“Modernization” increases parental investment and sibling resource competition: evidence from a rural development initiative in Ethiopia

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Abstract

Evolutionary models of parental investment often assume that negative effects of competition between offspring (i.e., quantity-quality trade-off effects) will be most apparent under conditions of resource scarcity. However, improvements in resource access associated with “modernization” may reduce levels of extrinsic environmental risk, creating a stronger association between parental investment and offspring success. Here we provide evidence that a rural development initiative in Ethiopia is associated with increased levels of parental investment in offspring status and increased levels of competition for this investment between siblings. Villages with access to an improved water supply, which have reduced levels of childhood mortality, are associated with higher investments in education, and the likelihood of offspring education is more determined by position within the family, compared to neighboring villages without access to water taps. However, there is no evidence of higher parental investment of base-level resources directly related to child health (indicated by childhood vaccination rates). Educational investment may be more sensitive to mortality changes, despite being costly and “surplus” to essential functions, because it has the potential to introduce the greatest economic payoffs for children, e.g., from jobs in an emerging wage-labour market. While tap villages are currently associated with a higher birth rate, we anticipate that in time, and with improved access to family planning, fertility will drop in response to shifts in environmental risk and improved pay-offs to strategies of high parental investment. These villages may be experiencing the initial stages of a demographic transition to small family sizes.

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1. Introduction

Human parents invest intensively in their offspring. Our evolved life history has been shaped by the costs of rearing large-brained children who experience a long period of juvenile dependency requiring both parental and grandparental support (Hill & Kaplan, 1999; Mace, 2000; Sear & Mace, 2008). Evolutionary life history theory predicts that since the energetic and time costs of raising simultaneous children (and grandchildren) are high, and resources are finite, parents face a trade-off between number of offspring born and number that can be successfully reared. Numerous animal studies support this model, showing that offspring fitness diminishes with family size (Lack, 1947; Roff, 2002; Stearns, 1992). However, evidence for trade-offs between family size (quantity) and child well-being and/or reproductive success (quality) in humans is mixed (Borgerhoff Mulder, 2000; Desai, 1995; Gillespie, Russell, & Lummaa, 2008; Hagen, Barrett, & Price, 2006; Hill and Hurtado, 1996; Kaplan, Lancaster, Bock, & Johnson, 1995; Low, 1991; Meij et al., 2009; Penn and Smith, 2007; Pennington & Harpending, 1988; Strassmann & Gillespie, 2002; Voland & Dunbar, 1995 and see review in Lawson and Mace, in press).

Many have emphasised the potential for human trade-offs to be masked by social, economic or cultural phenomena which improve resource availability (Borgerhoff Mulder, 2000; Draper & Hames, 2000; Gillespie et al., 2008; Hagen et al., 2006; Hill & Hurtado, 1996; Meij et al., 2009), thus defraying the costs of rearing large families (e.g., through kin support or economic and public health initiatives which reduce mortality and/or increase the local carrying capacity).
Economic models of the family have also assumed that, since quantity–quality trade-offs are driven by “credit constraint,” increases in personal or societal wealth will reduce negative effects of high fertility on offspring (Becker & Lewis, 1973; Grawe, 2010). However, across the world, it is the parents with the greatest access to wealth and resources benefiting from improved economic, technological, and health interventions who increasingly opt for a more quality-driven parental investment strategy (Coale & Treadway, 1986; Lee, 2003; Livi-Bacci, 1986), dramatically curtailing fertility as if sibling resource competition has been increased rather than reduced (Kaplan, Lancaster, Tucker, & Anderson, 2002; Mace, 2007).

In this study, we test one explanatory model for how technological and public health improvements, i.e., “modernization,” may magnify parental investment trade-offs based on the reduction of extrinsic environmental risk. We identify the impact of a rural Ethiopian development project, which has dramatically reduced childhood mortality, on levels of parental investment and the intensity of resource competition between siblings.

1.1. Environmental risk and parental investment

Recent studies have highlighted the importance of perceptions of local environmental stability in determining parenting behaviors, particularly whether local environmental mortality risks can be avoided by increasing parenting effort (Pennington & Harpending, 1988; Quinlan, 2007; Winterhalder & Leslie, 2002). Focus has been given to extrinsic, or “care-independent” risk factors, which introduce negative child outcomes largely beyond parental control, e.g., through high prevalence of infectious disease, unpredictable and fluctuating food availability and/or high rates of warfare and intragroup violence. High levels of extrinsic risk create substantial diminishing returns to parental effort, introducing a low saturation point beyond which “chance” becomes the principal determinant of offspring success (Pennington & Harpending, 1988; Quinlan, 2007). Under such conditions, parents should favour low levels of parental investment and resource competition between siblings will be relatively inconsequential to individual fitness. A pattern favouring the allocation of parental resources to high fertility rates whenever possible. Conversely, if external risk factors are low, parents have a greater reliability in their investment returns and so, a greater influence on child survival, development, and ultimately reproductive success. This pattern favouring increased levels of parental effort and elevated sibling competition for this investment, which in turn may lead to a reduction in fertility rates (Winterhalder & Leslie, 2002).

Several studies support a link between levels of extrinsic environmental risk and reproductive and parenting behaviors. In humans, patterns of early reproduction (which typically coincide with high fertility) have been associated with elevated risk factors such as crime rates (United States; Wilson & Daly, 1997), HIV infection (South Africa; Gant, Heath, & Ejikeme, 2009) and life expectancy (United Kingdom; Nettle, 2010). Using a cross-cultural sample, Quinlan (2007) has also presented evidence that high exposure to extrinsic risks (famine, warfare, or very high levels of pathogen stress), is associated with lower levels of direct parenting behaviors (e.g., less mother-child bodily contact and reduced sleeping proximity).

1.2. The impact of modernization

Modernization, through the introduction of social, economic, health, or technological interventions, has the potential to reduce extrinsic environmental risks, increasing the reliability of parental investment returns (Winterhalder & Leslie, 2002). As such, modernization may establish a closer association between parental investment and offspring quality and, subsequently, increased perceived or actual costs to resource competition between siblings (Kaplan et al., 2002; Kaplan, 1996). This argument has been used to account for the modern demographic transition to below replacement fertility in Europe during the 19th century, where improvements of public health (which reduces extrinsic sources of mortality and morbidity) and changing technologies of production (i.e., the introduction of wage-based labour reliant on education) may have interacted to yield increasing payoffs to investments in skill and education, health, and longevity. In turn, favoring investment in child quality at the expense of quantity (Kaplan et al., 2002; Kaplan, 1996). Within these populations, competition for parental investment between siblings may be particularly pronounced in relatively high socioeconomic strata (Lawson & Mace, 2009, 2010). This is because potential for resource generation is highest for those in receipt of initial wealth transfers (Rogers, 1990) and because welfare states guarantee “base” requirements in health care, schooling, and social opportunity are met, alleviating resource competition at lower levels of investment.

Conclusive evidence that parental investment and sibling resource competition are influenced by levels of modernization in populations currently undergoing demographic transition is, however, currently lacking (Gibson & Mace, 2006). A cross-cultural analysis by Desai (1995) on the influence of family size on childhood growth in 15 developing populations provides some supportive findings. Desai (1995) found that higher levels of both access to safe drinking water and health care facilities was associated with larger negative effects of closely spaced siblings on height, suggesting that improvements in parents’ ability to influence their own children’s well-being through public health initiatives may have resulted in more intensive competition between siblings for this investment. However, country-level associations of this sort may be confounded by extensive regional variation in alternative socioeconomic factors influencing family structure and child development (Lawson & Mace in press).

In the current study, we are able to directly explore factors altering individual parental investment decisions and competition between siblings following the introduction
of a new water development intervention within one rural Arsi Oromo community in Southern Ethiopia. Here, the recent construction of a pipeline has improved access to clean drinking water through village-level tap stands, resulting in an immediate and significant reduction in risk of early childhood mortality (in the first 3 years of life) from water-borne and water-washed parasitic, bacterial and viral infections (Gibson & Mace, 2006; Gibson, 2002). Such risk factors can be considered extrinsic, as they are relatively independent of parental care. The aim of this investigation is twofold: (1) to identify whether a water development project which has reduced extrinsic risks of negative child outcomes has also influenced levels of parental investment and (2) whether this has resulted in increased or reduced levels of resource competition between siblings in the household.

1.3. Measuring parental investment

All parents invest qualitatively different types of resources in offspring (Borgerhoff Mulder, 1998; Downey, 2001; Hertwig, Davis, & Sulloway, 2002). In this study, we consider two measures of parental investment relating to childhood education and health, which are important determinants of offspring future success. The first measure is school attendance. Among the Arsi Oromo, educating children clearly comes at a substantial investment cost to parents not only because it requires money for school materials, but also because it incurs a cost of time otherwise spent in agricultural activities which contribute directly to the household. Although less than a third of adults have received any education, levels are on the increase, possibly due to a recent rise in seasonal construction jobs in the cities, which has enhanced economic payoffs (through a flow of remittances back to the villages). The second measure is whether or not parents have ensured that individual offspring receive any vaccinations against common childhood diseases—polio, DPT (diphtheria, pertussis and tetanus), tuberculosis, and measles. Vaccinations are provided free of charge to all children in the study community but require the commitment of parental time and effort to ensure the availability of children to health practitioners. As such, while a majority of children are immunized, a significant number of disadvantaged children remain.

We explore competition between siblings for this investment by focusing on order of birth placement (which signifies number of older siblings in the household). Birth order effects are particularly useful for exploring parental investment trade-offs in traditional societies because relevant differences in wealth between groups can be hard to measure and confound with family size (as wealthier individuals tend to have larger families Gibson & Mace, 2007). Evolutionary life history theory and economic models of resource division predict that parental investment trade-offs are resolved according to birth order, i.e., investments are highest for first born offspring but reduce with each additional birth as resources diminish and competition increases (Blake, 1989). Early-born children benefit from a longer period of exclusive parental investment but are also a more reliable investment for parents (having survived longer and being closer in age to reproduction (Jeon, 2008). This pattern is well supported by cross-cultural evidence revealing that number of elder rather than younger siblings is the greatest determinant of household resource allocation (Hrdy & Judge, 1993; Lawson and Mace, 2009; Price, 2008; Rosenblatt & Skoogberg, 1974). However, it should be noted that other studies have indicated that older siblings can exert a positive influence through contribution to the household through labour force participation or child-care provision (Caldwell, 1982; Draper & Hames, 2000; Kramer, 2005; Sear & Mace, 2008).

2. Study site

The Arsi Oromo comprises patrilineal agro-pastoralists, who combine cattle rearing with maize, wheat, and sorghum cultivation in the rural low-lying areas of Arsi region (zone) in Southern Ethiopia. Once described as the “bread basket of Ethiopia” in recent years the region has experienced irregular rainfall and poor agricultural productivity; malnutrition is common (Gibson, 2002). High population growth, a shortage of basic public services, and lack of nonagricultural income-generating opportunities have increased competition for resources both within and between households (Gibson & Mace, 2006), fuelling recent increases in short-term out-migration to cities (for employment in an emerging construction industry) (Gibson 2009).

Villages in this region are very far from a natural, permanent water supply, partly due to a former government’s policies of forced settlement and land allocation (3–4-h walk to the nearest market town). However, since 1996, some of the villages in Hitosa and Dodota wereda (sub districts of Arsi Zone) benefited from a gravity water supply development scheme, funded by a British nongovernmental organization (Silkin, 1989). This scheme involved a pipeline being laid from high to lowland areas, using gravity to propel the highland spring water to the low-lying areas. The main aim of this scheme was to improve access to this clean spring water; the project did not introduce any other community-based activities that might alter health care, education, income-generating, or subsistence-related activities. Not all villages in the local area were included in the development project, some falling outside an arbitrary administrative boundary determining in which villages the NGO could operate. However, all benefited equally from other secular changes occurring across the region, including access to the same schools and health care facilities. Access to the improved water supply represents the only difference between villages, providing an opportunity to construct a natural experiment which pinpointed the direct demographic and behavioural impacts of the development intervention (see Table 1 for description of the study villages).
Previous demographic studies have revealed that this development project had a dramatic impact on the local ecology, namely, an immediate and dramatic reduction in levels of childhood mortality in the villages benefiting from new tap stands. A multivariate hazards regression model identified that the monthly risk of child death under 3 years of age was 50% lower following access to new tap stands (Gibson & Mace, 2006). Five years after the development project was initiated, children living in villages with new taps had lower levels of mortality than those children living in villages who received no improved water supply, while other explanatory factors such as levels of wealth, education, and adult body mass index (BMI) (% body fat) remained the same across villages (Table 1). Local government health surveys undertaken in the region suggest there has been a reduction in water-borne diseases associated with poor water supply, particularly diarrhoea and gastroenteritis caused by parasitic, bacterial, and viral infections (Gibson, 2002; Amudee clinic nurse, personal communication).

The installation of village-level tap stands is recognised locally as having had dramatic impact on improving community health and well-being, particularly for women who carried the water long distances (Gibson & Mace, 2002). Children’s time collecting water remains unchanged (Abate, 2004) and are generally perceived to have benefited through improved well-being since the taps were installed. In the words of one informant, “there are many changes since the installation of taps. The task of collecting water is easier for women; we are no longer rationing water for our children, we can wash ourselves more frequently.” However, a previous study has also indicated that larger surviving family sizes may have had a negative impact on child growth in tap villages. This effect may represent increased shortages in food availability within the household but may also reflect improved survival of small low birth weight children (Gibson & Mace, 2006).

3. Methods

3.1. Village sample

For the purposes of the study villages were selected to facilitate a natural experimental framework, which included closely comparable villages with and without taps. With the assistance of employees of the local NGO responsible for installing the taps, each village was randomly selected from groups which had been matched for comparability in a range of parameters (population size, wealth and distance to the all-weather road, the two markets and schools) (described in Fig. 1 and Table 1). The final sample used in the analyses presented here included two villages that benefited from the water supply scheme between 1996–1999 and three villages who were not included in the scheme, producing a total of 555 households with access to “taps” and 607 households “without taps.”

<table>
<thead>
<tr>
<th>Villages with taps</th>
<th>Villages without taps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total population in 2000</td>
<td>3147</td>
</tr>
<tr>
<td>Child mortality &lt;5 years (%)</td>
<td>14.5%</td>
</tr>
<tr>
<td>Household cattle herd size (median and IQR)</td>
<td>2 (3)</td>
</tr>
<tr>
<td>Adults (≥18 years) ever educated (%)</td>
<td>33.6</td>
</tr>
<tr>
<td>Adult female BMI (mean)*</td>
<td>19.9±0.13</td>
</tr>
</tbody>
</table>

* Adjusted for age and breastfeeding status.

3.2. Data collection and analyses

Background demographic and socioeconomic, including birth history and education, data was collected from all residents across the villages during house-to-house census surveys undertaken by M.G. between 2000 and 2003. Analyses were undertaken using multivariate models to assess the partial effects of a range of sociodemographic factors known to influence two dependent variables (any child school attendance and any vaccinations), including age, sex, household wealth measured in cattle herd size, family size, birth order, and a dichotomous variable reflecting village-level water tap access. Covariates for family size and birth order exclude miscarriages, still births, and neonatal deaths. Age, family size, birth order, and household herd size were entered into the model as continuous variables. A description of key variables included in the analyses, by village access to taps, is outlined in Table 2. To control for family effects (i.e., enabling levels of investment

Fig. 1. Map of the study site. (A–C) Villages without taps. (D and E) Villages with taps. The local market towns with health clinics are Iteya and Dera.
experienced by children to vary between families), multi-level modeling techniques were employed in each analyses, with household identity set as a random effect.

Multivariate logistic regression models were used to identify the determinants of child school attendance and vaccination. For the education model, the outcome is the probability of a child ever receiving any education at a government school. Government schools are within half a day’s walk from all villages. In this case, the final sample included 2225 school-aged children (6–18 years) resident in the villages during the survey. This included 1084 children from tap villages, and 1141 children from non-tap villages. For the vaccination model, the outcome is the probability of a child receiving any vaccinations provided free of charge by outreach health clinics which attend all the villages annually (partly vaccinated children were included). To exclude children vaccinated prior to the installation of taps, the sample was restricted to all children born within 6 years of the survey date. This included 662 children—321 from tap villages and 341 from non-tap villages.

For each dependent variable, the likelihood of an event occurring was estimated as a function of the various covariates outlined above. In each case, two models were built. The first model explored all main effects of the predictor variables outlined above. Separate models were also run to explore additional interaction effects between the independent variables. All statistical analyses were performed using MLwiN version 2.20.

4. Results

4.1. Child education

Multivariate logistic regression models for receiving any education are summarized in Table 3 for all school-aged children (6–18 years). The final model includes both main effect and interaction terms between independent variables. Across models, age, sex, wealth, family size, birth order, and village-level tap access were all predictors of receiving access to education. Probability of having received any education increased as a nonlinear function of age and increased with wealth of the household and family size. Increases in education with family size may indicate an unmeasured effect of household wealth but could also suggest that children in larger households benefit from siblings, perhaps through the division of household tasks which compete with school attendance (e.g., livestock tending). In line with cultural preferences for sons, males were significantly more likely to be attending school than females [OR 3.67 (CI 2.92–4.61), \(p \leq 0.001\)]. In the household census, 44.2% of school-aged males had received any education, while only 20.7% of females had ever attended school.

Child’s order of birth/number of older siblings was a strong negative predictor of schooling [OR 0.86 (CI 0.81–0.92), \(p \leq 0.001\)], i.e., the first born was most likely to be educated, and there was a linear reduction in access to school for each subsequent child. Overall, 41% of first births were educated, dropping to 37.1% for second–third births, 31.2% for fourth–fifth births, 32.4% for sixth–seventh births, and only 24.5% of eighth or later births were educated.

School-aged children living in “tap” villages were more likely to have received schooling (37.1% were educated) than those living in “non-tap” villages (in which only 30.5% had attended school) [OR 1.60 (CI 1.24–2.06), \(p \leq 0.001\)]. Moreover, the negative impact of elder siblings on a child’s access to education was more greatly exaggerated in tap villages [birth order*tap access OR 0.92 (CI 0.84–1.00), \(p \leq 0.05\)]. In raw percentages, this represents a drop of 51% of first births attending school to less that 26% of children with more than seven elder siblings. Fig. 2 illustrates how that the probability of receiving education dropped more sharply for each additional child under conditions of improved water supply, indicating more intensive

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Estimate (S.E.)</th>
<th>Odds ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>−8.73 (0.510)</td>
<td>***</td>
</tr>
<tr>
<td>Sex (Ref: female)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>1.30 (0.117)</td>
<td>*** 3.67 (2.92–4.61)</td>
</tr>
<tr>
<td>Age</td>
<td>0.850 (0.063)</td>
<td>*** 2.33 (2.07–2.65)</td>
</tr>
<tr>
<td>Age²</td>
<td>−0.023 (0.002)</td>
<td>*** 0.98 (0.97–0.98)</td>
</tr>
<tr>
<td>Herd size</td>
<td>0.043 (0.017)</td>
<td>** 1.04 (1.01–1.08)</td>
</tr>
<tr>
<td>Family size</td>
<td>0.109 (0.040)</td>
<td>*** 1.12 (1.04–1.20)</td>
</tr>
<tr>
<td>Birth order</td>
<td>−0.148 (0.033)</td>
<td>*** 0.86 (0.81–0.92)</td>
</tr>
<tr>
<td>Tap access (Ref: without taps)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>With access to water taps</td>
<td>0.468 (0.130)</td>
<td>*** 1.60 (1.24–2.06)</td>
</tr>
<tr>
<td>Between family variance</td>
<td>0.688 (0.137)</td>
<td>*** 1.99 (1.52–2.60)</td>
</tr>
<tr>
<td>Main effects+interaction terms (Model 2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Birth order* tap access</td>
<td>−0.086 (0.043)</td>
<td>* 0.92 (0.84–1.00)</td>
</tr>
</tbody>
</table>

* \(p < 0.05\), ** \(p < 0.01\), *** \(p < 0.001\).
levels of sibling competition for education between younger and elder siblings.

4.2. Child vaccination

Multivariate logistic regression models for probability of a child (under the age of 6) receiving any vaccinations are presented in Table 4. The final model includes both main effect and interaction terms between independent variables. Household herd size, family size, and birth order were all strong predictors of a child immunization. The results indicate that children from the wealthiest families (those with the largest household herd sizes and family sizes) were more likely to be vaccinated. Further, the probability of vaccination dropped with order of birth (i.e., the first born was most likely to be vaccinated), and there was a linear reduction in vaccination for each subsequent child [OR 0.73 (CI 0.57–0.93), \( p \leq 0.01 \)]. In raw percentages, this represents a drop from 87.4% of first births being vaccinated to less than 79.3% of those with seven or more older siblings.

Overall, 87.5% of children were vaccinated. There was no evidence of any difference in levels of child immunization between the clusters of villages, with roughly equal numbers being vaccinated in tap (87.9%) and non-tap villages (87.1%) [OR 1.25 (CI 0.72–2.16), \( p = 0.423 \)]. Further, patterns within households did not vary across villages, i.e., the interaction term between village-level tap access and birth order was not significant [OR 1.07 (CI 0.88–1.31), \( p = 0.485 \)].

5. Discussion

5.1. Modernization and parental investment in the Arsi Oromo

Access to a development project, which has improved early child survivorship, is associated with increased levels of parental investment in offspring education among the Arsi Oromo. In otherwise comparable villages, children benefiting from access to the improved water supply were more likely to attend the local school (which was of equal distance from each village). This finding indicates that parenting attitudes and behaviors have shifted. With the reduction of extrinsic child mortality risks (associated with poor water supply) parents may perceive that they have a greater influence on child outcomes over the long-term and ultimately on reproductive success. With a greater degree of reliability in investment returns, optimal levels of parental investment per child have increased. This finding however was not replicated for childhood vaccinations, as parents in both tap and non-tap villages were equally likely to ensure their children receive available vaccinations.

A qualitative distinction between “base” and “surplus” resources (Downey, 2001) may help to explain why only investments in child education differed between villages. Under this model, all parents, regardless of individual condition, are equally committed to investing in relatively low cost (base) investments necessary for acceptable chances of survival and healthy development. In contrast, the investment of surplus resources may be more sensitive to environmental shifts because such investments necessitate a substantial cost to parents. In the context of this study, investment in childhood immunization may be understood as approximating base level investment. While it is not universally ensured for all children, it is considerably more widespread than investment in child education and relatively affordable. Child education, on the other hand, clearly fits the definition of surplus level investment; it is both relatively uncommon and considerably more costly in terms of both time and material resources (i.e., through money for school materials and lost contribution of children to agriculture and livestock herding). It is likely that this high cost investment will also yield high economic payoffs to children.
in the long term from jobs in an emerging wage-labour market in neighbouring towns and cities (Kaplan, 1996).

Order of birth held a significant influence on child education and vaccination, implying resource competition between older and younger siblings, with later born children at a clear disadvantage in all villages. We find no evidence that improvements in resource access, driven by water tap installation, reduce the magnitude of these effects. In fact, despite the overall increases in the probability of receiving formal education, this resource was less equally divided among offspring in tap villages (Fig. 2), indicating an exaggeration of existing patterns of resource competition between siblings. With extrinsic childhood mortality risks significantly reduced, both parental discrimination and sibling competition for education may be exaggerated in tap villages, since this investment is perceived to be a more reliable measure of future economic and reproductive success. Similar intrahousehold biases in children’s education have been demonstrated among Arsi Oromo of differing socio-economic groups—with birth order effects exaggerated among wealthy households where investment payoffs are greater (Gibson and Sear, 2010).

Eloundou-Enyegue & Williams (2006) have recently reached similar conclusions concerning the impact of overall family size on schooling in Cameroon. Negative effects of siblings on education are often absent in rural regions but are increasingly evident over time and in more urbanized areas, suggesting modernization can increase the importance of sibling competition for parental investment (see also Martelet 2010). Existing biases for preferentially educating early born offspring may also have become magnified because strategies of concentrated investment safeguard against the increased costs of spreading resources more thinly across multiple offspring. Liddell, Barrett, & Henzi (2003) identify that levels of extrinsic risk have influenced parental investment decisions in a study on schooling in South Africa. The authors argue that weak birth order effects in school attendance may arise in this population because parents are facing high extrinsic risks, forcing parents to “bet-hedge,” i.e., spreading their investment across lots of offspring because they cannot predict which child will be successful.

5.2. Why does fertility remain high in the tap villages?

For the Arsi Oromo, a shift towards increased parental investment in education and higher costs to sibling resource competition in the presence of the development initiative is not currently reflected in lower fertility. In fact, as previously shown, the presence of tap stands is associated with an increased birth rate (Gibson & Mace, 2002, 2006). There are at least two possible reasons for this. First, while the importance of sibling competition has increased, this increase may not be sufficient to drive optimum fertility levels down. The installation of taps in Arsi villages has lead to large reductions in the time required to collect water and greatly increased time and energy of mothers now available for expenditure on other activities (Gibson & Mace, 2006; Gibson, 2002). As such villagers with access to taps may be able to make the best of both worlds, using this extra time to simultaneously invest more in each offspring and in more offspring, even in the face of higher competition between siblings.

Second, because the mortality decline has been brought about by an external intervention, the change has been both dramatic and immediate (Gibson & Mace, 2006); the transition to low fertility may differ from those cases where mortality reductions have arisen from endogenous, gradual economic and technological developments (Coale and Treadway, 1986). While parenting attitudes already seem to have responded to the shifts in parental investment trade-offs to some degree, fertility behaviors may lag behind in the absence of contraceptive technologies and an understanding of how to use them effectively (only a third of the current generation of parents have ever been educated). There is, however, some indication of a recent change in parents’ attitudes towards family planning: contraception uptake increased from <1% to 3.8% between 2000 and 2003; and in a recent survey in 2009 had risen to 19% (Gibson, 2002 and unpublished data). Country-level evidence indicates that populations undergoing mortality declines can experience an initial raise in birth rates prior to a long-term decline in fertility (Dyson & Murphy, 1985). The Arsi Oromo may be experiencing the initial stages of a demographic transition to smaller family sizes.

5.3. Conclusions

In this study, we identify a situation in which “modernization,” through a rural development initiative, is associated with a shift towards higher and more discriminative levels of investment in offspring education. Arsi Oromo villagers with recently improved access to safe water appear to be pursuing more quality-based parenting strategies, which in time may ultimately fuel a trend towards reducing fertility rates. These findings add to a growing body of literature demonstrating the importance of environmental risk in shaping human parental investment strategies (Kaplan et al., 2002; Nettle, 2010; Quinlan, 2007; Winterhalder & Leslie, 2002).

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