 5% of children had never attended school, primarily because they were still considered
197 too young. In the village, 79% of girls and 71% of boys were currently enrolled, while in the
198 town, 84% of girls and 87% of boys were enrolled. Of the 1,278 children interviewed, 80%
199 were enrolled and 70% had attended school. There was no significant difference in missing
200 school between the village and town.

201 Figure 3 shows children's time allocation by age, stratified by gender and location. Children
202 spend about half their time in personal or leisure activities. Leisure time decreases with age,
203 while time spent in education and work increases with age; except among the oldest children
204 who spend little time in education and more in either work (village) or leisure (town). Farm

205 work is predominantly done by village boys and older village girls. Girls do more household
206 chores than boys in both town and village.

207 *Education*

208 Table 2 shows results from our logistic regression of the three education outcomes. These
209 results support hypothesis (1): town residence is associated with higher odds of enrolment
210 and progression to secondary school. Contrary to hypothesis (2), girls have higher odds of
211 enrolment than boys, though there is no gender difference in progression to secondary
212 school. There are interactions between residence and gender, with gender differences being
213 reduced in the town (though this is only marginally significant for ever-enrolled). In the village
214 therefore, boys are less likely to be in school than girls; in the town, the overall level of
215 educational investment increases, and the gap between boys and girls is reduced. The
216 educational 'disadvantage' to village boys is surprising given historical trends in this area
217 indicating higher male enrolment rates (SM; Figure S2).

218 *Work*

219 Figure 4 presents results from the linear regression models, predicting hours spent in chores,
220 farm work, leisure, and overall productive work (chores + farm work + market work) (full
221 regression results are shown in SM; Table S2). Results for market work are not presented
222 given the negligible amount of time spent in this activity. We first discuss work patterns for
223 children who did not attend school, before considering children who did attend school.

224 Among children who did not attend school, Figure 4a shows that village/town differences are
225 clear and in line with hypothesis (3), that modernization would be associated with less
226 productive work. Hypothesis (4) stated that boys would do more farm work and girls more

227 household chores. Our results show that gender differences in the type of work done are
228 substantial, and in the expected direction. Differences in the amount of work done are more
229 complicated. Among 7–13-year-olds, there are no significant gender differences in work and
230 leisure in the town, but village boys do marginally more work and have marginally less leisure
231 time than village girls. Among 14–19-year-olds however, gender differences are exacerbated
232 with modernization. Girls do approximately four hours more chores than boys in both
233 locations. In the town, boys therefore do much less productive work than girls, and have more
234 leisure time, while in the village there is no significant gender difference in amount of work
235 among 14–19-year-olds.

236 Among children who attended school, gender and village/town differences are much smaller
237 (Figure 4b). Consistent with hypothesis (3), those in the town do slightly less productive work;
238 a difference which is significant among 14–19-year-olds. Those in the town also have
239 significantly less leisure time than those in the village, because they spend more time in
240 education. In line with hypothesis (4), some gender differences are statistically significant, in
241 that girls do more household chores than boys, and this difference is reduced in the town. In
242 the village, boys do more farm work than girls, while neither boys nor girls do much farm work
243 in the town. This leads to town girls doing more productive work and having less leisure time
244 overall, particularly among 14–19-year-olds.

245 These results suggest that the lower enrolment rates seen for boys in the village may be due
246 to their time spent farming. They also suggest that there may not be a straightforward trade-
247 off between work and school, because girls do similar amounts of, if not more, productive
248 work than boys, and yet are not less likely to be enrolled. In the next section, we estimate the
249 trade-offs in time allocation between work, leisure, and school.

250 *Trade-offs between work and school*

251 Figure 5 presents results from the fractional multinomial logistic regression model, showing
252 the predicted difference in time allocation, in hours, between school attenders and non-
253 attenders (full model output in Table S3). This gives us an indication of the opportunity costs
254 of schooling, as it shows which activities are reduced to allocate time to education. In Figure
255 5, activities for which we cannot be statistically confident of a difference between school
256 attenders and non-attenders have confidence intervals that cross 0. For example, school
257 attendance has negligible impacts on market work for both genders. As expected, school
258 attendance substantially increases time in education, particularly among older children, who
259 allocate 9-11 hours a day to education. Which activities are reduced to make space for
260 schooling depends on gender and location.

261 Among 7–13-year-olds, school attendance primarily reduces leisure time, by up to seven
262 hours a day. Village boys are the exceptions here; school leads to a relatively small reduction
263 in leisure time, but a larger reduction in farm work of around four hours a day. Village girls
264 also have a small reduction in both chores and farm work with school attendance, while for
265 both girls and boys in the town, only chores are reduced. These results imply that the
266 opportunity costs of schooling are highest for village boys, while there are relatively small
267 trade-offs between work and education for girls or town boys.

268 Among 14–19-year-olds, the effect of school attendance on reducing work is greater for girls.
269 School attendance reduces time spent in household chores by approximately five hours for
270 girls in the town. For village girls, school attendance reduces household chore time by around
271 three hours, and farm work by around two hours. As in the younger group, village boys trade-
272 off education and farm work, with school attendance decreasing farm work by around five

273 hours. Town boys, in this case, are the exception, as they only show small trade-offs between
274 work and education, with school attendance instead reducing leisure time by nearly eight
275 hours. Thus, the opportunity costs of school attendance are elevated at older ages for both
276 town and village girls, to a level similar to village boys, but are negligible for boys living in
277 town.

278 In summary, hypothesis (5), that work would trade-off against education but that this trade-
279 off would decrease with modernization, is partially supported. We do find trade-offs between
280 work and education, particularly for older children, but a substantial amount of the time that
281 children spend in education is traded-off with leisure time, rather than work. Further, there
282 are gender differences in this trade-off. Modernization impacts boys' time allocation to a
283 greater degree than girls'. In the village, boys' work is valuable, and this appears to impact
284 their enrolment. In the town, boys do much less work, lowering the opportunity costs of
285 schooling. Girls' work patterns on the other hand show much smaller differences with
286 modernization, with the opportunity costs of older girls' time being quite high in both the
287 town and village.

288 DISCUSSION

289 Consistent with ECT, we report evidence that modernization increases investment in
290 education, reduces farm work, and is associated with lower opportunity costs to schooling.
291 However, contrary to our expectations, the strongest trade-offs in time allocation are not
292 between school and work, but between school and leisure time. Furthermore, we find that
293 the classic narrative of ECT applies primarily to boys; male-dominated farm work is relatively
294 incompatible with schooling, while female-dominated household chores are more readily

295 combined with school. These findings have important theoretical and applied implications for
296 our understanding of socioeconomic ‘modernization’ and its impacts on childhood
297 experience.

298 In this context, the opportunity costs of educating children appear modest. This in turn implies
299 that the returns to education need not be particularly high to justify parental investment in
300 child schooling. Education uptake may therefore be driven, not just by increasing economic
301 benefits, but by decreasing opportunity and direct costs. Throughout Tanzania, household
302 labor requirements have shrunk in recent years following villagization policies (*ujamaa*), and
303 shifts towards less labor-intensive crops (Varkevisser, 1973; Wijisen & Tanner, 2002). Direct
304 costs have also declined with the abolition of primary school fees, though families do bear
305 the costs of school supplies, for example uniform and stationery.

306 Low opportunity costs to schooling in this setting, and perhaps more broadly across low-
307 income, high-fertility African populations, may not be characteristic of past European
308 transitions. However, historical analyses of education uptake in Industrial England similarly
309 contradict the view that schooling uptake was driven primarily by anticipated economic
310 returns. It has been argued that the promotion of compulsory education was a way of
311 controlling young people’s time, rather than because school would be useful to children
312 (Cunningham, 1990; Horrell & Humphries, 1995). Thus, schooling may be better considered
313 as a form of cooperative child care, which frees parental time for other productive activities
314 by reducing the burden of child supervision and direct care. A fruitful area for future study
315 would be to consider the impact of schooling on parental productivity.

316 If education is not very costly, as in this context where both opportunity costs and direct costs
317 of schooling (at least at the primary level) appear modest, school enrolment can be high even

318 in the absence of high returns. This has consequences for fertility decline, implying that
319 schooling does not necessitate, or even necessarily incentivize, a switch to a 'quality over
320 quantity' focused parental investment strategy. Indeed, despite near universal primary school
321 enrolment and growing secondary school attendance in this population, fertility rates remain
322 high, suggesting many families perceive education and high fertility as compatible strategies.
323 In rural South Africa, high investment in education was also observed despite limited payoffs;
324 with parents argued to invest in education in the hope that at least one child may benefit, but
325 continuing to have many children to provide old-age security and household labor (Liddell,
326 Barrett, & Henzi, 2003).

327 The opportunity costs of boys' work appear much higher than those for girls, particularly at
328 younger ages, and this is reflected in boys' lower school enrolment rates in the village. Lower
329 enrollment of boys is an unexpected pattern, given the typically assumed greater economic
330 pay-offs to male wage-labor and the international focus on out-of-school girls (United
331 Nations, 2015). Yet, other studies have also recently documented a 'male disadvantage' in
332 education in pastoralist settings in both Kenya and north-eastern Tanzania (Hedges et al.,
333 2016; Mburu, 2016). We suggest this trend is driven by the relative compatibility of girl's
334 household chores with school attendance. Sending boys to school and foregoing their work
335 may be a more significant decision, involving the expense of employing someone else to herd
336 the cattle, losing opportunities for passing on knowledge and skills to the next generation and
337 potentially foregoing income from cattle keeping altogether (Siele, Swift, and Kratli, 2013).

338 While often overlooked by both theoretical and policy-grounded research on childhood,
339 leisure and social time is an important component of childhood experience, and may have
340 important implications for child health, wellbeing, and achievement (Bock & Johnson, 2004).

341 Our results indicate that schoolgirls sacrifice leisure time, and combine education with
342 household work. This situation, where gender equality in the public sphere (school) has been
343 achieved, at least superficially, but gender differences remain in the private sphere
344 (household), echoes the 'double shift' seen in many 'modern' economies, in which women
345 combine full-time work with responsibility for unpaid household work and childcare
346 (Hochschild & Machung, 1989; McDaniel, 2012).

347 *Conclusions*

348 ECT dominates contemporary research into the impact of modernization on parental
349 investment and reproductive strategies, particularly in evolutionary anthropology and
350 demography (Lawson & Borgerhoff Mulder, 2016). Yet, available data on patterns of
351 educational investment and children's work, presented here and elsewhere, provide mixed
352 support for assumptions about the costs and benefits of education, and the consequent
353 motivations for limiting fertility. Indeed, many contemporary low-income populations have
354 both high school enrollment and high fertility, supporting the view that low opportunity costs
355 of schooling are an important explanatory factor behind stalled fertility declines. This
356 conclusion echoes wider concerns that historical processes need not necessarily be reflected
357 in current and future patterns of change (Thornton 2001).

358 Our analyses also make clear that the impact of modernization on childhood cannot be
359 understood without considering gender. Parents in this population, and elsewhere, are
360 increasingly educating daughters, often more than their sons, a pattern which may be driven
361 by relatively low opportunity costs and emerging employment opportunities for young
362 women. We caution that for girls, school attendance involves sacrificing leisure time to
363 combine school with household chores, with unknown consequences for their wellbeing.

364 More holistic studies of the costs and benefits of children's time allocation, that fully explore
365 children's time beyond the most obviously 'functional' behaviors of work and schooling, will
366 provide better understanding of how best to promote positive outcomes across all
367 dimensions of children's lives.

368

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Table 1: Sample size and description of child education outcomes and household characteristics.

	Village	Town	Total
Sample:			
Number of households	234	222	456
Number of children aged 7–19	768	619	1,387
Number of children interviewed	740	538	1,278
Mean household size (SD)	8.0 (2.9)	7.1 (3.2)	7.6 (3.1)
Mean number of children aged 7–19 per household (SD)	3.3 (1.7)	2.7 (1.8)	3.0 (1.7)
Education outcomes:			
Ever enrolled (%)	702 (91.4)	608 (98.2)	1,310 (94.5)
Currently enrolled (%)	574 (74.7)	528 (85.3)	1,102 (79.5)
Progressed (%; 14–19-year-olds)	80 (30.9)	196 (72.3)	276 (52.1)
Attended on previous day (%; currently enrolled and followed up only)	490 (87.2)	417 (88.7)	907 (87.9)
Mean years of education (SD; previously enrolled)	5.9 (2.5)	8.1 (2.8)	6.6 (2.8)
% households:			
With salaried member	1.7	12.6	7.0
With skilled member	3.0	20.3	11.4
With business or shop	10.3	32.9	21.3
Farming and selling agricultural produce	45.3	4.1	25.2
Subsistence farming	38.0	9.9	24.3
Owning land	95.3	72.5	84.2
Growing crops	96.2	47.3	72.4
Owning cattle	43.6	7.2	25.9
With electricity	2.1	50.5	25.7
With water source on own land	3.4	36.0	19.3
Classed as 'severely food insecure'	50.4	48.4	49.5

Table 2: Results from logistic regression models of educational outcomes; ever enrolled in school, currently enrolled in school (whole sample), and progressed to secondary school (for 14–19 year olds only).

	Ever enrolled	Currently enrolled	Progressed (14–19-year-olds)
Town (reference = village)	12.22** [3.67,40.72]	7.00** [3.83,12.82]	5.86** [3.40,10.10]
Female (reference = male)	1.98* [1.06,3.72]	1.82* [1.14,2.88]	1.27 [.74,2.18]
Residence#gender interaction	.27+ [.06,1.20]	.41* [.20,.87]	1.22 [.56,2.64]
Household food security score	1.05+ [.99,1.10]	1.04* [1.01,1.08]	1.06** [1.02,1.09]
Age (years)	1.74** [1.50,2.02]	.58** [.54,.63]	1.25** [1.12,1.41]
Constant	.01** [.00,.07]	2099.90** [578.02,7628.80]	.00** [.00,.03]
Random intercept for household	.96 [.48,1.90]	.83 [.52,1.34]	
N	1,367	1,367	523

+ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$

Exponentiated coefficients presented; 95% confidence intervals in brackets

370 Figure captions

371 **Figure 1:** Map of the study area showing distribution of households interviewed, as well as
372 the main roads and schools attended by children.

373 **Figure 2:** A field worker completes a time allocation diagram during an interview with a girl
374 outside her home in the town.

375 **Figure 3:** Mean percentage of time spent in education, market work, farm work, household
376 chores, and leisure between 5am and 10pm on the previous school day, by age. Data are
377 displayed by gender and urban/rural residence. Time spent in leisure decreases with age,
378 while time spent in education and work increases with age. Farm work is predominantly done
379 by village boys and older village girls. Girls do more household chores than boys in both town
380 and village. Only a small amount of time is spent doing market work by any children.

381 **Figure 4a:** Predicted hours spent in household chores, farm work, leisure, and productive
382 work from linear regression models, for those who did not attend school on the previous day.
383 Results are shown by village and town, and for boys (hollow blue triangles) and girls (solid red
384 diamonds). Error bars represent 95% confidence intervals.

385 **Figure 4b:** Predicted hours spent in household chores, farm work, leisure, and productive
386 work from linear regression models, for those who did attend school on the previous day.
387 Results are shown by village and town, and for boys (hollow blue triangles) and girls (solid red
388 diamonds). Error bars represent 95% confidence intervals.

389 **Figure 5:** Predicted hours from fractional multinomial logistic regression models showing the
390 absolute difference between school attenders and non-attenders in time spent in education,
391 leisure, household chores, farm work, and market work, by gender and residence. Models
392 were run separately according to age group and are adjusted for gender, age, household food
393 security, and enrolment status. The baseline, 0, represents time allocation for non-attenders.
394 School attendance increases time spent in education, and decreases time spent in other
395 activities. 95% confidence intervals that cross the baseline indicate a non-significant
396 difference between attenders and non-attenders. Village markers are solid. Town markers
397 are hollow; boys' markers are blue triangles and girls' are red diamonds.

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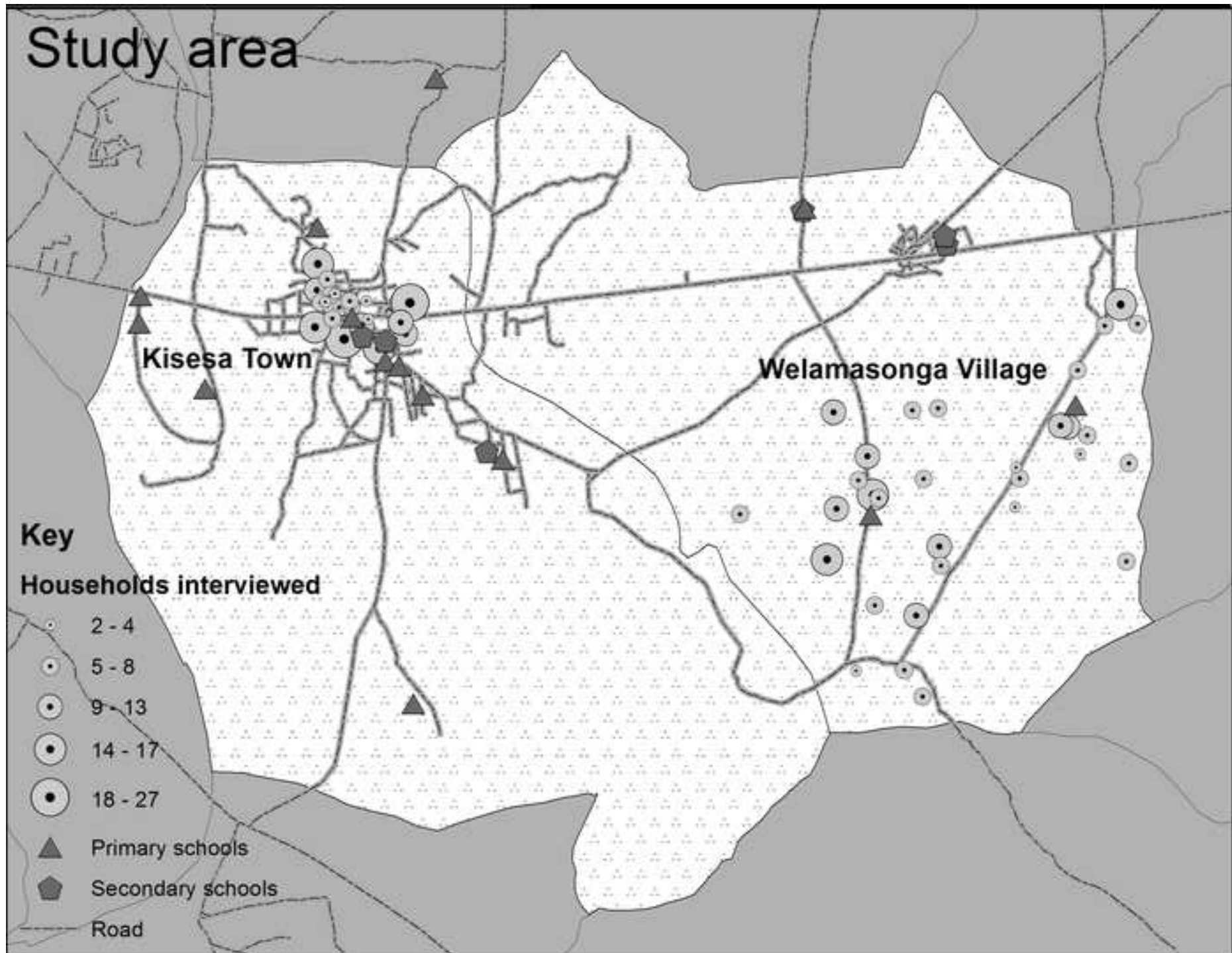




Figure 3

