WPS4755

Policy Research Working Paper 4755

Intrahousehold Inequality and Child Gender Bias in Ethiopia

Feridoon Koohi-Kamali

The World Bank
Africa Region
Poverty Reduction and Economic Management Department
October 2008

Abstract

The Rothbarth model of intrahousehold resource allocation has consistently failed to detect child gender bias in many applications over the past two decades. This paper challenges the current consensus that the Rothbarth method is not effective in revealing child gender bias from consumption behavior of adults. It proposes an approach to the Rothbarth model that restricts its application to samples of nuclear households, and employs an index of child gender based on the number of children in the household and related to a specific selective mechanism of discrimination. It demonstrates the effectiveness of this approach with an application to a 2005-06 Ethiopian consumption survey of 21,299 households conducted by Ethiopia's Statistical Authority, covering both urban and rural areas. The paper presents the first clear and extensive evidence of discrimination against girls by all four adult goods employed, and the outcome persists, in various degrees, when reexamined with a lower definition of child age, and with female-headed households. The findings provide support for gender-based policies in child-health and education in Ethiopia.

This paper—a product of the Poverty Reduction and Economic Management(AFTP2) Department, Africa Region—is part of a larger effort in the department to engage in evidece based policy dialogue. Policy Research Working Papers are also posted on the Web at http://econ.worldbank.org. The author may be contacted at fkoohi@levy.org, or through cruggeriladerchi@worldbank.org.

Intrahousehold Inequality and Child Gender Bias in Ethiopia

Feridoon Koohi-Kamali

Intrahousehold Inequality and Child Gender Bias in Ethiopia

Feridoon Koohi-Kamali∗ June, 2008

1-*Introduction*

Child gender bias is often regarded as predominantly an Asian rather than an African phenomenon, though it is unclear whether this is due to a relatively greater absence of women in the job market, a problem common to old Asian cultures. Africa has received far less attention in this regard. Although in general, the greater role of the female labor force in African than Asian agriculture has been well documented, there are likely to be many African countries where this rather generalized comparison does not hold, as the case examined in this study will demonstrate. However, there is also a more general, second reason for the relative absence of studies on child gender bias in Africa, namely the lack of an effective approach for analyzing inequality in intra-household resource allocation due to gender of children. In particular, the Rothbarth model, most suitable for this purpose, has consistently failed to uncover such bias in all its applications undertaken over a long period.

This study applies the approach to the Rothbarth model advocated in Koohi-Kamali (2007) to Ethiopian household budget data and obtains similar results. Moreover, these results are significant beyond Ethiopia, in that the above employed wartime Iranian data in which measures had to be adopted to overcome the problems of involuntary purchases related to various forms of rationing and shortages, essential since the application of the Rothbarth model presupposes voluntary levels of adult goods expenditure. The present study is relatively free from the problems of involuntary expenditure levels, and, in that sense, provides the first extensive evidence for the effectiveness of the method and the approach advocated for its application.

In section 2, I shall discuss the issues required for an effective application of the Rothbarth method to an analysis of child gender bias in intra-household allocations;

∗ Research Scholar, Levy Economics Institute of Bard College, New York, U.S.A., fkoohi@levy.org. This is a background paper for the Programmatic Poverty and Gender Update for Ethiopia (see report "Unleashing the potential of Ethiopian women: trends and options for economic empowerment") which received generous funding from the Multi-donor Trust Fund for the Gender Action Plan Trust Fund (GAP TF) for its gender inequality diagnostics. The author also wishes to express his special thanks to Caterina Ruggeri Laderchi for her support and extensive comments on earlier drafts.

section 3 deals with the data and the types of truncations employed; section 4 examines the results in three separate parts. A final section sums up the findings, and a few of the remaining issues yet to be dealt with.

2-*Inferring Child Gender Bias from Adults' Consumption*

One can think of households as consisting of two demographic groups: adults and children, and although household income is usually due to the earnings of adults, the share of household income available to adults is influenced by the variation in the household demographics. An increase in household size due to arrival of a new child will reduce the extent of the available resources, hence the share of income for adult consumption, since, given unchanged income, the extra cost will have to come from somewhere. Rothbarth (1943) seems to be the first to suggest expenditure on adult goods provides an adult welfare indicator, and if the adults were fully compensated for the loss of income, that amount would offer a measure of cost of children. Crucial for the validity of this method is that the changes in the levels of adult goods be solely due to changes in income, that is, the demographic change does not additionally increase adult goods consumption through the change in the relative 'price' of non-adult compared to adult goods. It should be noted that even if adults were fully compensated for loss of the adult share of income, there might still be re-arrangements in adults' consumption after the demographic change. If such substitution effects were absent, or negligible, then the model offers a sensible method to infer child welfare from adult consumption. The question then would be whether the adult income share can be econometrically identified by the exclusively adults' part of total adult consumption. Such would be the case if one had a priori information on goods known to have such an exclusively characteristic; tobacco, alcohol, or adult clothing are typical examples. Note that the model identifies child welfare indirectly, and the focus of the analysis is on measuring not child but adult welfare. If the fall in that measure is larger when, say, there are more boys than girls in the family, then one can infer that parents as decision-makers are willing to sacrifice more of their living standard for the welfare of boys. Thus, for this model, child consumption is not an informative way to examine child welfare. The method extracts the effect of household income allocated to adults from the total, and thus identifies the intra-household resource allocation sharing-rule between adults and children[1].

Child gender bias is a common problem, yet the most promising method for its analysis, namely the Rothbarth method of inferring child gender inequality from the consumption pattern of the household's adult members, first proposed in Deaton (1987) in application to Cote D'Ivoire[2], has produced little, if any, interest despite strong evidence of bias against girls by welfare outcomes in many countries to which it has been applied over the last two decades[3]. Recently, however, Koohi-Kamali (2007) has demonstrated the problems in these applications, and the effectiveness of the adult goods method in revealing discrimination against girls in household consumption pattern, once

---

[1] The model may be based on the total level of adult goods expenditure as a group to be taken as adult welfare indicator. The identification of such an aggregate group involves hazardous guessing about its sub-groups. It is thus safer to employ easily identified individual adult goods, and the later applications of the method are typically based on such commodities. Moreover, inferring adult welfare from the aggregate group of adults goods comes at a cost, since an additional identification assumption is required to interpret behaviour, namely that different adult goods are affected by changing number of children as if they had only income effects, i.e. substitution effects due to changes in within-group relative prices were absent, see Deaton al et. (1989). In this study, I follow the commonly employed individual commodities version of the model. It should, however, be noted that employing narrow commodity groups can cause problems since goods such as tobacco are not very responsive to changes in income, see Cramer (1969), although evidence suggests this difficulty is less severe for developing countries.

[2] Subsequently published, with an additional application to Thailand, as Deaton (1989).

[3] Deaton (1997) contains references on the countries studied to that date, and China (People's Republic), is first examined in Burgess and Zhuang (2003); the third attempt on Indian data is Case and Deaton (2002). Bhalotra and Attfield (1998), and Gong et al. (2005) are the second attempts with, respectively, rural Pakistani and Chinese data, while Gibson and Rozelle (2004) applies the model to Papua New Guinea. This list is unlikely to be exhaustive. In a new study on gender and intrahousehold inequality in Ethiopia, Kebede (2008) argues that detection of gender bias in consumption of adult goods must be based on a system of demand equations, rather than single equations, in order to allow for price effects because demand may be affected by income changes in one direction, but by price changes in another, thus gender effects obtained from income changes alone, as in Rothbarth's method, may be misleading. This study is based on a system of adult goods equations applied to the Ethiopian Rural Household Survey, a four-round panel survey. Kedebe's tests for gender bias by income, and by price effects separately, indicate statistically significant bias against Ethiopian girls for based on income effects. However, when the income and price effects are considered together to provide a distinctly superior approach, the adverse against girls evidence *disappears*, Kebede (2008. p.23). Kedebe suspects this outcome to be due to the household distributing risk among different demographic groups rather than just one, though considers examining the question "quite beyond the scope" of the study. However, if risk distribution affecting both boys and girls were the explanation, one would expect to find similar results by welfare outcomes in Ethiopia, which is clearly contradicted by evidence, see table 6 below.

these problems are taken into account. There are essentially two major shortcomings in all these earlier applications. First, they ignore a rather important institutional feature of most developing countries, namely the extended family, usually containing adult earners besides the household head and spouse who are likely to influence decision-making on internal resource allocation. The average non-nuclear household size is likely to be significantly larger because of a larger number of adults, and usually greater adult employment. This would violate the assumption underlying the Rathbarth model, which presupposes that expenditure patterns reflect the preferences of the parents as the sole decision-makers[4], see Deaton and Muellbauer (1986), i.e. it is a model of internal allocation in a *nuclear* family. The extended family is a major household type in most developing countries, and in many likely to constitute the principal unit of consumption[5]. An indiscriminate application of the model to all types of household, as in all previous attempts, is likely to prevent the evidence of child gender bias in consumption pattern to reveal itself. Second, the earlier applications assume gender bias is related to the age of children, and are therefore based on indices of child age/gender; yet no hypothesis, or systematic evidence, is available to support the presumption that child gender bias related to the age of children. By contrast, there is quite a plausible hypothesis that such a bias relates to the *number* of children: parents with strong preferences for boys, who have girls early in their fertility cycle, are likely, in the absence of prenatal screening technology, to continue having more children until they meet their targeted sex composition of children, see for example Muhuri and Preston (1991), suggesting unwanted girls are more likely to live in larger households, and be among the older children. Evidence about the presence of such a mechanism has so far come from demographers, usually in the form of correlations between children's proportions of boys

[4]Most of the economic functions of the extended family in developing countries relate to support for adult relatives. Examples of such functions are: transfers to the elderly, protection against unexpected economic shocks such as sickness or unemployment, provision of a viable unit of consumption when individual incomes are low. Although little is known about how these functions relate to intrahousehold allocation, see, however, Attanasio and Rios-Rull (2000), it would be surprising if they did not affect the assumptions of the Rothbarth internal allocation rule.

[5] For example, Lanjouw and Ravallion (1993, table 1) for rural Pakistan contains demographic groups by the number of adults. If we assume there are no extended families in groups with up to three adults, and households with four or more are exclusively of non-nuclear types, then the extended families account for 56% of their sample.

and girls, or, less commonly, the birth-order of the first girl, and the number of children. Although such evidence is not an indication of conditionality of size on the proportion of girls, it is hard to think of causal mechanisms emanating from size. Therefore, in the *absence* of the technology of pre-selection, such evidence would provide some idea about the presence of gender bias. However, pro-boy adult preferences do not always result in additional births because the fertility-stopping rule is unlikely to be homogenous across couples. For some couples, the disadvantage of an additional female birth may outweigh the benefits of an additional male birth. Such couples are likely to stop at a lower parity, even though that decision would be based on son preference[6], see Clark (2000). Note, however, that such an outcome is also consistent with daughter preference. Therefore, as pointed out by Leung (1991), the correlations evidence can indicate the presence of child gender bias, but *not* its direction; a sensible approach for obtaining the evidence for the latter would be through an examination of household internal allocation *conditional* on gender demographics. This provides the motivation for the test of the child number hypothesis of gender bias by the model of adult goods consumption adopted in this study. Based on this, the child gender demographic groups below are, therefore, defined over the *number* of children, not their age.

Provided one takes into account these issues, the Rothbarth model remains rather attractive if the focus of analysis is on child welfare or *inequality among children*. The model is well understood, and there is broad consensus on its effectiveness for estimation of child cost, e.g. Gronau (1988), a cogent critique of equivalence scales models, regards it as ‘the only’ theoretically consistent model among them. Indeed, the case for its application to child gender bias is even stronger since this would not involve obtaining estimates from equalizing the adult goods expenditure of the base and selected families, which is believed to result in the underestimation of the child cost scales, Gorman (1979). This will not be an issue if one is solely concerned with the differential expenditure effects of boys as compared to girls. Finally, since the model’s predictions can be tested on a single cross-section budget survey, it has a relatively modest data requirement. These features compare favorably with, for instance, the very demanding requirements of

[6] Suppose a couple with two girls and no boy most prefers to have two boys and one girl. The couple might regard (an approximate) 50% risk of a third girl sufficiently high to stop having more children.

a version of the cooperative model developed in Browning and Lechene (2001) to analyze the impact of adult inequality on child welfare[7].

I deal with the above two issues by a) confining the samples employed to strictly nuclear type of households, b) examine the effect of child gender by an index based on the number of children in the household. However, age of children may exert some influence on adult goods consumption quite apart from those due to child gender; hence I control separately for age of children. To do so, I employ the following version of the Working-Leser functional form on which almost all previous studies are based (except for a separate gender index here).

$$w_j = \alpha_0 + \alpha_1 \ln\left(\frac{x_h}{n_h}\right) + \eta \ln n_c + \gamma_g \frac{n_g}{n_c} + \sum_{a=1}^{4} \delta_a \frac{n_a}{n_c} + \delta z + \varepsilon \qquad (1)$$

where w_j denote budget share of adult goods j, x_h is household total expenditure , n_h is household size, n_a / n_c indicate proportion of kids in different age groups a over total number of children n_c, n_g / n_c is the proportion of girls in the household and constitutes our child gender index, z is the vector of additional variables, regional dummies; variables specific to the analysis of child gender bias, such as dummies for the mother's age, and her educational level; their interactive terms, etc.; ε a normal error term. This is the standard semi-logarithmic Working-Leser functional form, which could be augmented if there is a curvature effect for the logarithm of per capita total expenditure-in which case a quadratic term for total expenditure can be added to the LHS of (1) giving

$$w_j = \alpha_0 + \alpha_1 \ln\left(\frac{x_h}{n_h}\right) + \alpha_2 \left[\ln\left(\frac{x_h}{n_h}\right)\right]^2 + \eta \ln n_c + \gamma_g \frac{n_g}{n_c} + \sum_{a=1}^{4} \delta_a \frac{n_a}{n_c} + \delta z + \varepsilon \qquad (2)$$

I provide least square estimates by (1) or (2) for each j=4 adult goods in this study, depending on whether there is a significant total expenditure curvature effect on j. All expenditures are on annual basis, and the definition of total expenditure employed

[7] This study demonstrates that such a task requires the abandonment of the assumption of efficient outcomes on which the core cooperative model, see Browning et al. (1994), rests; the introduction of non-co-operative structure 'considerably complicates the theoretical analysis and also makes greater data demands', (p. 5). Indeed, many years of budget surveys are required to distinguish distributional regions, and large number of parameters involved results, for some of the regions, in 'very imprecise estimates' (p.15).

includes imputed rent, but excludes housing investment[8]. (1) and (2) are different from the usual semi-log budget share equation employed in earlier applications of the Rothbarth model to child gender bias in two respects. With the sample restricted to nuclear households, each observation contains two adults, the head and the spouse, so the proportion of adults does not appear above since it is no longer a variable, that is, variation in household size comes entirely from the change in the total number of children across households, hence demographic proportions are defined over n_c rather than n_h. I also note that (1) and (2) employ separate demographic proportions for child age, and child gender, combined into the same indices in earlier studies; with child gender defined over the number of children. I employ five different age groups of children, under 2, 3-6, 7-9, and 10-12 years, omitting those 13-15 as the missing group to avoid collinearity; though I also check my results with age groups under 13. Similarly, there are two gender proportions of children, for boys and girls; the one included above is the proportion of girls. I include, in the vector of variables in z, controls for urban/rural, and for the latter, whether the household resides in a rural area under the safety net system run by the government, and if so, whether in addition the area has a free school feeding program[9]. I also include controls for regions. For the 10 regions of the survey, 9 regional dummies are employed in (1) and (2), with Addis Ababa acting as the missing, reference region.

An issue arising here is whether to estimate equations (1) and (2) for households with positive purchases of adult goods, or over all households, inclusive of those with non-purchase. Household demographics affect whether a good is purchased at all; and, if so, additionally, its amount of purchase. If one is interested in whether girls receive fewer resources than boys, conditional on the household having a positive purchase, then a two-step estimation process is required, with the second stage based on positive adult goods

[8] As a check, this produces average annual budged shares for tobacco, and clothing and footwear of 0.53, and 6.12 respectively, similar to those reported in the latest available Household Income and Consumption Expenditure Survey (HICES) for the 1999/2000 (2001, p. 37, table III.13). However, the average per capita total expenditure, reported separately in HICES 2005-06, differs somewhat from that based on the above definition, and the documentation available to this study cannot shed light on this difference.

[9] The list of rural weredas in safety net regions, some with school feeding programmes, was separately available. This was then matched with the survey regions/weredas to construct safety net and school feeding dummies for the analysis.

observations. By including non-purchase households in the sample, we obtain sharper results that capture both kinds of influences. For this reason, the relevant approach, as in previous applications, is to employ all positive and zero observations together, and it is the one I have adopted in this study.

Deaton (1987) proposed a test of gender bias for the Rothbarth model that provides the evidence for almost all the parametric tests conducted so far. This test represents the effect of differences in child gender-by-age on income (total expenditure) as a ratio obtained from parameter estimates of the Working-Leser types of equations for each adult good, and specifically incorporates child-age estimates[10]. Gender test by this method would represent the effect of the child gender index in (1) and (2) as modified for each child-age group, but would not allow testing for gender bias over all child-age groups except when the age structure effects are all insignificant; and can hence be set equal to zero as a restriction on (1) and (2). To test for the effect of gender on consumption over the total number of children, required by the selective mechanism of gender bias discussed above, the evidence should be in terms of the *direct* influence, that is, across all child-age groups, of the child gender index on adult goods consumption.

Regarding the direct effect, the gender coefficient indicates the amount by which average expenditure share on an adult good is expected to change if a son is replaced by a daughter; holding constant the age structure of the children. More specifically, if adults are less willing to cut their standard of living, as indicated by their consumption of adult goods, when there are more girls in the household, that is, when n_g / n_c increases, then one would expect this proportion to have a positive effect on the budget share of each adult good, i.e. higher the n_g / n_c , relative to that for boys, greater the expenditure on adult good j. Therefore, bias against girls should result in a *positive* sign for this index. One can then choose a significant threshold for the child gender coefficient estimate, and examine whether the reported t-ratio is positive and above the chosen critical value.

[10] The ratios, called *outlay equivalents*, measure the expenditure effect of the additional total expenditure on an adult good, equivalent to that generated by the presence of an additional boy (girl) in a given age group; they are specifically defined to test bias for each child gender-age category.

3-*Data and Sample Truncations*

The data for this study are based on the 2005-06 HICES conducted by the Ethiopian government’s Statistical Authority, consisting of over 21,299 households, and covering the entire country. The samples employed in this study, however, are smaller. The sample selection path I have employed is a result of two main types of truncations. By far the most important is the restriction of the samples to nuclear families. The definition of a nuclear household I employ for sample truncation is household head and the spouse and at least one child under 15 years of age; thus household containing children above that age are excluded. Table 1 shows the percentages for different types of households. Nuclear households, with at least one child, account for 52 % of the total. However, about a third of such nuclear households, accounting for a 17% of the entire survey households, are those with non-biological children of the head or spouse. Moreover, The HICES 2005-6 suggests Ethiopia has a significant orphan children problem. The survey defines these as children with dead parents, or children living in households with absent biological parents. Technically, only the former children qualify as orphans, and they constitute about 12% of all children in the sample, increasing to 31% of all children if the broader survey definition of orphan child is adopted. Some studies suggest that parents discriminate among children by their degree of “genetic relatedness”, resulting in non-biological children receiving poorer treatment than biological ones, see Case, et al. (2000). Examination of this question would introduce additional issues into the analysis of child gender inequality best to set aside in a study concerned mainly with a comparison in the treatment of children by gender in a standard biological parents-children set-up. I have therefore confined the sample employed in this study to the first type of nuclear families, i.e. those with biological children of the head and spouse. This leaves out many important issues affecting child gender bias in Ethiopia that can be analyzed within the current framework of nuclear household once the basic evidence is established, but makes the basic task manageable in a study of this type.

Another type of truncation is intended to remove the adverse influences of families with incomplete fertility. The predominance of households in the early phases of their fertility cycle in the sample does not allow sufficient scope to observe the gender bias in fertility behavior; particularly important for this study as marriage at very early ages is common in Ethiopia, see Pathfinder (2006). Completed fertility tends to be the characteristic of families with more children, that is, those more likely to be closer to the end of their fertility cycle. Undoubtedly the best way to deal with this issue is to confine the samples to those with completed fertility, that is, families with the mother aged above, say, 35. Unfortunately, this would severely reduce the sample size. A compromise employed here is to exclude at least some with mothers at an early phase of their fertility, e.g. mother younger than 20.

Four categories of expenditure appear reasonable candidates for adult goods in Ethiopia: tobacco, coffee, adult clothing, and adult personal services and personal effects, ‘personal services’ for short. Since the latter provides consistently the strongest evidence for child gender bias in Ethiopia, I note that items in this group are made up of shaving-related goods and services, in addition to after-shave, perfumes, hand-bags and wallets, sticks and wig[11]. Table 2 shows the incidence of purchase/non-purchase for each group in the survey, ranging from just under a quarter to well over a third of the household. As such, the percentages of non-purchase are not unlike those expected of some common adult goods; see Subramanian and Deaton (1991) for India, Koohi-Kamali (2007) for Iran. Finally, table 3 gives the mean and the standard deviation of the main variables of equations (1) and (2) for the main, all-country (covering both urban and rural areas) sample of nuclear households consisting solely of the household head, the spouse and their biological, under 15, children.

Child gender has different dimensions worth examining because they are of interest to public policy, or perhaps of particular importance for understanding the issue in the Ethiopian context. In this regard, I shall examine two additional issues below. First is the sensibility of the precise age definition of a child. This is an important issue on its own right, but, in addition, the influence of child labor earnings on internal allocation would be hard to isolate with the model employed here. Moreover, as there may be some child consumption of adult goods at the child-adult age boundary, the evidence with a sample of lower child age definition provides a robustness check on whether the selected

[11] The number of observations on positive purchase of alcohol amount to just over 100 households in the entire sample. Jewellery was also examined, but it seemed an uninformative candidate for an adult good in Ethiopia, perhaps because its expenditure constitutes a form of investment.

commodities constitute suitable adult goods for Ethiopia. For these reasons, I shall repeat the estimation with a sample with child age restricted to 12 or less here. Second, Ethiopia has a very large percentage of female-headed households, FHH henceforth, see Desta al et. (2006). Some studies suggest household budget under mother's rather than father's control improves child welfare. I shall also examine child gender bias with a sample of (nuclear) FHHs.

4-*Results*

I shall discuss the results of this study in three separate parts along the lines discussed in the last section.

4.1-Main Results

The first column of table 4 sums up the main finding of this study with a sample of nuclear household with at least one (biological) child of the household head and spouse, and no restriction on the survey adopted child age definition of <15, that is, the estimated effects of n_g / n_c from (1) and (2) on the budget share of tobacco, coffee, adult clothing, and adult personal services (I shall return to other columns of this table below). The detailed estimates appear, separately for each adult good, in table 5.

The first notable feature of table 4 (1st column) is that the reported estimates are *all positive*, i.e. the expected direction for bias against girls, two (adult services and adult clothing) are significant at 1%, the other two at 5%. Therefore, all four groups of adult goods, in various degrees, suggest the presence of child gender bias in Ethiopian consumption patterns. As to the size of gender effects on consumption, note that the gender estimates appear small, but they are broadly similar to the size of the gender effects indicating discrimination against boys reported by Deaton (1987, LSMS, Table 5) for Cote D'Ivoire for two of the commodities also common to our study, namely adult clothing and tobacco. Moreover, although these effects are small, so are the budget shares of adult goods relative to which these effects should be measured. However, the child gender ratio for girls in (1) and (2) varies between 0-1, and its household-level unit change is 1 over number of children. 1 over the average number of children in the sample is the average value of this unit change, i.e. 1/3.26=0.307 for the sample of table 5. Hence, the percentage change in the budget share of each good, as a result of a unit change in the gender ratio, is obtained from dividing the gender estimate by the mean of the dependent variable multiplied, first by 100, and further again by 0.307. For Table 5 values, a unit change in the child gender ratio result in increases in the budget shares of 19.5% for personal services, 22.1% for adult clothing, 8.2% for coffee, and 7.6% for tobacco.

Next, I turn to the detailed estimates by each adult goods group given in table 5. These tables show reasonable range for the effect of total expenditure on all four adult goods groups. Moreover, while for tobacco and adult clothing, the semi-log functional form captures this effect, for coffee and adult personal services, there is an additionally significant curvature effects for the quadratic value of total expenditure. As for demographics, other than proportion of girls in the family, household size (number of children) affects all four adult goods positively, though insignificantly for tobacco[12]. The proportions of children in different age groups exert both positive and negative effects on adult goods consumption. The significant instances are only in small children, up to 2, for tobacco and adult clothing; for children aged 3-6; for adult personal services, but there is no significant age composition of children at all above age 7.

Urban=1/rural=0 variable (all country sample) is negatively significant for all four adult goods, suggesting urban households have lower consumption of adult goods, similar to Deaton (1987). The rural safety network influences significantly the budget share of personal services positively, and tobacco negatively. The availability of school feeding programs in some areas under safety network tends to affect the budget allocation to tobacco and coffee significantly, and to adult personal services and adult clothing insignificantly. The budget allocations to adult goods are also very significantly affected by the regions in which households live, the largest tends to be SNNP, although their influences cannot easily be summed up as they are not similar across adult goods.

Finally, it may be argued that since child number is employed in both proportion of girls and (logarithm) of household size, and in view of the earlier comments on the correlation between gender proportion and child numbers, the possible residual correlation between these two LH variables of (1) and (2) may have prevented clean

[12] Interpreting the empirical evidence on the ‘puzzling’ direction of the size effect is a matter of some controversy; see Deaton and Paxson (1998). However, it is not clear how important are economies of scale in the context of a model for goods consumed solely by adults.

estimates of child gender effect. The examination of correlation coefficient between the two variables in the sample employed above is informative in this regard; this turns out to be close to zero and insignificant (Pearson C.C.=-0.0107/ sig. prob=0.3426)[13]. This seems to suggest that the values reported for the proportion of girls are exclusively due child gender effect on adult consumption, and provide sensible measure of bias against girls.

I end this section by a brief examination of the correspondence between the above results and welfare outcomes for Ethiopian male and female children. This obviously is critical, as the absence of such correspondence would generate doubts about the findings of our study, whilst its presence would make the econometric findings of no evidence of gender bias in other studies equally doubtful. The two most commonly employed welfare indicators are the child population sex ratio, and differences in school attendance by gender. The sex ratio is supposed to be balanced, except to a limited extent among low age child groups. The unbalanced ratio may be partly due to relative under-recording of births, but pronounced unbalanced sex ratio is an indication of neglect and poorer survival of girls compared to boys, see Kynch and Sen (1983). Schooling is also a major determinant of lifetime chances of children. Table 6 provides the ratio of girls to boys aged 0-14 and the ratio of number of girls' "ever-attended" formal school to that for boys; both obtained from HICES 2005-6 survey- top row for the entire survey, the bottom for the sample employed in table 5. The child (0-14) ratio of number of girls to boys is 0.893 for the entire survey sample, indicating a large gender gap that is hard to explain solely by under-recording. It is, for example, worse than 0.90 reported in Ahmand and Morduch (1993) for the same age group for Bangladesh, a country with some of the worst recorded outcomes for women in the world. School attendance evidence also suggests bias against girls in education. The same applies to the ratios obtained from the sample, bottom row, employed in table 5. There is thus correspondence between our adult goods results on child gender bias, and the welfare outcomes for Ethiopian children.

[13] Similar lack of correlations were found for all the various samples examined later in this study.

4.2-Sensitivity to Child Age Definition

This section examines the effects of child gender on adult consumption with a lower definition of child age than that of 14 employed in the HICES 2005-06. I exclude from the sample of section 4.1 any household containing a child above 12 years of age. We now have four child age groups in (1) and (2), and the missing age group is =<10, leaving only three child age variables in (1) and (2) for 0-2, 3-6, 7-9 years. The child gender effects for this new sample is summarized in table 4, column 2, headed "child <13"; and the detailed results appear in table 7.

Table 4/column 2 indicates that the gender estimates are all positively significant at 1% level. Turning to table 7 for the details, consumption elasticities look reasonable, household size effects are positively significant throughout. Child age composition exerts no significant effect on tobacco, or adult clothing, but there is a significant negative age composition effects by all age groups on coffee, and that of 3-6 years on personal services. Urban/rural location is negative throughout, though insignificant for adult clothing. The safety net dummy tends to affect significantly consumption except for adult clothing. The regional effects, as before, vary in direction, but SNNP tends to have the largest impact.

Overall, the results suggest robustness to the age definition of children employed, and offer some support for the suitability of selected commodities as goods exclusively consumed by adults.

4.3-FHH

The share of FHH in the HICES 2005-06 is 31.4% of the survey households. However, some 20% of the FHH are of nuclear type, although those with biological children constitute a sub-group of just about 10% within it, resulting in a rather small sample size of 442 households[14]. Thus, the influence of FHH on child gender estimates

---

[14] The definition of a FHH adopted above results in 37.1% of the all households surveyed in Tigray, well within the range reported in Desta al et. (2006) of 31-40% for this region. Yet when restricted to nuclear households, they account for only 2% of the total in this region, less than a dozen in numbers. More generally, nuclear observations constitute 52% of the survey observations (11166 nuclear households with children), of which only 4% (442) are FHHs.

with the type of sample employed in this section is unlikely to be clearly revealed. Nonetheless, the results will offer some indication of presence of bias with FHH; given the importance of such household in Ethiopia, even this limited evidence should be of some interest.

Table 4, last column, sums up the child gender effects with the FHH sample. Once again, these are all positive but less significant than those examined in the previous columns; indeed, the effect is insignificant for tobacco. Turning to the detailed given in table 8, one encounters insignificant consumption elasticity estimate for tobacco, and household size effect is weakly significant for personal services only. Moreover, there is only one instance of negatively significant child age effect in the table, for the 7-9 age group, on adult clothing.

Overall, one can say that earlier gender effects are present here in varying degree, but if one expected to observe larger gender effects for FFHs because they tend to be poor, there is certainly no evidence here to support it, which is not to say that such evidence would not be present with a larger FFH sample, inclusive of households with non-biological children, than the one employed in this section. However, if one were willing to accept that, relative to all nuclear households (table 4/1st column), FHHs display lower evidence of child gender effect, this would imply that women's control of family budget improves child welfare, an outcome consistent with noncooperative bargaining approach, see Lundberg and Pollack (1993), and backed with evidence by that approach for Africa; see Hoddinott and Haddad (1995)[15].

5-*Conclusion*

This study reinforces the approach adopted in Koohi-Kamli (2007) to the application of the Rothbarth model of intra-household allocation to child gender bias and the evidence provided for the presence of child gender bias in adult consumption patterns is, not surprisingly, more extensive for Ethiopia. I provided estimates for the effect of proportion of girls, having controlled for the effects of child number and child age, in the household on its consumption of adult goods, based on a sample of nuclear households

[15] The latter provides empirical support that enhancement of women's income can reduce intrahousehold inequality partly through expenditure on goods important to welfare of children, e.g. food compared to tobacco.

with biological children of the head and spouse. There is evidence of bias against girls by all four adult goods employed in this study. The group of adult personal services provides the strongest, and the most consistent evidence of discrimination in Ethiopia. In addition, evidence by other adult goods of this study is notable for suggesting similar effects, though these are typically not as strong. Moreover, the absence of correlation between size (number of children) and proportion of girls seem to suggest that the approach taken has succeeded to isolate the specifically child gender effect on adult consumption. I also examined the Ethiopian child gender effects in two different dimensions, with regard to changing the age definition of a child, with respect to FHH. The results are robust to the child age definition, and broadly similar with a sample of FHHs, though the outcome for the latter should be regarded with care given the size of the sample employed. Finally, it must be emphasized that many important issues relevant to child gender bias in Ethiopia have been left out. Perhaps the most obvious, and possibly important, is whether Ethiopian girls living with non-biological parents face more severe discrimination than those in this study. Moreover, the investigation of this question assumes added urgency in Ethiopia given the large percentage of Ethiopian orphan children, a category overlapping with non-biological children, but quite distinct from it. Both issues are very possibly further influenced by FHH, given the importance of this kind of household in Ethiopia. With the relatively large share of nuclear households with non-biological head/spouse in the current survey, around 17.6% of households, see table 1, such an examination could uncover additional dimensions of intra-household gender bias based on their degree of child-parents genetic link about which very little is known, in Ethiopia or elsewhere.

Table 1- Percentage distribution of types of household in the Ethiopian 2005-06 HICES	
Extended households	34.7% (7401)
Nuclear/biological children of head-spouse	34.3% (7298)
Nuclear/ non-biological children of head-sp	17.6% (3751)
Nuclear/other types (one person, etc.)	13.4% (2849)
All Nuclear Types	65.3% (13898)
All Household Types	100% (21299)

Table 2- Survey incidence of purchase/non-purchase of selected adult goods	
Adult Personal effects and services*	24.2% (7606)
Adult Clothing	35.2% (5656)
Coffee	26.2% (5222)
Tobacco	36.5% (7872)

*mostly shaving-related items and services, perfume, hand bag, wallets, sticks, wig, etc.

Table 3-Mean and St. Dev. of the principle Variables-the main All-Country Sample		
Variables:	Mean	Stand. Deviation
Ad. Personal Serv. bud.share	0.00390	0.01110
Adult Clothing budget share	0.00226	0.01680
Coffee budget share	0.01278	0.04574
Tobacco budget share	0.00594	0.02044
Log. Of total expenditure	7.20124	0.60212
Log. of total expenditure Sq.	52.22039	8.95880
Household size	1.01038	0.61086
Proportion of Children 0_2	0.22832	0.31236
Proportion of Children 3_6	0.24911	0.27834
Proportion of Children 7_9	0.14938	0.20215
Proportion of Children 10_12	0.10646	0.17028
Proportion of Girls	0.47541	0.33653
Urban/Rural Dummy	0.46641	0.49890
Safety net Dummy	0.39899	0.48972
school feed Dummy	0.17592	0.38078
Regional Dummies:		
1-Tigray	0.06401	0.24478
2-Affar	0.04094	0.19816
3-Amhara	0.16781	0.37372
4-Oromiya	0.23726	0.42543
5-Somali	0.05957	0.23670
6-Benishangul	0.04715	0.21197
7-SNNP	0.16477	0.37099
8-Harari	0.03283	0.17819
9-Dire Dawa	0.03270	0.17786
Sample size	7890 housholds	

Table 4-Effects of child gender Bias on pattern of adult goods Consumption (Absolute t-ratios in brackets)			
	Child age<15	Child age<13	FHH
Ad. Prsnal Ser.	0.00248 (6.02)	0.00160 (4.01)	0.00513 (3.16)
Adult Clothing	0.00163 (2.62)	0.00122 (2.24)	0.00379 (2.22)
Coffee	0.00343 (2.20)	0.00448 (3.03)	0.01260 (1.77)
Tobacco	0.00147 (2.16)	0.00215 (3.10)	0.00159 (1.00)

Table 5-Child gender bias effect on adult goods (Absolute t-ratios in brackets)/***Child<=14***				
Goods:	Personal services	Adult clothing	Coffee	Tobacco
Constant	-0.05518(4.48)	-0.00212(0.73)	-0.09498(2.28)	0.01161(3.52)
Ln. totx	0.01515(4.60)	0.00073(2.04)	0.02707(2.44)	-0.00099(2.43)
Ln.totx2	-0.00098(4.44)	-	-0.00186(2.49)	-
Hhdsize	0.00077(2.76)	0.00136(3.24)	0.00410(3.50)	0.00029(0.65)
Ch0_2	-0.00039(0.41)	-0.00228(1.94)	-0.00050(0.22)	0.00189(1.68)
Ch3_6	-0.00282(3.03)	-0.00144(1.30)	0.00027(0.12)	0.00151(1.32)
Ch7_9	-0.00116(1.35)	-0.00202(1.42)	-0.00083(0.33)	0.00036(0.27)
Ch10_12	0.00085(0.70)	-0.00103(0.74)	0.00397(1.31)	0.00130(0.71)
Girls prp	0.00248(6.02)	0.00163(2.62)	0.00343(2.20)	0.00147(2.16)
Urb/rur	-0.00127(2.66)	-0.00180(3.09)	-0.00803(5.56)	-0.00322(5.89)
Safenet	0.00233(4.27)	0.00029(0.48)	0.00176(1.23)	-0.00567(8.55)
Sch. Fed	-0.00040(0.68)	0.00149(1.47)	-0.00925(3.66)	0.00232(2.41)
Tigray	-0.00048(0.58)	-0.00114(0.65)	-0.00065(0.16)	-0.00288(2.58)
Affar	0.00325(2.58)	-0.00562(4.17)	0.00038(0.11)	0.00048(0.32)
Amhara	-0.00062(1.18)	0.00068(0.70)	-0.01192(5.01)	-0.00343(3.09)
Oromiya	0.00030(0.62)	-0.00398(4.32)	0.00928(5.11)	0.00071(0.67)
Somali	-0.01320(1.90)	-0.00689(5.00)	-0.03959(1.69)	0.00035(0.27)
Benish.	0.00060(0.82)	-0.00374(3.55)	-0.00832(2.33)	-0.00069(0.44)
SNNP	-0.00008(0.11)	-0.00144(1.66)	0.06280(24.38)	0.01473(14.61)
Harari	0.00154(1.59)	-0.00580(3.17)	-0.01175(3.10)	0.00130(0.88)
DireDw.	0.00370(3.50)	-0.00254(1.53)	-0.01325(3.37)	-0.00101(0.59)
R^2	0.0318	0.0171	0.2490	0.1116
RMSE	0.01183	0.01670	0.03976	0.01930
Sample	7889	7889	7889	7889
w^-	0.00390	0.00226	0.01278	0.00594

Table 6- Sex and Schooling ratio of Girls to Boys Aged 0-14, HICES 2005-06		
	No. of Girls / No. of Boys	Girls at school /Boys at school
All Ethiopia Sample*	0.895	0.807
Nuclear sample of Table 5	0.902	0.807

* Inclusive of number of non-biological children of the household head or spouse.

Table 7-Child gender bias effect on adult goods (Absolute t-ratios in brackets)/***Child<=12***				
	Personal services	Adult clothing	Coffee	Tobacco
Constant	-0.05757(4.12)	-0.00593(1.81)	-0.09443(1.99)	0.01610(4.58)
Ln. totx	0.01606(4.28)	0.00075(2.02)	0.02852(2.24)	-0.00131(2.89)
Ln.totx2	-0.00105(4.14)	-	-0.00198(2.31)	-
Hhdsize	0.00011(0.35)	0.00104(2.26)	0.00295(2.43)	0.00173(3.31)
Ch0_2	-0.00011(0.11)	0.00146(0.99)	-0.00436(1.68)	-0.00046(0.40)
Ch3_6	-0.00161(2.10)	0.00218(1.40)	-0.00673(2.61)	-0.00072(0.61)
Ch7_9	-0.00008(0.09)	0.00099(0.84)	-0.00487(1.95)	-0.00051(0.41)
Girls prp	0.00160(4.01)	0.00122(2.24)	0.00448(3.03)	0.00215(3.10)
Urb/rur	-0.00096(1.86)	-0.00088(0.83)	-0.00808(5.17)	-0.00393(6.44)
Safenet	0.00285(4.31)	0.00041(0.47)	0.00276(1.83)	-0.00581(7.86)
Sch. Fed	0.00012(0.18)	0.00181(1.49)	0.00316(0.89)	0.00266(2.54)
Tigray	-0.00148(1.83)	0.00041(0.25)	-0.00418(0.97)	-0.00367(1.31)
Affar	0.00510(3.82)	-0.00472(3.48)	-0.01023(2.70)	0.00384(1.48)
Amhara	-0.00017(0.21)	0.00106(0.93)	-0.01352(5.32)	-0.00199(0.87)
Oromiya	0.00051(0.92)	-0.00363(3.74)	0.01005(4.72)	0.00018(0.14)
Somali	-0.01097(1.50)	-0.00474(3.91)	-0.03001(1.17)	0.00182(0.81)
Benish.	0.00227(1.91)	-0.00253(1.53)	-0.00948(2.32)	0.00075(0.52)
SNNP	0.00034(0.47)	-0.00087(0.94)	0.05322(16.23)	0.01444(12.34)
Harari	0.00139(1.27)	-0.00451(2.85)	-0.01379(3.38)	0.00326(1.13)
DireDw.	0.00904(4.23)	-0.00239(1.30)	-0.01545(3.68)	-0.00372(0.81)
R^2	0.0326	0.0202	0.2411	0.1136
RMSE	0.01203	0.01586	0.04064	0.02000
Sample	6964	6964	6964	6964
w^-	0.00393	0.00220	0.01333	0.00614

Table 8-Child gender bias effect on adult goods (Absolute t-ratios in brackets)/***Female H.H.***				
	Personal services	Adult clothing	Coffee	Tobacco
Constant	-0.09749(2.07)	0.01771(2.36)	-0.28568(1.46)	-0.00227(0.29)
Ln. totx	0.02541(2.03)	-0.00181(2.01)	0.08941(1.71)	0.00097(1.04)
Ln.totx2	-0.00163(1.94)	-	-0.00581(1.66)	-
Hhdsize	0.00271(1.69)	-0.00097(0.72)	0.00652(1.04)	0.00151(1.28)
Ch0_2	0.00068(0.30)	-0.00013(0.03)	-0.00651(0.47)	-0.00045(0.18)
Ch3_6	-0.00183(0.80)	-0.00153(0.81)	-0.02679(1.38)	-0.00213(0.83)
Ch7_9	0.00351(0.74)	-0.01274(1.80)	-0.00358(0.30)	-0.00031(0.10)
Ch10_12	-0.00336(0.98)	0.00208(0.32)	0.00604(0.42)	-0.00467(1.21)
Girls prp	0.00513(3.16)	0.00379(2.22)	0.01260(1.77)	0.00159(1.00)
Urb/rur	-0.00290(1.10)	-0.00513(1.77)	-0.06993(6.45)	-0.00497(1.93)
Safenet	0.00999(2.60)	-0.00290(1.33)	0.00901(0.96)	-0.00239(0.91)
Sch. Fed	-0.00408(0.98)	0.00306(1.09)	-0.02854(2.32)	0.00506(1.03)
Tigray	-0.01174(2.04)	-0.00054(0.18)	0.00298(0.19)	-0.00397(1.25)
Affar	-0.01963(2.33)	-0.00157(0.36)	-0.04737(2.07)	-0.00835(1.78)
Amhara	0.00027(0.14)	-0.00119(0.61)	-0.05233(2.30)	-0.00647(0.95)
Oromiya	-0.00126(0.79)	-0.00249(1.55)	0.00021(0.03)	0.00434(2.51)
Somali	-0.00320(0.88)	-0.00542(1.56)	-0.00847(0.63)	-0.00549(1.39)
Benish.	-0.01661(1.29)	-0.00148(0.36)	-0.02474(0.73)	-0.00361(0.64)
SNNP	-0.00429(1.05)	0.00325(1.04)	0.03998(3.57)	0.00557(1.65)
Harari	-0.00088(0.24)	0.00101(0.22)	-0.01696(1.19)	0.00055(0.15)
DireDw.	0.00027(0.10)	-0.00149(0.55)	-0.09384(3.14)	-0.00474(0.62)
R^2	0.2431	0.1037	0.3082	0.1554
RMSE	0.01023	0.01073	0.04298	0.01139
Sample	433	433	433	433
w^-	0.00380	0.00163	0.00817	0.00366

Bibliography:

Ahmand, A. and J. Morduch (1993), "Identyfing Sex Bias in the Allocation of Household Resources: Evidence from Linked Household Surveys from Bangladesh", *Harvard Institute of Economic Research Discussion Paper* No. 1636.

Attanasio O., and J. Rios-Rull (2000), "Consumption smoothing in island economies: Can public insurance reduce welfare?", *European Economic Review*, **44**:1225-58.

Bhalotra, S. and C. Attfield (1998), "Intrahousehold Resource Allocation in Rural Pakistan: A Semiparametric Analysis, *Journal of Applied Econometrics,* **13**: 463-480.

Browning M. and , F. Bourguignon, P. Chiappori, and V. Lechene (1994), "Income and outcomes: a structural model of intrahousehold allocation", *Journal of Political Economy* , **102(6)**: 1067-96.

Browning, M and V. Lechene (2001), "Caring and Sharing: Tests Between Alternative Models of Intra-household Allocation", Discussion paper **01-07**, *Department of Economics Oxford University and Institute of Economics University of Copenhagen*.

Burgess, R. and J. Zhuang (2003), "Modernisation and Son Preference", *STICERD*, Development Economics Discussion Paper No. 29, *London School of Economics*.

Case A. and A. Deaton (2002), "Consumption, health, gender and poverty", *Research Program in Development Economics*, Princeton University.

Case, A., I. Lin, and S. McLanahan (2000), "How Hungry Is the Selfish Gene?", *Economic Journal*, **110 (Oct.)**:781-804.

Clark, A. (2000), "Son Preference and Sex Composition of Children: Evidence From India", *Demography*, **3(1)**: 95-108.

Cramer, J.S. (1969), *Empirical Econometrics,* Amsterdam: North-Holland.

Deaton, A. (1987), "The allocation of goods within the household: adults, children, and gender", *Living Standard Measurement Unit, The World Bank*; Research Program in Development Studies, Priceton University.

Deaton, A. (1989), "Looking for boys-girls discrimination in household expenditure data", *World Bank Economic Review*, 3: 1-15.

Deaton, A. and J. Muellbauer (1986), "On Measuring Child Costs: With Application to Poor Countries", *Journal of Political Economy*, **94(4)**: 720-744.

Deaton, A. and C. Paxson (1998), "Economy of scale, household size, and the demand for food", *Journal of Political Economy*, **106(5)**: 897-930.

Deaton, A., J. Ruiz-Castillo, and D. Thomas (1989), “The influence of Household Composition on Household Expenditure Patterns”, *Journal of Political Economy*, **97(1)** :179-200.

Desta, M., G. Haddis, and S. Atakelt (2006), *Female-Headed Households and Livelihood Intervention in Four Selected Weredas in Tigray, Ethiopia*, Report No. **44**, Drylands Coordination Group, Addis Ababa.

Federal Democratic Republic of Ethiopia (2001), *Report on The 1999/2000 Household Income, Consumption, and Expenditure*, Addis Ababa: General Statistical Authority.

Gibson, J. and S. Rozelle (2004), “Is it Better to Be a Boy? A Disaggregated Outlay Equivalent Analysis of Gender Bias in Papua New Guinea”, *Journal of Development Studies*, **40(4)**: 115-136.

Gong, X, A. von Soest, and P. Zhang (2005), “The Effects of Gender of Children on Expenditure Patterns in Rural China: A Semiparametric Analysis”, *Journal of Applied Econometrics*, **20**: 509-527.

Gorman, W.M. (1976), ‘Tricks With Utility Functions’, in (ed.s) Artis M. and A.R. Nobay, *Essays in Economic Analysis*, pp. 211-43, Cambridge: Cambridge University Press.

Gronau, R. (1988),’Consumption Technology and the Intra-family Distribution of Resources: Adult Equivalent Scales Reexamined’, *Journal of Political Economy*, **69(6)**: 1183-1205.

Haddinot, J. and L. Haddad (1995), “Does Female Income-Share Influence Household Expenditure? Evidence from Cote D’Ivoire”, *Oxford Bulletin of Economics and Statistics*, **57(1)**: 77-96.

Kebede, B (2008), “Intrahousehold Allocation in Rural Ethiopia: A Demand System Approach”, *Review of Income and Wealth*, **54(1)**: 1-26.

Koohi-Kamali, F. (2007), “Robust Detection of Child Gender Bias from Adults Consumption Patterns: Tests Based on an Iranian Budget Survey”, paper presented at MENA chief economist series, World Bank.

Kynch, J, and A.K. Sen (1983), “Indian women: well-being and Survival”, *Cambridge Journal of Economics*, **7(3/4)**: 363-380.

Lanjouw, P. and M. Ravallion (1993),”Are Larger Households Really Poorer?”, *Policy Research Department*, Washington: World Bank.

Leung, S.F. (1991), 'A Stochastic Dynamic Analysis of Parental Sex Preferences and Fertility', *Quarterly Journal of Economics*, **Nov**.: 1063-1088.

Lundberg, S and R. Pollak (1993), "Separate Spheres Bargaining and the Marriage Market", *Journal of Political Economy*, **101(6)**: 988-1010.

Muhuri, P. and S. Preston (1991), "Effects of Family Composition on Mortality Differentials by Sex Among Children in Matlab, Bangladesh", *Population and Development Review*, **13 (3)**: 415-434.

Pathfinder International (2006), *Report on Causes and Consequences of Early Marriage in Amhara Region*, Addis Ababa.

Rothbarth, E. (1943), "Note on a Method of Determining Equivalent Income for Families of Different Composition", App.4, *War-time Pattern of Saving and Spending*, by Charles Madge, Cambridge:Cam. U.P.

Subramanian, S. and A. Deaton, (1991), "Gender Effects in Indian Consumption Patterns", *Sarvekshana*, **14**: 1-12.