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# Gender bias in households' educational expenditures: Does the stage of schooling matter?

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ABSTRACT

Gender gaps in educational outcomes still exist, especially in Sub-Saharan Africa. This incidence could be attributed to an uneven allocation of household resources towards the schooling of boys and girls. Utilising the household level data from the latest wave of the Ghana Living Standards Survey, the paper sheds light on gender bias in households' educational expenditures using a 'Hurdle or Two-Part Model' estimation strategy. The two-part model unpacks the key sources of gender bias in household's expenditure allocations. A number of interesting findings emerge: The study established a significant pro-male bias in both the enrollment decision and the conditional expenditure decision among the cohort of individuals in the post-secondary schooling age while only the former source of bias is present in the senior-secondary schooling age cohort. Strikingly, however, no gender bias is found in the positive expenditure decision for boys and girls belonging to the basic education school-going age cohort, even though a pro-male bias operates in the conditional educational expenditure decision for children in the primary school-going age group. Contrary to earlier findings, we find a pro-female bias in a household's decision of how much to spend conditional upon enrolling boys and girls for the cohort of children in the junior secondary schooling age. These findings have important implications for policy action.

## 1. Introduction

After more than a decade of the global call for gender parity in access to education, gender gaps in educational outcomes – a reflection of unequal access to education – still exist, both globally and in Sub-Saharan Africa (SSA), in particular. The SSA region has one of the highest gender gaps in educational outcomes in the world with a gender parity index – i.e. the ratio of female to male literacy rates – of 0.74 in 2011(UNESCO, 2013). In Ghana, for example, an important gap still exists between men and women in terms of literacy, although the disparities have waned over time. Performance in overall adult literacy rate in Ghana have been less dramatic over the years: between 1999 and 2013, in particular, Ghana's adult literacy rate has increased from about 50% in 1999 to 56.3% in 2013 with the gender gap in adult literacy rate remaining largely unchanged over the same period (see Fig. 1). In 2013, the adult literacy rate for males is about 20 percentage points higher than that of their female counterparts (Ghana Statistical Service (GSS), 2014) and this is not very different from what was observed seven years ago.

A plausible culprit for the persistent gap in literacy rates among males and females, in spite of the implementation of numerous educational sector programmes[1] with the goal of combating gender differential treatments in educational access, is the continual existence of gender discrimination in household's educational expenditure allocations. Scarcity of economic resources often leads to gender discrimination in intra-household allocation of resources and this bias largely disfavors females. Extant literature have provided some evidence on gender bias in intra-household allocation of resources (see Deaton, 1989; Gong, Soest van, & Zhang, 2005), albeit only a few of such studies investigate differential treatments in household's educational expenditure (Aslam and Kingdon, 2008; Kingdon, 2005; Lancaster, Maitra, & Ray, 2003; Subramanian and Deaton, 1990, 1991;

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[1] In Ghana, educational sector policies/programmes such as the free compulsory universal basic education (FCUBE), the school feeding programme, the capitation grant programme were introduced with the ultimate goal of boosting child school participation, especially at the basic education level.

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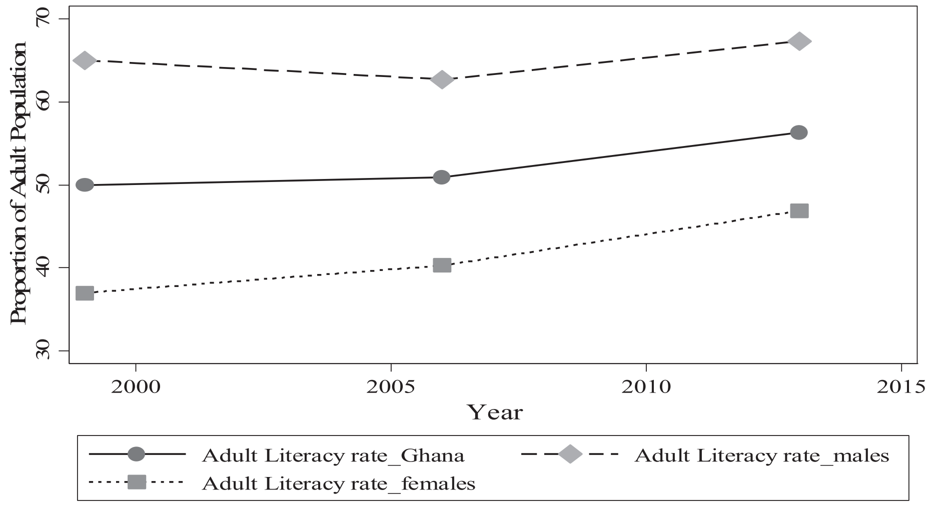


Source: Ghana Statistical Service (GSS) (2000; 2008; 2014)

**Fig. 1.** Trends in Adult Literacy Rate in Ghana, 1999–2013, by Gender. Source: Ghana Statistical Service (GSS) (2000, 2008, 2014).

Subramanian, 1995). Much of the literature on gender bias in intra-household educational expenditure allocation do not focus on countries in SSA[2] even though SSA appears to be the region with the highest gender gaps in educational outcomes.

The current study therefore fills an important gap in the literature on gender bias in educational expenditure allocation using a recent household survey data set from Ghana. More specifically, this paper makes the following contributions to the literature: First, we examine the drivers of households' educational expenditures in order to provide an in-depth understanding on households' demand for education. This approach is based on the fact that households' educational expenditure allocations offers an important opportunity to assess their true demand for education, hence households' preferences towards the provision of educational opportunities for their children (Qian and Smyth, 2011). Second, and probably the most important, the study explores the possibility of a gender bias in the educational expenditure allocations of households; a fact that could plausibly explain the persistent gap in educational outcomes between males and females. In this vein, we exploit the important property of the Hurdle or two-tiered model to unravel the key sources of gender bias in households' educational expenditure allocations. Lastly, we provide additional evidence on the weakness of the conventional 'Engel curve' methodology in detecting gender-differentiated treatment in intra-household allocation of resources even where such gender biases are strongly expected.

The remainder of the paper proceeds as follows: Section 2 presents an overview of related studies while Section 3 discusses the model, empirical estimation strategy and data. The empirical results of the paper are presented in Section 4 while Section 5 concludes the paper.

## 2. Overview of related studies

A significant body of literature has examined the drivers of households' demand for education by focusing on educational outcomes such as child school enrolment and/or educational attainment. The evidence thereof points largely to the importance of family background in children's educational attainment or enrolment (see Connelly and Zheng, 2003; Glick and Sahn, 2000; Iddrisu, Danquah, and Quartey, 2017a; Iddrisu, 2014; Lloyd and Blanc, 1996; Rolleston, 2011; Sackey, 2007; Zimmerman, 2001). For example, the positive and significant effect of parental educational attainment on children's schooling is, by now, well established in the literature (see Binder, 1998). Using a 1988 Chinese household survey data, Knight and Shi (1996) established that an individual's educational attainment depends on that of their parents and that father's educational attainment is more important than that of mother's in explaining children's educational achievement. Similarly, using various household survey data sets from China, Broaded and Liu (1996), Zhou, Moen, and Tuma (1998), Connelly and Zheng (2003) and Nielsen, Nyland, Nyland, Smyth, and Zhang (2006) provided pervasive evidence on the importance of parental educational attainment in children's educational achievement. Several studies have also demonstrated the importance of household income in children's educational outcomes (see Al-Qudsi, 2003; Clark-Kauffman, Duncan, & Morris, 2003; Blanden and Gregg, 2004; Aakvik, Salvanes, & Vaage, 2005; Iddrisu et al., 2017a).

Sackey (2007), Rolleston (2011) and Iddrisu et al. (2017a) are among the very few studies on Ghana that have sought to provide evidence on the importance of family background in children's educational access or attainment. Using three waves of the Ghana Living Standards Survey (3, 4, and 5), Rolleston (2011), for instance, examined, in part, the role of welfare and other aspects of economic privilege in a child's school attendance and progression in Ghana. The author found that household welfare, the gender of the child, and parent's educational attainment significantly influence a child's ever-enrolment with the gender effect being in favor of males. Similarly, Iddrisu et al. (2017a) showed that family resources such as parental education and household income crucially determines children's school participation. In particular, the authors observed that household income does not significantly influence entry into primary school whereas children's completion of primary school depends significantly on household income. Gender differences in school participation was also observed but only with regard to enrolment in secondary school.

In spite of the important contribution that these studies have made to our understanding of the drivers of households' demand for education, they are however limited in their attempt to provide a clear-cut evidence on households' educational preferences. Precisely, by using measures of educational outcomes/output such as children's educational attainment, these studies inadequately capture households' demand for education since a child's level of education is determined partly by the child's personal characteristics such as his/her innate

[2] Ogundari and Abdulai, (2014) for example, analysed the determinants of households' education and health expenditures using a Nigerian household survey data set. The authors, however, did not provide evidence on gender bias in households' educational expenditures.

abilities. Thus, by focusing on educational outcomes, these studies only partially capture households' desire to educate their children (Qian and Smyth, 2011).

Against this backdrop, and in an attempt to meaningfully investigate households' preferences for child schooling, literature on the pattern of households' educational expenditures have emerged. Examples include, Glewwe and Patrinos (1999), Tansel and Bircan (2006), Aslam and Kingdon (2008), and Iddrisu, Danquah, and Quartey (2017b). The findings emerging from this strand of literature suggests, broadly, that household resources including financial and human resources have a significant effect on households' educational expenditures. Specifically, households with higher incomes and better-educated parents spend relatively more on child schooling. For example, Glewwe and Patrinos (1999) maintained that households' willingness to spend on education increases as the income of the household increases, and there is a stronger tendency for households in urban areas to spend more resources in educating their children relative to rural households. This finding is consistent with that of Tansel and Bircan (2006) and Qian and Smyth (2011). Ogundari and Abdulai (2014), using a household survey data from Nigeria, found that household income, household size and the level of education of the household head positively and significantly drive households' decisions on whether to spend and on how much to spend on education. As well, they observe that, relative to male-headed households, female-headed households tend to spend more on the education of household members.

In parallel, there is an important body of literature which seeks to examine the presence a gender-biased investment in child schooling (see Chaudhuri and Roy, 2006; Kingdon, 2005; Li and Tsang, 2003; Lancaster, Maitra, & Ray, 2008). Gender discrimination in household expenditure on child schooling against girls is broadly highlighted in these studies. For instance, using household- and individual-level data derived from the Pakistan Integrated Household Survey, 2001/02, Aslam and Kingdon (2008) found the presence of pro-male biases in both the enrolment decision as well as the decision of how much to spend conditional on enrolment for children in the middle and secondary school ages. However, for children in the primary school age-group, the study established the presence of a pro-male bias only in the decision of whether to enroll sons and daughters in school. Likewise, Lancaster et al. (2008) and Himaz (2009) found evidence in support of a significant gender differential treatment, largely in favor of males, in households' educational expenditure allocations in India. These studies corroborates earlier evidence provided by Gong et al. (2005) for China. More recently, studies by Masterson (2012) for Paraguay and Saha (2013) for India corroborates earlier findings on the existence of a significant gender bias in favor of boys in intra-household educational expenses.

The present literature on households' educational expenditures on child schooling and its variation by the gender of the child reveals the relative paucity of such studies in respect of countries in SSA and Ghana, in particular. Thus, an attempt to investigate the drivers of households' educational expenditures and its differential, in terms of the gender of the child, would significantly contribute to the literature on households' demand for education. The current study makes an important contribution to the literature on households' demand for education in the following ways: First, we examine the drivers of households' educational expenditures in order to provide an in-depth understanding on households' demand for education. This approach is based on the fact that households' educational expenditure allocations offers an important opportunity to assess their true demand for education, hence households' preferences towards the provision of educational opportunities for their children (Qian and Smyth, 2011). Second, and perhaps the most important, the study explores the likelihood of a gender bias in the educational expenditure allocations of households; a fact that could possibly explain the insistent gap in educational outcomes between males and females. In this vein, we exploit the important property of the Hurdle or two-tiered model to unravel the key sources of gender bias in households' educational expenditure allocations. Lastly, following the precedent of Aslam and Kingdon (2008), we provide additional evidence on the weakness of the conventional 'Engel curve' methodology in detecting gender-differentiated treatment in intra-household allocation of resources even where such gender biases are strongly expected.

## 3. Model, empirical estimation strategy and data

### 3.1. Model and estimation strategy

Extant studies that sought to detect gender bias in household expenditures have commonly utilized the Engel curve (EC) methodology (see Deaton, 1989; Chaudhuri and Roy, 2006; Lancaster et al., 2008; Aslam and Kingdon, 2008). The suitability of the EC approach have however been called to question given that it has often failed to detect biases even in cases where such biases are strongly expected to exist. Consequently, in our attempt to more meaningfully provide an understanding of gender bias in intra-household expenditure allocation, we model households' educational expenditure allocation in a two-step process (see Kingdon, 2005; Aslam and Kingdon, 2008): (1) the household's decision on whether to spend anything on a child's education (the zero versus positive expenditure decision) – the 'binary decision', and (2) the household's decision of *how much* to spend conditional on spending a positive amount – the 'conditional expenditure decision'. This process is estimated using the Hurdle or the 'two-part' model estimation strategy (see Supplementary online material, ***Model and Estimation techniques*** for a detailed discussion on the rationale behind the application of the Hurdle model in this paper and a description of the salient aspects of the technique).

Thus, the empirical analysis in this paper would be carried out within the framework of the Hurdle model. The Hurdle model allows for an in-depth examination of the correlates of households' expenditures and more importantly, for the examination of gender differences in households' expenditures. In order to test the relative soundness of the Hurdle model in detecting gender biases associated with household spending, we estimate as well an unconditional Ordinary Least Squares (OLS) (conventional Engel curve) equation of the budget share of education[3]. Specifically, therefore, the paper estimates: (i) A Probit equation of the binary decision of whether or not the budget share of education is positive; (ii) A conditional OLS equation of the logarithm of budget share of education; and (iii) an unconditional OLS (conventional Engel curve) equation of the budget share of education. The estimations in this paper are conducted using household-level data sets for the full (Ghana) sample and for a sub-sample of rural and urban households.

To detect gender bias in households' educational expenditure decisions, we include the proportion of household members in 16 age-gender categories.[4] That is, for both males and females, we classify each household member into one of eight (8) distinct age groups, namely; 0–1 year, 2–5 years, 6–12 years, 13–15 years, 16–18 years, 19–24 years, 25–60 years and above 60 years. The choice of these age groups, especially for ages below 25 years is largely driven by the current

[3] See Aslam and Kingdon (2008) for the theoretical exposition of the conventional Engel curve model.

[4] The 16 age-gender categories are individual dummy variables that capture different age-gender groups: F0to1 indicate females in the 0 to 1 year age group; F2to5 represent females in the 2 to 5 years age group; F6to12 indicate females in the 6 to 12 years age group; F13to15 represent females in the 13 to 15 years age group; F16to18 represent females in the 16 to 18 years age group; F19to24 represent females in the 19 to 24 years age group; F25to60 represent females in the 25 to 60 years age group and Fabove60 represent females in the 'beyond 60 years' age group. Similar age-group dummies are computed for males as well resulting in 16 age-gender dummies.

structure of Ghana's educational system (see Iddrisu et al., 2017a; for a discussion of the Ghanaian education system). Formal education in Ghana begins with 2 years of Kindergarten, followed by 6 years of primary education, and then by 3 years of Junior High School (JHS) education. Upon completion of JHS successfully, candidates are then enrolled into another 3 years of Senior High School (SHS) education, before progressing to the tertiary level of schooling. The first phase (2 year Kindergarten) of the Ghanaian educational system largely corresponds with children in the 2–5 years age group, while the second, third, forth, and fifth phases of the educational system in Ghana corresponds, generally, to the 6–12 years, 13–15 years, 16–18 years and 19–24 years age groups respectively. Now, we examine the presence of gender-bias in households' educational expenditure decisions by focusing on the differences in the marginal effects of males and females age-group dummies for the following age-groups: primary school-going age cohort (6–12 years), junior secondary school-going age cohort (13–15 years), senior secondary school-going age cohort (16–18 years) and post-secondary school-going age cohort (19–24 years).

### 3.2. Data

This paper uses household-level data drawn from the latest wave of the Ghana Living Standards Survey (henceforth GLSS 6) conducted in 2012–2013 by the Ghana Statistical Service (GSS). The GLSS 6 contains information on households' total educational expenditures per annum, making it useful for the examination of the pattern of households' educational expenditures and their variation by the gender of the child. Given that any child aged *2 years or older* can be enrolled in school in Ghana, we fit the equations for only households with at least one child belonging to the 2–24 years age cohort. This reduces the sample to 12,998 households from 16,772 households (see Supplementary online material, *Data and Descriptive Statistics* for a detailed overview of the GLSS data set and a discussion of the summary statistics of the key variables used in this paper in Table 1).

## 4. Empirical results

The main empirical results of this paper are discussed in this section. Specifically, we examine the drivers of household's educational expenditure allocations and the presence of gender bias in these allocations using both the conventional Engel curve and the two-part methodologies. In addition, we examine the argument that the incorrect functional form of the conventional Engel curve approach plausibly accounts for its failure to detect gender bias. In this vein, the paper estimates both a Hurdle model and a conventional Engel curve model using household level data. Three separate samples are used in this investigation: the full (Ghana) sample, the urban sub-sample and the rural sub-sample. The locality-disaggregated samples allows us to examine the presence of locality-based differences in expenditure allocations among households.

Table 2 present the results for the full sample and the locality-disaggregated sample (urban and rural) estimations. The results of the unconditional OLS (conventional Engel curve) estimation are presented in column (a) while columns (b) and (c) reports the results of a probit of a positive educational expenditure and the conditional OLS of the natural logarithm of budget share of education. We address concerns relating to potential selectivity bias problem in the conditional OLS estimation (see Supplementary online material, *Potential Selectivity Bias Problem* for insights on this issue). Considering the results from the conventional Engel curve estimations, we observe that household income explains households' education budget share in Ghana and it suggests that the higher the income of a household, the higher the amount that the household allocates to educational spending (see column (a) of Table 2). There are however important variations in the effect of household income on education budget shares across locality.

In addition, we find that the larger the size of a household the greater the amount it spends on education. This possibly reflects the fact that large-sized households are associated with relatively more children of school-going age which is the reason why they allocate higher shares of their annual spending budgets to education. Consistent with the descriptive evidence (see Supplementary online material, *Data and Descriptive Statistics*), urban households significantly allocate more of their spending to education than rural households while households whose heads are working in industrial and services related activities have higher education budget shares than those with heads engaged in agriculture related jobs. Female-headed households have higher educational budget shares compared to their male counterparts in Ghana. This is true for the locality-disaggregated estimations as well. Relative to households whose heads have no educational experience, households that have heads with some educational experience spend more on education. The reason for this may be that heads with some educational experience have a relatively greater appreciation of the benefits of schooling and so are more willing to invest in the schooling of their young members. Regional dummies indicate a higher educational budget shares in the southern regions[5] of Ghana compared to the Upper West region. These results are broadly consistent with estimates from the Hurdle models (presented in columns (b) and (c) of Table 2).

For instance, with respect to the first stage estimation of the Hurdle model (column (b) in Table 2), we find that household income relates positively to the probability of a positive educational expenditure in the full sample and the rural sub-sample estimations. Among urban households, we find that conditional on having a positive educational expenditure, richer households allocates more resources towards child schooling than poor households.[6] Households located in urban areas are significantly more likely to have a positive education budget share as well as a higher conditional education spending relative to their rural counterparts: this lends some support to our descriptive evidence that suggest a marked higher education budget shares in urban areas relative to rural areas.[7]

We turn now to the issue of most interest in this paper: whether there are gender differentiated treatments in educational expenditure allocations among households. To do this we perform a *t*-test of differences in the marginal effects of the respective age-gender dummies[8]: Table 3 reports the differences in the marginal effects (DME) of the demographic variables in four age groups (i.e. age groups 6–12, 13–15, 16–18 and 19–24) for the Ghana sample and the locality-disaggregated sub-samples. Columns (a)–(d) of Table 3 reports respectively the DMEs of the demographic variables derived from the probit of a positive education budget share, the conditional education budget share, the combined probit and conditional OLS, and the unconditional OLS estimations (see Supplementary online material, *How to compute Differences in Marginal Effects (DMEs)* for an illustration of how the DMEs are computed in this paper). Considering the estimates from the unconditional OLS estimations (column (d) of Table 3), we find that there is no gender bias in households' educational expenditure allocations for children in the primary school-going age (6–12 years) and also for children in the senior secondary school-going age (16–18 years) in Ghana (full sample); the locality-disaggregated models corroborate these findings.

Strikingly however, we observe the presence of a gender bias in households' educational spending among children in the junior secondary school-going age (13–15 years) and post-senior secondary

[5] Ghana currently has 10 regions with only three (Northern, Upper East and Upper West regions) of them classified as northern regions of Ghana while the rest are the southern regions of Ghana.

[6] See Supplementary Online Material, *The effect of household income on conditional education expenditure among urban households* for a more detailed discussion of the findings from the Hurdle model estimations.

[7] See Supplementary Online Material, *Data and Descriptive Statistics*.

[8] This approach is akin to the approach adopted by Aslam and Kingdon (2008).

**Table 1**
Descriptive statistics of regression variables.

| Variable | Description | Mean | S.D. | Range |
|---|---|---|---|---|
| Educshare | Continuous: it measures the share of households' total annual expenditure allocated to education. | 0.19728 | 0.24976 | 0–2.2173 |
| lnrealpc | Continuous: it is the logarithm of households' total annual consumption expenditure per adult equivalent. | 1.690443 | 0.7649997 | −2.23 to 5.58 |
| lnrealpc2 | Continuous: it is the square of 'lnrealpc' and it is meant to capture the non-linearity in the effect of household income. | 3.442773 | 2.670333 | 1.31e−07–31.20 |
| lnhsize | Continuous: it captures the logarithm of household size. | 1.503898 | 0.5288917 | 0–3.37 |
| *Age-gender composition dummies* | | | | |
| F0to1 | Binary: it is a dummy for the group of females in the 0–1 year age cohort. | 0.1268153 | 0.33278 | 0–1 |
| M0to1 | Binary: it is a dummy for the group of males in the 0–1 year age cohort. | 0.1371158 | 0.3439841 | 0–1 |
| F2to5 | Binary: it is a dummy for the group of females in the 2–5 years age cohort. | 0.2639311 | 0.440781 | 0–1 |
| M2to5 | Binary: it is a dummy for the group of males in the 2–5 years age cohort. | 0.2709389 | 0.4444634 | 0–1 |
| F6to12 | Binary: it is a dummy for the group of females in the 6–12 years age cohort. | 0.403411 | 0.4906026 | 0–1 |
| M6to12 | Binary: it is a dummy for the group of males in the 6–12 years age cohort. | 0.4111787 | 0.4920683 | 0–1 |
| F13to15 | Binary: it is a dummy for the group of females in the 13–15 years age cohort. | 0.1863391 | 0.3893965 | 0–1 |
| M13to15 | Binary: it is a dummy for the group of males in the 13–15 years age cohort. | 0.1930935 | 0.3947424 | 0–1 |
| F16to18 | Binary: it is a dummy for the group of females in the 16–18 years age cohort. | 0.1643026 | 0.3705656 | 0–1 |
| M16to18 | Binary: it is a dummy for the group of males in the 16–18 years age cohort. | 0.1646403 | 0.3708713 | 0–1 |
| F19to24 | Binary: it is a dummy for the group of females in the 19–24 years age cohort. | 0.2547281 | 0.4357267 | 0–1 |
| M19to24 | Binary: it is a dummy for the group of males in the 19–24 years age cohort. | 0.2267815 | 0.4187678 | 0–1 |
| F25to60 | Binary: it is a dummy for the group of females in the 25–60 years age cohort. | 0.7977879 | 0.4016665 | 0–1 |
| M25to60 | Binary: it is a dummy for the group of males in the 25–60 years age cohort. | 0.6538332 | 0.4757672 | 0–1 |
| Mabove60 | Binary: it is a dummy for the group of males in the 'above 60' years age cohort. | 0.101486 | 0.3019839 | 0–1 |
| Urban | Binary: it measures the geographical location of a household and it assumes a value of 1 if a household is located in an urban area and 0 otherwise. | 0.4067882 | 0.4912555 | 0–1 |
| Head_male | Binary: it captures the gender of the head of the household and it assumes a value of 1 if the head is a male and 0 otherwise. | 0.7374198 | 0.4400548 | 0–1 |
| Head_educ | Binary: it measures whether a household's head has ever attended school and it takes a value of 1 if the head has a schooling experience and zero otherwise. | 0.6762074 | 0.4679417 | 0–1 |
| *Regional dummies* | | | | |
| Western | Binary: it measures the geographical location of a household and it assumes a value of 1 if the household is located in the 'Western Region' and zero otherwise. | 0.1023303 | 0.303095 | 0–1 |
| Central | Binary: it measures the geographical location of a household and it assumes a value of 1 if the household is located in the 'Central Region' and zero otherwise. | 0.0899189 | 0.2860777 | 0–1 |
| Greater Accra | Binary: it measures the geographical location of a household and it assumes a value of 1 if the household is located in the 'Greater Accra Region' and zero otherwise. | 0.974333 | 0.2965594 | 0–1 |
| Volta | Binary: it measures the geographical location of a household and it assumes a value of 1 if the household is located in the 'Volta Region' and zero otherwise. | 0.0945626 | 0.2926223 | 0–1 |
| Eastern | Binary: it measures the geographical location of a household and it assumes a value of 1 if the household is located in the 'Eastern Region' and zero otherwise. | 0.1059608 | 0.3078005 | 0–1 |
| Ashanti | Binary: it measures the geographical location of a household and it assumes a value of 1 if the household is located in the 'Ashanti Region' and zero otherwise. | 0.112462 | 0.3159474 | 0–1 |
| Brong Ahafo | Binary: it measures the geographical location of a household and it assumes a value of 1 if the household is located in the 'Brong Ahafo Region' and zero otherwise. | 0.1000507 | 0.3000802 | 0–1 |
| Northern | Binary: it measures the geographical location of a household and it assumes a value of 1 if the household is located in the 'Northern Region' and zero otherwise. | 0.1175279 | 0.3220618 | 0–1 |
| Upper East | Binary: it measures the geographical location of a household and it assumes a value of 1 if the household is located in the 'Upper East Region' and zero otherwise. | 0.0886525 | 0.2842535 | 0–1 |
| Upper West | Binary: it measures the geographical location of a household and it assumes a value of 1 if the household is located in the 'Upper West Region' and zero otherwise. | 0.0935529 | 0.2912168 | 0–1 |
| *Household head's occupation* | | | | |
| Head_Agric | Binary: it measures the economic activity of the head of the household and it takes a value of 1 if the head is engage in Agriculture related activity and zero otherwise. | 0.5232548 | 0.49948 | 0–1 |
| Head_Industry | Binary: it measures the economic activity of the head of the household and it takes a value of 1 if the head is engage in Industry related activity and zero otherwise. | 0.1257702 | 0.3316042 | 0–1 |
| Head_Services | Binary: it measures the economic activity of the head of the household and it takes a value of 1 if the head is engage in Services related activity and zero otherwise. | 0.3364565 | 0.4725171 | 0–1 |
| Head_Other | Binary: it measures the economic activity of the head of the household and it takes a value of 1 if the head is engage in Other non-classified activities and zero otherwise. | 0.0145184 | 0.1196197 | 0–1 |

school-going age (19–24 years). Among children in the junior secondary school-going age, the bias is in favor of girls, indicating that households' educational budget shares increases by significantly more when an additional girl aged 13–15 years is added to the household than when an additional boy of that age is added. In the case of individuals in the 19–24 years, a significant pro-male bias in households' educational budget shares is observed, suggesting that households' educational budget shares increases by significantly more when an extra male aged 19–24 years is added to the household than when additional female of that age range is added. However, Aslam and Kingdon (2008) argues that the incorrect functional form of the Engel curve approach is one of the contributing factors in its inability to detect gender bias in expenditure allocations even in instances where such biases are expected to exist. In what follows, we explore this argument by considering the DMEs from the Hurdle model estimations (see Table 3).

*Exploring the 'Averaging' explanation for the failure of the Engel curve approach in detecting gender differentiated treatments in households' expenditure allocations*

In addressing the issue of whether the incorrect functional form of the conventional Engel curve model accounts for its apparent failure to detect gender bias in households' expenditure allocations we calculate the DMEs of the coefficients of the demographic variables on the two outcomes of the Hurdle estimations (i.e. columns (a) and (b) of

**Table 2**
OLS, Probit and Conditional OLS, full and locality-disaggregated samples.

| | Full | | | Urban | | | Rural | | |
|---|---|---|---|---|---|---|---|---|---|
| | Educshare (a) *Coeff.* | Anyexpend (b) *ME* | Ln_Educshare (c) *Coeff.* | Educshare (a) *Coeff.* | Anyexpend (b) *ME* | Ln_Educshare (c) *Coeff.* | Educshare (a) *Coeff.* | Anyexpend (b) *ME* | Ln_Educshare (c) *Coeff.* |
| lnrealpc | 0.026*** | 0.702*** | −0.047 | 0.076*** | 0.354 | 0.374*** | 0.017 | 0.651*** | −0.091 |
| | (0.009) | (0.075) | (0.0605) | (0.029) | (0.283) | (0.135) | (0.011) | (0.079) | (0.077) |
| lnrealpc2 | −0.004 | −0.114*** | −0.017 | −0.013* | 0.001 | −0.096*** | −0.004 | −0.123*** | −0.017 |
| | (0.003) | (0.020) | (0.017) | (0.007) | (0.063) | (0.032) | (0.004) | (0.024) | (0.026) |
| lnhsize | 0.127*** | 1.539*** | 1.228*** | 0.167*** | 1.655*** | 0.344*** | 0.086*** | 1.359*** | 0.297*** |
| | (0.009) | (0.0829) | (0.064) | (0.016) | (0.162) | (0.082) | (0.011) | (0.103) | (0.090) |
| *Age-gender composition dummies* | | | | | | | | | |
| F0to1 | −0.075*** | −0.562*** | −0.439*** | −0.096*** | −0.538*** | −0.308*** | −0.061*** | −0.542*** | −0.396*** |
| | (0.006) | (0.055) | (0.041) | (0.010) | (0.107) | (0.055) | (0.006) | (0.065) | (0.056) |
| M0to1 | −0.075*** | −0.490*** | −0.449*** | −0.094*** | −0.512*** | −0.376*** | −0.062*** | −0.468*** | −0.380*** |
| | (0.006) | (0.055) | (0.040) | (0.011) | (0.110) | (0.055) | (0.006) | (0.065) | (0.053) |
| F2to5 | −0.033*** | −0.133*** | −0.186*** | −0.027*** | 0.154 | −0.040 | −0.032*** | −0.164*** | −0.20*** |
| | (0.005) | (0.049) | (0.031) | (0.009) | (0.106) | (0.040) | (0.006) | (0.057) | (0.042) |
| M2to5 | −0.030*** | −0.0773 | −0.151*** | −0.018** | 0.362*** | −0.053 | −0.032*** | −0.157*** | −0.141*** |
| | (0.005) | (0.049) | (0.030) | (0.009) | (0.111) | (0.039) | (0.006) | (0.057) | (0.042) |
| F6to12 | 0.004 | 0.483*** | 0.0474* | 0.023*** | 0.861*** | 0.107*** | −0.004 | 0.455*** | −0.003 |
| | (0.005) | (0.050) | (0.029) | (0.009) | (0.133) | (0.036) | (0.006) | (0.057) | (0.040) |
| M6to12 | 0.003 | 0.431*** | 0.072** | 0.004 | 0.976*** | 0.044 | 0.009 | 0.382*** | 0.079* |
| | (0.005) | (0.048) | (0.029) | (0.009) | (0.138) | (0.036) | (0.006) | (0.056) | (0.041) |
| F13to15 | 0.027*** | 0.362*** | 0.216*** | 0.047*** | 0.859*** | 0.203*** | 0.016** | 0.283*** | 0.198*** |
| | (0.006) | (0.070) | (0.031) | (0.011) | (0.163) | (0.039) | (0.007) | (0.080) | (0.044) |
| M13to15 | 0.014** | 0.359*** | 0.206*** | 0.033*** | 0.690*** | 0.168*** | 0.008 | 0.351*** | 0.130*** |
| | (0.006) | (0.067) | (0.030) | (0.011) | (0.167) | (0.039) | (0.007) | (0.074) | (0.042) |
| F16to18 | 0.054*** | 0.0902 | 0.340*** | 0.061*** | 0.282** | 0.278*** | 0.055*** | 0.073 | 0.362*** |
| | (0.007) | (0.061) | (0.034) | (0.012) | (0.114) | (0.043) | (0.008) | (0.073) | (0.048) |
| M16to18 | 0.046*** | 0.394*** | 0.394*** | 0.058*** | 0.709*** | 0.231*** | 0.045*** | 0.357*** | 0.360*** |
| | (0.007) | (0.068) | (0.033) | (0.012) | (0.151) | (0.044) | (0.008) | (0.078) | (0.046) |
| F19to24 | 0.022*** | −0.527*** | 0.193*** | 0.005 | −0.613*** | 0.066 | 0.036*** | −0.370*** | 0.286*** |
| | (0.006) | (0.045) | (0.033) | (0.010) | (0.0969) | (0.043) | (0.008) | (0.056) | (0.047) |
| M19to24 | 0.051*** | −0.197*** | 0.445*** | 0.046*** | −0.113 | 0.258*** | 0.060*** | −0.135** | 0.418*** |
| | (0.006) | (0.051) | (0.035) | (0.011) | (0.108) | (0.045) | (0.008) | (0.061) | (0.048) |
| F25to60 | 0.030*** | −0.0293 | 0.0865** | 0.027** | −0.0677 | 0.034 | 0.032*** | 0.028 | 0.121** |
| | (0.007) | (0.050) | (0.041) | (0.012) | (0.0937) | (0.054) | (0.008) | (0.061) | (0.057) |
| M25to60 | −0.002 | −0.108 | 0.011 | −0.031* | −0.156 | −0.215*** | 0.017* | −0.051 | 0.035 |
| | (0.009) | (0.071) | (0.053) | (0.016) | (0.137) | (0.073) | (0.010) | (0.085) | (0.070) |
| Mabove60 | −0.020** | −0.065 | −0.099* | −0.054*** | −0.0933 | −0.303*** | 0.002 | −0.030 | −0.036 |
| | (0.010) | (0.083) | (0.059) | (0.019) | (0.179) | (0.087) | (0.011) | (0.095) | (0.075) |
| Urban | 0.060*** | 0.156*** | 0.557*** | | | | | | |
| | (0.005) | (0.043) | (0.029) | | | | | | |
| *Regional dummies* | | | | | | | | | |
| Western | 0.066*** | −0.415*** | 0.920*** | 0.055*** | −0.851*** | 0.614*** | 0.071*** | −0.248*** | 0.964*** |
| | (0.010) | (0.086) | (0.061) | (0.021) | (0.241) | (0.112) | (0.011) | (0.096) | (0.076) |
| Central | 0.094*** | −0.063 | 1.001*** | 0.070*** | −0.464* | 0.528*** | 0.116*** | 0.196* | 1.244*** |
| | (0.011) | (0.094) | (0.059) | (0.022) | (0.245) | (0.114) | (0.013) | (0.114) | (0.071) |
| Greater Accra | 0.074*** | −0.517*** | 0.891*** | 0.063*** | −0.787*** | 0.638*** | 0.068*** | −0.320** | 0.843*** |
| | (0.011) | (0.091) | (0.062) | (0.021) | (0.233) | (0.108) | (0.023) | (0.163) | (0.141) |
| Volta | 0.008 | −0.398*** | 0.298*** | 0.007 | −0.511** | 0.184 | 0.011 | −0.362*** | 0.293*** |
| | (0.009) | (0.089) | (0.063) | (0.023) | (0.258) | (0.119) | (0.010) | (0.095) | (0.077) |
| Eastern | 0.059*** | −0.321*** | 0.673*** | 0.041* | −0.547** | 0.371*** | 0.071*** | −0.238** | 0.822*** |
| | (0.010) | (0.088) | (0.062) | (0.022) | (0.243) | (0.115) | (0.012) | (0.098) | (0.076) |
| Ashanti | 0.073*** | −0.379*** | 0.812*** | 0.086*** | −0.658*** | 0.617*** | 0.049*** | −0.246** | 0.794*** |
| | (0.101) | (0.089) | (0.059) | (0.022) | (0.239) | (0.110) | (0.011) | (0.106) | (0.076) |
| Brong Ahafo | 0.046*** | −0.277*** | 0.552*** | 0.019 | −0.569** | 0.264** | 0.064*** | −0.170* | 0.671*** |
| | (0.010) | (0.088) | (0.063) | (0.021) | (0.245) | (0.116) | (0.011) | (0.099) | (0.078) |
| Northern | −0.001 | −0.847*** | 0.168*** | −0.002 | −0.504** | 0.075 | 0.001 | −0.906*** | 0.174** |
| | (0.008) | (0.081) | (0.062) | (0.021) | (0.252) | (0.120) | (0.009) | (0.084) | (0.074) |
| Upper East | 0.002 | −0.160* | 0.129** | −0.015 | −0.438 | −0.018 | 0.007 | −0.096 | 0.202*** |
| | (0.009) | (0.087) | (0.062) | (0.023) | (0.273) | (0.130) | (0.440) | (0.090) | (0.070) |
| Head_male | −0.044*** | −0.355*** | −0.129** | −0.035** | −0.288** | −0.021 | −0.048*** | −0.407*** | −0.229*** |
| | (0.008) | (0.068) | (0.050) | (0.015) | (0.122) | (0.070) | (0.010) | (0.086) | (0.068) |
| *Household head's occupation* | | | | | | | | | |
| Head_Industry | 0.018*** | 0.104* | 0.2617*** | 0.032*** | 0.085 | 0.242*** | 0.012* | 0.140* | 0.256*** |
| | (0.006) | (0.057) | (0.038) | (0.011) | (0.107) | (0.052) | (0.007) | (0.077) | (0.057) |
| Head_Services | 0.045*** | 0.170*** | 0.3502*** | 0.054*** | 0.201** | 0.303*** | 0.037*** | 0.165** | 0.379*** |
| | (0.006) | (0.049) | (0.033) | (0.009) | (0.095) | (0.045) | (0.008) | (0.066) | (0.050) |
| Head_Other | 0.019 | −0.0188 | 0.1556 | 0.005 | 0.1325 | 0.109 | 0.026 | −0.121 | 0.210 |
| | (0.016) | (0.152) | (0.101) | (0.030) | (0.333) | (0.123) | (0.180) | (0.172) | (0.145) |
| Head_educ | 0.053*** | 0.424*** | 0.322*** | 0.075*** | 0.446*** | 0.326*** | 0.039*** | 0.381*** | 0.289*** |
| | (0.005) | (0.043) | (0.031) | (0.009) | (0.094) | (0.046) | (0.006) | (0.051) | (0.040) |

(*continued on next page*)

**Table 2** (*continued*)

| | Full | | | Urban | | | Rural | | |
|---|---|---|---|---|---|---|---|---|---|
| | Educshare (a) *Coeff.* | Anyexpend (b) *ME* | Ln_Educshare (c) *Coeff.* | Educshare (a) *Coeff.* | Anyexpend (b) *ME* | Ln_Educshare (c) *Coeff.* | Educshare (a) *Coeff.* | Anyexpend (b) *ME* | Ln_Educshare (c) *Coeff.* |
| Constant | −0.141*** | −1.541*** | −3.7609*** | −0.211*** | −1.468*** | −3.436*** | −0.078*** | −1.278*** | −3.772*** |
| | (0.012) | (0.105) | (0.082) | (0.039) | (0.370) | (0.187) | (0.014) | (0.119) | (0.107) |
| Prob > F/Prob > chi2 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Wald chi2(*)/F(*) | 92.38 | 2207.06 | 118.91 | 38.33 | 844.55 | 29.95 | 44.04 | 1315.53 | 53.66 |
| Pseudo R2/Adj. R2 | 0.2217 | 0.3688 | 0.2780 | 0.2126 | 0.4794 | 0.1953 | 0.1794 | 0.3329 | 0.2093 |
| Observations | 11,844 | 11,844 | 9934 | 4818 | 4818 | 4118 | 7026 | 7026 | 5816 |

Notes: Robust standard errors in parenthesis; ***, **, * indicate significance at 1%, 5% and 10% respectively; ME represents marginal effects while Coeff. represent coefficient; The dependent variables are Educshare (budget share of education), Anyexpend (a dummy for positive educational budget share) takes a value of 1 if a household spends a positive amount on education and zero otherwise, and Ln_Educshare (the natural log of Educshare). The base category for age-gender dummies is Fabove60 (i.e. females older than 60 years), while the base dummy for household head's occupation is heads in Agriculture jobs; the base dummy for regional locations is Upper West while the base category for the urban dummy is rural; the base dummy for household head's gender is female while that for household head's educational experience is no education.

**Table 3**
Difference in marginal effects (DME) × 100 of gender variables, Hurdle models and unconditional OLS equations.

| Sample size | Probit of Positive Educshare (a) | Conditional OLS of Educshare (b) | Combined probit + conditional OLS (c) = *f*(a, b) | Unconditional OLS (conventional Engel curve) (d) |
|---|---|---|---|---|
| *Panel A: Males 6–12 and Females 6–12* | | | | |
| Ghana | −5.22 (0.32) | 0.38 (0.04) | 1.30 (0.04) | −0.10 (0.87) |
| Urban | 11.57 (0.37) | −1.39 (0.18) | 1.47 (0.13) | −1.91 (0.17) |
| Rural | −7.38 (0.23) | 0.84 (0.05) | 1.24 (0.06) | 1.32 (0.16) |
| *Panel B: Males 13–15 and Females 13–15* | | | | |
| Ghana | −0.27 (0.98) | −0.15 (0.09) | −3.50 (0.00) | −1.31 (0.09) |
| Urban | −16.90 (0.42) | −0.77 (0.04) | −4.92 (0.00) | −1.43 (0.31) |
| Rural | 6.84 (0.50) | −0.70 (0.59) | 2.42 (0.00) | −0.81 (0.36) |
| *Panel C: Males 16–18 and Females 16–18* | | | | |
| Ghana | 30.41 (0.00) | 0.82 (0.20) | 7.85 (0.00) | −0.81 (0.38) |
| Urban | 42.75 (0.01) | −1.04 (0.62) | 6.83 (0.00) | −0.35 (0.82) |
| Rural | 28.48 (0.00) | −0.02 (0.29) | 6.87 (0.00) | −0.99 (0.37) |
| *Panel D: Females 19–24 and males 19–24* | | | | |
| Ghana | 33.00 (0.00) | 3.83 (0.00) | 8.47 (0.00) | 2.88 (0.00) |
| Urban | 50.00 (0.00) | 4.23 (0.00) | 5.66 (0.00) | 4.10 (0.00) |
| Rural | 23.50 (0.00) | 1.35 (0.00) | 8.14 (0.00) | 2.40 (0.03) |

Note: p-values of the *t*-test of the DMEs are in parenthesis and the shaded cells indicate significance at the 10% level of statistical significance or less.

Table 3).[9] Unlike the Engle curve model results, more interesting findings emerge from the hurdle model estimates. In Table 3, the DMEs of the gender variables in the probit of a positive education budget share are negative for the age groups 6–12 years and 13–15 years, indicating the presence of a pro-female bias in education budget shares for children in these age groups; the differences are however insignificant.

On the contrary, the DMEs of the gender variables show a significant pro-male bias in the binary decision of allocating a positive educational expenditure for age groups 16–18 years and 19–24 years. This implies that an additional male household member in the 16–18 and 19–24 age cohorts has a higher impact on the probability of non-zero education budget compared to an additional female household member in the same age group. These results are corroborated in the locality-disaggregated samples as well with boys aged 16–18 years in rural Ghana having a higher impact on the probability of non-zero education budget share than their female counterparts.

The DMEs in column (b) of Table 3 reveals quite a different perspective to the issue of gender bias in households' educational expenditures. An important pro-male bias exists in the conditional education budget share in Ghana for children in the primary school-going age group (6–12 years); that is, conditional on enrolling both boys and girls in school, an additional boy in the 6–12 age group raises the conditional education budget share more than that of an additional girl in the same age group. This is unsurprising in view of the cultural attitudes towards female education, especially in rural areas. So, even though, both boys and girls in the 6–12 years age cohort have a similar chance of enrolment, boys receive a higher conditional education budget shares than girls in Ghana; notably in rural areas. Thus, for children in the primary school-age cohort, the presence of gender bias in households' educational preference is seen not in the binary decision of whether to enroll boys and girls in school but rather in the conditional decision of how much to spend on enrolled boys and girls; clearly, by averaging the (often) oppositely signed probit and conditional expenditures DMEs – as is implicit in the Engel curve approach–, it is more probable to conclude that there is an absence of gender bias, and one would miss the fact that there is bias through one of the channels (i.e. the conditional expenditure decision).

Surprisingly, however, a significant pro-female bias is present in households' conditional education expenditure decision in Ghana for children in the junior secondary school-going age cohort (13–15 years) – this is driven by patterns in urban areas. The finding indicates that an extra girl aged 13–15 years raises a household's conditional education spending by more than an extra boy in the same age group; this is in contrast to the findings of Aslam and Kingdon (2008) wherein the

[9] See Supplementary Online Material, *Computing the DMEs in columns (a), (b) and (c) of* Table 3 for details on how the DMEs in columns (a), (b) and (c) are computed.

authors observed a pro-male bias in households' conditional education spending for children in the 10–14 age group. The presence of a pro-female bias in the conditional expenditure decision of households for children in the junior secondary school-going age group could be explained by the fact that, after enrolling boys and girls alike, households may incur more expenditure on the schooling of daughters than on sons. Unlike boys, girls' schooling are often associated with higher spending on transport and school clothing for safety and modesty concerns (see Aslam and Kingdon, 2008).

Moreover, no gender bias is observed in households' conditional education expenditures for children in the 16–18 age cohort; so the existence of gender differentiated treatments in households' educational expenditure allocations is seen largely in the binary decision of a positive education budget share (i.e. whether to enroll boys and girls in school) for individuals in this age cohort. Among post-senior secondary school-aged household members, furthermore, an additional male member raises the conditional education budget share of a household more than an additional female member does, reflecting the presence of a strong pro-male bias in households' education budget shares for this age group. This reinforces the pro-male bias that is present in the binary decision of a positive education budget share, thus, yielding a strong pro-male bias in households' education budget shares as observed in the Engel curve estimation; a plausible reason for the ability of the Engel curve method to detect bias in the educational expenditure allocation for the 19–24 age group is the fact that the DMEs for the two channels are both positive and highly significant. In sum, comparing the Hurdle model outcomes with the conventional Engel curve method results, we show that by 'unpacking' the two sources of gender bias, the Hurdle model makes the detection of gender bias much more easier relative to the conventional Engel curve method. The results in Panels A and C of Table 3, sheds light on this issue.[10]

## 5. Conclusion

The study explores the possibility of a gender bias in the educational expenditure allocations of households using the latest wave of the Ghana Living Standards Survey. The study utilized the Hurdle model to 'unpack' the sources of gender bias in households' education expenditure allocations. The outcomes of the Hurdle models are however compared to those of a conventional Engel curve estimates in order to provide some evidence on the relative superiority of the Hurdle model in discovering gender bias. A number of interesting finding emerge. We find an absence of gender differentiated treatments in households' decision to enroll boys and girls in school, in particular, for children in the basic education school-going age cohorts (6–12 years and 13–15 years) albeit an important gender bias is observed in households' conditional education expenditure for this age group of children: while a pro-male bias is detected in case of primary school-aged children, a significant pro-female bias is present in the case of junior secondary school-aged children. Evidence on pro-female bias in households' education expenditure allocation is probably the first evidence on the issue in the literature. Among post-junior secondary school aged children, a significant pro-male bias exist in the binary decision of a positive education budget share – i.e. whether to enroll boys and girls in school. Gender bias in intra-household education expenditure is more obvious among individuals in the 19–24 years age cohort with females facing double discrimination in households' educational expenditure allocation.

These findings suggest that to progressively address gender differences in human capital endowments, the factors that restricts females' education to levels below the senior secondary education level must be addressed. As a matter of fact, females face a higher dropout rate than their male counterparts especially at higher levels of education and this incidence could be linked to parental disincentive to invest in the education of a girl child. As is apparent from the results, the introduction of the massive supply-side factors such as the establishment of more public basic schools and related subsidy programmes including the famous school feeding programme as well as the Education for All (EFA) campaign have played an important role in dampening the negative cultural attitudes towards female education and thereby have helped improve female school participation at the basic education level; thus the non-existence of gender differentiated treatment in the choice of a positive education expenditure for boys and girls at age groups 6–12 and 13–15. However, the non-existence of similar programmes at the post-basic education level in many developing countries, especially those in SSA might explain households' continual disincentive to give boys and girls an equal chance of schooling. Thus, policies to ensure equity in human capital endowments across sexes as well as ensure the empowerment of women must seek to address not only supply-side related constraints to female school participation but more importantly the demand-side constraints – changing attitudes towards girls, household labor practices and keeping girls in school once they reach puberty, in particular.

## Conflict of interest

None.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.wdp.2018.09.001.

## References


Aakvik, A., Salvanes, K. G., & Vaage, K. (2005). Educational attainment and family background. *German Economic Review, 6*, 377–394.

Al-Qudsi, S. (2003). Family background, school enrolments and wastage: Evidence from Arab countries. *Economics of Education Review, 22*, 567–580.

Aslam, M., & Kingdon, G. G. (2008). Gender and household education expenditure in Pakistan. *Applied Economics, 40*(20), 2573–2591.

Binder, M. (1998). Family background, gender and schooling in Mexico. *Journal of Development Studies, 35*, 54–71.

Blanden, J., & Gregg, P. (2004). Family income and educational attainment: A review of approaches and evidence for Britain. *Oxford Review Economic Policy, 20*, 245–263.

Broaded, C. M., & Liu, C. (1996). Family background, gender and educational attainment in urban China. *China Quarterly, 145*, 53–86.

Chaudhuri, K., & Roy, S. (2006). Do parents spread educational expenditure evenly across the two genders? Evidence from two North Indian states. *Economic and Political Weekly, 41*, 5276–5282.

Clark-Kauffman, E., Duncan, G., & Morris, P. (2003). How welfare policies affect child and adolescent achievement. *American Economic Review, 93*, 299–303.

Connelly, R., & Zheng, Z. (2003). Determinants of school enrolment and completion of 10 to 18 year olds in China. *Economics of Education Review, 22*, 379–388.

Deaton, A. (1989). Looking for boy-girl discrimination in household discrimination data. *World Bank Economic Review, 3*, 1–15.

Ghana Statistical Service (GSS) (2000). *Ghana living standards survey report of the fourth round (GLSS 4)*. Accra-Ghana: Ghana Statistical Service (GSS).

Ghana Statistical Service (GSS) (2008). *Report of the fifth round of the Ghana living standards survey (GLSS 5)*. Accra-Ghana: Ghana Statistical Service.

Ghana Statistical Service (GSS) (2014). *Ghana living standards survey round six (GLSS 6), main report*. Accra-Ghana: Ghana Statistical Service.

Glewwe, P., & Patrinos, H. A. (1999). The role of the private sector in education in Vietnam: Evidence from the Vietnam living standards survey. *World Development, 27*(5), 887–902.

Glick, P., & Sahn, E. D. (2000). Schooling of girls and boys in a West African country: The effects of parental education, income, and household structure. *Economics of Education Review, 19*, 63–87.

Gong, X., Soest van, A., & Zhang, P. (2005). The effects of gender of children on expenditure patterns in rural China: A semiparametric analysis. *Journal of Applied Econometrics, 20*(4), 509–527.

Himaz, R. (2009). *Is there a boy bias in household education expenditure? Working Paper No. 46, Young Lives*. Oxford OXI 3TB, UK: Department of International Development, University of Oxford.

Iddrisu, A. M. (2014). The effect of poverty, household structure and child work on school enrolment. *Journal of Education and Practice, 5*(6), 145–156.


[10] See Supplementary Online Material, *Detecting gender bias in empirical estimations: the Hurdle model* versus *the conventional Engel curve model* for a detailed exposition of this issue.

Iddrisu, A. M., Danquah, M., & Quartey, P. (2017b). Paying for education among households in Ghana: Is there any role for household resources and contextual effects? *International Journal of Development Issues, 16*(2), 214–226.
Iddrisu, A. M., Danquah, M., & Quartey, P. (2017a). Analysis of school enrolment in Ghana: A sequential approach. *Review of Development Economics, 21*(4), 1158–1177.
Kingdon, G. G. (2005). Where has all the bias gone? Detecting gender bias in the intrahousehold allocation of educational expenditure. *Economic Development and Cultural Change, 53*, 409–451.
Knight, J., & Shi, L. (1996). Educational attainment and the rural-urban divide in China. *Oxford Bulletion of Economics and Statistics, 58*, 83–117.
Lancaster, G., Maitra, P., & Ray, R. (2003). *Endogenous power, household expenditure patterns and new tests of gender bias: Evidence from India.* mimeo, Monash University and University of Tasmania.
Lancaster, G., Maitra, P., & Ray, R. (2008). Household expenditure patterns and gender bias: Evidence from selected Indian states. *Oxford Development Studies, 36*(2), 133–157.
Li, D., & Tsang, M. (2003). Household education decisions and implications for gender inequality in education in rural China. *China: An International Journal, 1*(2), 224–248.
Lloyd, C. B., & Blanc, A. K. (1996). Children's schooling in sub-Saharan Africa: The role of fathers, mothers, and others. *Population and Development Review, 22*(2), 265–298.
Masterson, T. (2012). An empirical analysis of gender bias in education spending in Paraguay. *World Development, 40*(3), 693–709.
Nielsen, I., Nyland, B., Nyland, C., Smyth, R., & Zhang, M. (2006). Determinants of school attendance among migrant children: Survey evidence from China's Jiangsu province. *Pacific Economic Review, 11*, 461–476.
Ogundari, K., & Abdulai, A. (2014). Determinants of household's education and health spending in Nigeria: Evidence from survey data. *African Development Review, 26*(1), 1–14.
Qian, X. J., & Smyth, R. (2011). Educational expenditure in urban China: Income effects, family characteristics and the demand for domestic and overseas education. *Applied Economics, 43*(24), 3379–3394.
Rolleston, C. (2011). Educational access and poverty reduction: The case of Ghana 1991–2006. *International Journal of Educational Development,* 338–349.
Sackey, A. H. (2007). *The determinants of school attendance and attainment in Ghana: A gender perspective* (pp. 173). Nairobi-Kenya: AERC Research Paper.
Saha, A. (2013). An assessment of gender discrimination in household expenditure on education in India. *Oxford Development Studies, 41*(2), 220–238.
Subramanian, S. (1995). *Gender discrimination in intra-household allocation in India.* Unpublished mimeo, Department of Economics, Cornell University.
Subramanian, S., & Deaton, A. (1990). Gender effects in Indian consumption patterns. Discussion Paper No. 147, Indira Gandhi Institute of Development Research Bombay, India.
Subramanian, S., & Deaton, A. (1991). Gender effects in Indian consumption patterns. *Sarvekshana, 14*, 1–12.
Tansel, A., & Bircan, F. (2006). Demand for education in Turkey: A tobit analysis of private tutoring expenditures. *Economics of Education Review, 25*, 303–313.
UNESCO (2013). *Adult and youth literacy: National, regional and global trends, 1985–2015.* Montreal, Canada: UNESCO Institute for Statistics.
Zhou, X., Moen, P., & Tuma, N. B. (1998). Educational stratification in urban China: 1949–94. *Sociology of Education, 71*, 199–222.
Zimmerman, J. F. (2001). Determinants of school enrolment and performance in Bulgaria: The role of income among the poor and rich. *Contemporary Economic Policy, 19*(1), 87–98.