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Panchanan Das
University of Calcutta, India
daspanchanan@ymail.com

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Panchanan Das
Professor of Economics
University of Calcutta, India

This paper sets out to make a detailed analysis of inequality of opportunity for income, wage and asset across different regions of Ghana by using household level information by using GLSS 7 data. The study also provides an objective measure of contribution of different circumstance variables to inequality of opportunity. As circumstances affect household's gross income, wage income and asset level, inequality of opportunity presents in the distribution. In this study, the ex-ante concept of inequality of opportunity is used. We use Shapley decomposition to find out how much each circumstance contributes to total inequality of opportunity. Although gender has very little contribution to inequality of opportunity in household's gross income and asset holding, gender difference plays a notable role in explaining unequal opportunity in wage earning

1. Introduction

This paper sets out to make a detailed analysis of inequality of opportunity for income, wage and asset across different regions of Ghana, a country in Sub-Saharan Africa which is designated popularly as inegalitarian subcontinent, in which economic inequality has been understudied. The study contributes to a growing literature by providing a comprehensive analysis of the levels, origins and drivers of income and asset inequality by using Ghana's living standard survey data. We measure income and wealth inequality by applying Theil's index of the counterfactual distribution and decompose inequality of opportunity by applying Shapley decomposition across different regions of Ghana. The study also provides an objective measure of contribution of different circumstance variables to inequality of opportunity.

Ghana was colonized by the British in the late 19th century and had turbulent histories with political conflicts and severe macroeconomic crises. Historically, inequality in Ghana dates back to the era of colonial administration and further accentuated by post-colonial development policies and strategies (Aryeetey et al. 2009). The economy of Ghana remained fairly egalitarian and was driven purely by traditional farming during the earlier phase of colonial era. The major activities were traditional farming, collection of farm produce and other related

work (Szereszewski 1965). As a majority of the population lived on subsistence, inequality was very low during this period. But, economic inequality started to increase with the gradual expansion of cocoa cultivation in the forest belt of Ghana since the 1930s[1]. The rapid expansion of cocoa cultivation improved substantially the living standards of large cocoa farmers constituting less than 1 per cent of country's population accruing nearly 4 per cent of national income in 1960. The large farmers producing cocoa were able to appropriate a large share of the country's income because of the factors inherent to the cocoa crop in combination with economic and institutional legacies left from the pre-colonial period in Ghana. As there were no credit institutions in the rural economy at that time they were the major creditors to small farmers. The large farmers who had better contacts with the markets and had access to credit provided by merchant firms were in more favourable position (Gunnarsson 1978). Another major factor that ensured that cocoa farmers controlled a disproportionate share of the nation's income and led to rising levels of inequality was the spectacular rise of cocoa prices between 1931 and 1951.

Ghana experienced faster economic growth and fall in absolute poverty since the adoption of the structural adjustment programme in the early 1980s. However, the faster growth has not been associated with improvement in job creation among the young age people. The benefits of economic growth have not been equally distributed across different groups of people, and income inequality has worsened during the high growth phase in Ghana. In 2012-13, the Gini coefficient of income in this country was nearly 0.4 when it experienced GDP growth at around 14 per cent (Ghana Statistical Service, 2014). The faster growth with rising inequality may be an indication of dissociation of growth with job creation especially among the youth. According to the official statistics, the youth unemployment rate was nearly 11 per cent during that time. Higher unemployment potentially may widen inequality. Ghana Living Standard Surveys (GLSS) conducted between 1991 and 2013 show that inequality by any measure increased across sex, region and locality. Oduro et al. (2011) found that the mean value of gross wealth of women was lower than those of men for all asset categories.

Research on inequality in income and wealth in Africa has been expanded since the mid-1990s through the initiative of the African Economic Research Consortium in the shape of a collaborative project on 'Poverty, Income Distribution and Labour Market Issues in Africa'.

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[1] Ghana was the world's largest producer of cocoa in 1911

Since then a number of studies have examined income inequality with household level information in Ghana (Canagarajah et al., 1998; McKay and Aryeetey, 2007; Annim, et al. 2012). Cooke, et al. (2016) documented that income inequality showed an increasing trend during the high growth phase of Ghana. Studies conducted by Annim et al. (2012) showed wide disparities in terms of consumption and income in the country. This study highlighted that the impressive growth has not been associated with adequate job creation especially among the youth. The high unemployment rate among the young age people increases dependency ratio that potentially may widen inequality（Deaton and Paxson 1994, Cameron 2000, Zhong 2011, Van Vliet and Wang 2015, Goldin 2016).

While the persistence of income inequality in Ghana has been documented in a number of studies, the possible sources behind high inequality in in this country has not been focussed so far. This paper sets out to carry out an empirical analysis of inequality of opportunity of income and wealth in Ghana where the majority of the labour force is working in agriculture. This study analyses inequality in terms of circumstances and efforts as used in the literature of equal opportunity with household level information by using GLSS 7 data.

Inequality persists in a society primarily because of the presence of unequal opportunity (Arrow et al. 2000). Unequal opportunity creates barriers to access to quality education, jobs and other positions. Unequal access to quality education, for example, across social groups by their caste identity and also between gender classes transmits into unequal access to quality jobs and pay differences between them. Thus, it is important to examine the role of these social variables in explaining economic disparity among the working age people. This study analyses these interrelated issues on inequality by estimating the relative contributions of circumstances and efforts.

Section 2 describes in short the data and variables used in this study. Section 3 discusses on the methods of measurement of inequality and unequal opportunity. Some observed facts on inequality in Ghana have been highlighted taken mainly from the Report of GLSS 7 in section 4. Empirical results on inequality of opportunity on household's gross income, wage income and asset are provided in section 5. Section 6 summarises and concludes.

2. Data

The Ghana Living Standards Survey (GLSS), a customized version of the Living Standards Measurement Study (LSMS) of the World Bank, provides information on households' income and expenditure, education, along with other information like the demographic characteristics and socio-economic characteristics of households in Ghana. The survey was conducted by using two-stage stratified sampling method. The first stage sample consists of 1,000 enumeration areas covering rural and urban areas as the Primary Sampling Units (PSUs) which were allocated into the 10 administrative regions using probability proportional to population size. At the second stage, 15 households from each PSU were systematically selected and the total sample size at this stage is 15,000.

The survey defined household consumption expenditure as the sum of the values of goods and services purchased by households, consumed from own production, received as gifts and payments in kind. Household income, on the other hand, includes wages and salaries, and income from other sources by all household members both cash and in-kind.

3. **Inequality and unequal opportunity: measurement issue**

3.1 Measuring inequality

In this study Theil's T index is used as a measure of inequality. It is a specific measure based on the entropy class of inequality indexes. Entropy has the meaning of deviations from perfect equality when it is applied to income distribution. If individual i has an income y_i, there are n people in this society, and average income in the society is $\bar{y}$, then the general entropy measure of inequality is

$$GE(\alpha) = \frac{1}{\alpha(1-\alpha)} \frac{1}{n} \sum_{i=1}^{n} \left[\left(\frac{y_i}{\bar{y}} \right)^{\alpha} - 1 \right] \qquad (1)$$

The parameter α in the GE class represents the weight given to distances between incomes at different parts of the income distribution. With positive and large α, the index GE will be more sensitive to what happens in the upper tail of the income distribution. For a positive and small α, the index will be more sensitive to what happens at the bottom tail of the income distribution. The values of GE measures vary between 0 and ∞, with zero representing an equal distribution and higher value representing a higher level of inequality.

GE(1) is the Theil's T index. Although $GE(\alpha)$ is not defined for α=1, by applying L-Hostital's rule, Theil's T index is obtained as

$$GE(1) = \frac{1}{n}\sum_{i=1}^{n}\frac{y_i}{\bar{y}}\ln\left(\frac{y_i}{\bar{y}}\right) \qquad\qquad (2)$$

Theil's T index measures inequality by the extent to which an actual society deviates from a perfectly equal society. It is based on computing for everyone the ratio of their income share to their population share. To calculate Theil's T index, we, first, sort the income distribution by income level. Then calculate the average income level in the income distribution, calculate the ratio between each income and the average income level and log of the ratio, multiply the ratio and log of ratio, and take the sum, divide the sum by n to get GE (1).

Theil's T index satisfy the principle of transfers: if income is redistributed from relatively richer individuals to relatively poorer individuals, GE(1) decreases. The basic advantage of using Theil's T index is that it is additively decomposable into "within group" and "between group" components:

$$GE(1) = \frac{1}{n}\sum_{j=1}^{k}\sum_{i=1}^{n_j}\frac{y_{ji}}{\bar{y}}\ln\left(\frac{y_{ji}}{\bar{y}}\right) = \sum_{j=1}^{k}\frac{n_j\bar{y}_j}{n\bar{y}}\ln\frac{\bar{y}_j}{\bar{y}} + \sum_{j=1}^{k}\frac{n_j\bar{y}_j}{n\bar{y}}\frac{1}{n_j}\sum_{i=1}^{n_j}\frac{y_{ji}}{\bar{y}_j}\ln\frac{y_{ji}}{\bar{y}_j}$$

$$= GE(1)_b + GE(1)_w$$

$$(3)$$

3.2 Measuring inequality of opportunity

Inequality of any outcome variable like income is originated from two sources: inequality of opportunity and inequality of effort. Inequality of opportunity captures differential access in getting income because of circumstances like the economic class, gender and race (Lucas, 1995). Differences in income due to circumstances are ethically unacceptable and should be compensated by following the compensation principle. Differences due to effort, on the other hand, are ethically acceptable by following the reward principle, and do not need any intervention (Fleurbaey, 2008). Inequality persists in a society primarily because of the presence of inequality of opportunity (Arrow et al. 2000). The success of policy interventions in alleviating inequalities and improving welfare depends upon their efficacy in compensating for the circumstance-based disadvantages and in expanding opportunities (Peragine, 2004; Ferreira and Gignoux, 2011). For this reason, although the ultimate objective of any society is to reduce income or wealth inequality, focus should be on reducing inequalities that arise from

unequal opportunity (World Bank 2006). Unequal opportunity is important from the standpoint of social justice.

In measuring inequality of opportunity we use *ex-ante* approache. In this approach there is equality of opportunity if all individuals face the same set of opportunities regardless of their circumstances. We have used Roemer's (1998) definition of equal opportunity in which individuals exerting the same effort are entitled to obtain the same earning.

In this study, circumstances include gender, religion, ethnic group, and parental education:

$$C_i = \{C_{i,1}, C_{i,2}, C_{i,3}, C_{i,4}\}$$

$$C_{i,1} = (male, female)$$

$$C_{i,2} = (Catholic, Protestant, Pentecostals, other\ Xtian, Islam, traditional\ and\ other\ religion\ )$$

$$C_{i,3} = (AKAN, GA\ DANGME, EWE, GUAN, GURMA, MOLE\ DAGBANI, GRUSI\ and\ MANDE)$$

$$C_{i,4} = (Father's education, Mother's education)$$

The whole sample can be partitioned into 160 types which are non-overlapping

$$T = \{t_1, t_2, \ldots, t_j, \ldots, t_{160}\}$$

This type distribution is a representation of the opportunity set expressed in terms of earning for any individual endowed with given circumstances.

In this study, we assume that effort is two-dimensional: person's education and work experience,

$$E_i = \{E_{i,1}, E_{i,2}\}$$

$$E_{i,1} = (illiterate, primary, secondary, graduate)$$

$$E_{i,2} = (with\ experience, without\ experience)$$

Therefore, the whole sample can be partitioned into *8* tranches:

$$\tilde{T} = \{\tilde{t}_1, \ldots, \tilde{t}_p \ldots \tilde{t}_8\}$$

Checchi and Peragine (2010) proposed a measure of inequality in terms of a counterfactual distribution obtained by removing inequality within types from the original distribution. The counterfactual distribution is constructed by replacing individual earning of those with same circumstances (*j*) and same degree of effort (*k*) with their mean income of $\{y_{j,k}\}$. Then, a smooth distribution of the earning is constructed by taking the mean earning for each type, $\{\bar{y}_j\}$, by replacing $\{y_{j,p}\}$.

here $\bar{y}_j = \frac{1}{N_j}\sum_k y_{j,k}$, N_j is the size of type t_{j}, $j =1,2,....160$; $k= 1, 2, ..., 8$.

Inequality in this counterfactual distribution is the inequality of opportunity:

$$IO = I(g(C,\bar{E}))$$

In this approach, inequality of opportunity is measured by "between group" component of the Theil index.

To measure unequal opportunity, we assume that income level of a person depends on person's endowments like level of education, work experience, job training, skill and other productivity related factors (E), and on those factors which are beyond the individual's control like gender, castes and religion (C), and unobserved random factors (u):

$$y_i = g(C_i, E_i, u_i) \qquad (4)$$

C is exogenous variable in the sense that an individual has no control over them, but E is endogenous and depends partially on C:

$$E_i = E_i(C_i, \varepsilon_i) \qquad (5)$$

The linear form of (4) and (5) are given respectively as

$$y_i = C_i'\beta + E_i'\gamma + u_i \qquad (4')$$
$$E_i = C_i'\delta + \varepsilon_i \qquad (5')$$

Therefore, the reduced form is

$$y_i = \underbrace{C_i'\beta}_{direct\ effect} + \underbrace{C_i'\gamma\delta}_{indirect\ effect} + \underbrace{\gamma\varepsilon_i}_{effort\ effect} + \underbrace{u_i}_{residual} \qquad (6)$$

or,
$$y_i = C_i'\theta + v_i \qquad (7)$$

where
$$\theta = \beta + \gamma\delta$$
and
$$v_i = \gamma\varepsilon_i + u_i$$

The ex-ante counterfactual distribution, the distribution of the predicted outcomes obtained from equation (7), $\tilde{Y}_{EA} = C_i'\hat{\theta}$, is used to measure unequal opportunity. The explained variability of this regression model will capture both the direct effect of circumstances and the

indirect effect that circumstances play, through their effect on effort. Theil's inequality index of $\tilde{Y}_{EA}$ is the parametric measure of unequal opportunity.

We use Shapley decomposition method to find out the relative contribution of gender, castes and religion to discrimination. This decomposition is based on the well-known concept of Shapley value in cooperative game theory. The Shapley decomposition provides the marginal effect of gender, castes and religion on discrimination by capturing the effects of sequential elimination of within group inequality, between group inequality, relative size of each group and ranking of individuals.

4. Inequality in Ghana: observed facts

Ghana consists of three main geographical zones: the forest belt, the coastal strip and the savanna hinterland. The forest belt is endowed with fertile land, favourable weather conditions and vast amount of natural resources. The bulk of the country's mineral resources are located in the forest belt. The coastal belt has fishing potential and it serves as a gateway to trade through sea routs. The savanna hinterland is essentially a semi-arid with poor soil quality as compared to the rich top-soil of the forest area. These three geographical zones have been divided further into 10 regions.

Inter-regional as well as intraregional inequality in Ghana increased since 1930s and at a slower rate since 1950s. By 1948, a little less than 90 per cent of the population was employed in subsistence or extra subsistence agriculture in the Western, Central, Eastern and Ashanti regions whose earnings were considerably lower than outside subsistence level of income. On the other hand, cocoa cultivation expanded in these regions. Also, the spread of education and training produced a large number of skilled workers who were absorbed in high-paid jobs particularly in the public sector and in the craft industry (Austin 2014). These changes in employment structure marked a significant change in income distribution in these regions. Inequality between cocoa farmers and other low-earning occupational groups increased in these regions. The cocoa sector itself was marked by a large degree of differentiation. In Ashanti, Gini coefficient of income distribution was 0.48 in 1956-57, indicating a high level of inequality among cocoa farmers in the region. Togoland and the Northern Territories, on the other hand, were considerably less developed than the southern parts of the country partly because of poor soil quality and the unfavourable climate. As there was no alternative earning

opportunities aside subsistence agriculture, most of the people in these regions were engaged in subsistence production.

Rising trend in inequality has been clearly documented in different rounds of living standard surveys (GLSS) conducted in Ghana since 1991. The widening income inequality is also evident across regions in terms of the conventional measures of inequality like Gini coefficient, Mean-log deviation [GE (0)] and Theil's index [GE (1)]. However, the trend of income disparities across the regions is not similar （Cooke, Hague and McKay 2016). In Ashanti and Eastern Regions, inequality increased, but other regions recorded a declining trend during 1991-1998. During 1998 - 2012 income inequality increased in all regions excepting in Ashanti Region. Between 1991 and 2013, Upper East Region experienced the highest rate of inequality. Even though the inequality indices were so high in the Northern Region, the Upper East Region recorded the highest percentage change in income inequality followed by the Eastern and the Upper West Regions.

The Report of GLSS 7 provides some basic measures which are helpful to understand the nature of income distribution at the regional level. The distribution of households by quintile of income distribution along with average annual household expenditure and per capita expenditure in each region as provided in the Report of GLSS 7 is shown in Table 1. Ghana's mean household annual income and per capita income were recorded at GH¢ 44042 and GH¢ 21819 with notable inequality in 2016-17. Nearly 32 per cent of the households were in the 5th quintile and just above 12 per cent in the lowest quintile of income distribution. Regional variation in income distribution is very much prominent in Ghana. Ashanti was the richest and Upper West region was the poorest in terms of annual average household income. The regions excepting the Greater Accra and Ashanti have mean household income and per capita income lower than the national average indicating a high degree of regional variation in income distribution.

The pattern of inequality among households is not similar across regions in Ghana. While the share of households in the 5th quintile and in the 1st quintile were 58.6 per cent and 1.1 per cent respectively in Greater Accra, the respective share in Ashanti were (38.5 per cent and 5.1 per cent. These figures suggest a significant difference in income distribution even in these two prosperous regions of the country. In relatively poorer regions like Upper East and Upper West,

the share of households in the lowest quintile was much higher than other regions, but there was much difference in these two regions with little difference in mean household income and per capita income. Upper West region recorded the highest percentage of households in the lowest quintile (56.6 per cent) and the lowest percentage in the highest quintile (5.7 per cent).

Table 1 Regional distribution of households by quintile of income distribution

	Quintile					Mean annual household income	Mean annual per capita income
	1	2	3	4	5		
Western	11.4	20.9	21.2	24.2	22.2	30,862	9,058
Central	7.9	16.6	22.6	22.1	30.7	32,564	12,189
Greater Accra	1.1	3.6	9.7	26.9	58.6	64,701	21,592
Volta	22.9	24.7	21	17.8	13.6	31,612	7,394
Eastern	6	17.9	23.4	23.8	28.9	21,592	7,718
Ashanti	5.1	11.9	18.2	26.4	38.5	72,491	56,664
Brong Ahafo	15	19.9	22.1	22	21	30,710	12,606
Northern	41.1	22.7	14.6	11.1	10.6	22,919	5,748
Upper East	45.7	24.3	13.4	6.9	9.7	16,130	3,372
Upper West	56.6	20.6	9	8	5.7	12,958	3,604
Ghana	12.4	15.4	17.9	22.5	31.7	44,042	21,819

Source: GLSS7 Main Report (Table 10.23), Ghana Statistical Service (2019)

4.1 Theil's index of income and asset

We have calculated Theil's T index, a general entropy measure with parameter value 1, of gross household income, wage income and total asset across regions by using GLSS 7 unit level data (Table 2). Asset inequality is significantly higher than income inequality for obvious reasons. Again inequality in total income is higher than inequality in wage income in Ghana. The decomposition of Thail's T index into "within region" and "between region" components highlights that the major part of total inequality in income and asset distribution is originated from the variation of them within the region. However, between region variation is significantly higher in asset distribution as compared to income distribution. Inequality in total asset is the highest in the Western part of the country followed by the Volta region. Thaill's inequality index for asset is observed to be the lowest in Upper East region of Ghana. A variation in income inequality across regions is observed as well. Thail's T index of total income varies from 1.17 in Upper East to 2.73 in Volta region. But, the regional variation in inequality in wage income is very low in Ghana.

Table 2 Theil's T index for total income, wage income and total asset by region: 2016-17

	Total Income	Wage Income	Total Asset
Western	1.72	0.51	5.18
Central	1.22	0.37	1.95
Greater Accra	1.42	0.45	2.39
Volta	2.73	0.44	4.74
Eastern	1.45	0.43	1.48
Ashanti	1.33	0.46	2.35
Brong Ahafo	1.65	0.50	1.43
Northern	1.77	0.44	2.33
Upper East	1.17	0.51	0.99
Upper West	2.00	0.46	3.12
All region	1.72	0.47	3.94
Within region	1.62	0.45	3.58
Between region	0.10	0.01	0.35

Source: Author's estimation by using unit level data of GLSS 7.

The extent of inequality and its regional pattern can be explained partly in terms of sources of income, type of employment and circumstances relating to social and demographic factors. In Ghana, about three fourth of household income is originated from non-farm self-employment, while wage income accounts for 14.1 per cent and agricultural income accounts for 5 per cent (Table 3). In Greater Accra, more than 80 per cent of household income come from non-farm self-employment, while in Upper West region this share is little more than 50 per cent. The share of household income originated from non-farm self-employment is relatively high in economically affluent regions and low in economically backward regions. The second major source of household income has been wage employment. Income from wage employment varies from 23 per cent in Upper West region to 9.4 per cent in Brong Ahafo region. A notable part of income originates from agriculture in Brong Ahafo.

Table 3 Households' income by sources

	Wage income	Agricultural income	Income from non-farm self-employment	Rental income	Remittance	Other income
Western	16.7	6.1	73.2	2.5	1.3	0.3
Central	13	4.3	77.9	2.5	1.8	0.5
Greater Accra	12.6	0.5	82.3	3.1	0.9	0.7
Volta	9.5	7	78.3	2.9	1.5	0.7
Eastern	18.5	15	56.7	5.8	2.9	1.1

Ashanti	18.6	4.1	70.1	4.8	1.7	0.7
Brong Ahafo	9.4	11.2	75.7	1.9	1.6	0.2
Northern	9.9	8.9	73.3	6.2	1.5	0.1
Upper East	16.5	7.5	67.1	6.9	1.5	0.5
Upper West	23.1	8.3	53.6	12.9	0.6	1.4
Ghana	14.1	5	75.3	3.6	1.4	0.6

Source: As for Table 1

Household income and its distribution are largely related to the nature of economic activities. The Report of GLSS 7 points out that, on average, roughly 70 per cent of the working age people are economically active of whom 65 per cent were employed. The Upper West Region, where around 23 per cent of household income come from wage employment, exhibits the lowest (54.7 per cent) share of economically active persons. The survey report also reveals that underemployment rate is higher for females than males. A sharp disparity is observed in the underemployment rates across different regions, with Northern Region showing the highest underemployment rate at around 40 per cent and Greater Accra Region exhibiting the lowest at 10 per cent. But, the unemployment rate is the highest at nearly 12 per cent in Greater Accra followed by Ashanti (10.3 per cent).

5. Unequal opportunity in income and asset

We have used counterfactual distribution of income and asset in measuring unequal opportunity. The distribution of estimated income or asset obtained from OLS estimates of regression equation by taking circumstances as explanatory variables. For counterfactual distribution we estimate the following regression equation:

$$lny_i = \beta_0 + \beta_1 D_{gender} + \sum_{j=1}^{5} \gamma_j D_{religion} + \sum_{k=1}^{8} \delta_k D_{ethnic} + \sum_{l=1}^{2} \theta_l D_{parent} + \varepsilon_i \qquad (8)$$

Here, y_i denotes income or asset variable for household i, gender dummy, D_{gender}, equals 1 for female. We incorporate 5 religion dummies representing Catholic, Protestant, Pentecostals, other Xtian, and Islam by taking Traditional and other religion as a reference group. The regression equation also includes 8 ethnic dummies for AKAN, GA DANGME, EWE, GUAN, GURMA, MOLE DAGBANI, GRUSI and MANDE, with other ethnic group as a reference group. To measure the effects of parent's education we include 2 dummies for parent's (father and mother) education level graduate and above.

5.1 OLS estimates of income and asset

We estimate 3 regression equations for household's gross income, wage income and total asset in terms of their log values as response variable and the estimated coefficients are shown in Table 4. The intercept term (β_0) conditional mean values of the response variable (log values of gross household income, wage income and total asset) without considering the effects of circumstances. While there is no significant gender gap in household's gross income, women earn less wage income as compared to men. Gender discrimination is clear in the case of asset holding. Mean income and asset vary across the religious groups. Christian and Muslim are in better position than the Traditional and other religion[2] in Ghana both in terms of income and asset. Among different religious groups, Muslims have much more average gross income and asset. Although there is no significant difference in average wage income among people across different ethnic groups, a notable difference is observed in asset and gross household income among them. The average asset holding is the highest for ethnic group AKAN as compared to others, but MOLE DAGBANI and MANDE ethnic groups are worse off than the other ethnic group in terms of asset holding. In terms of gross household income, people among GA DANGME, EWE, AKAN, and GUAN ethnic groups have higher average income than those among other ethnic group. But, the average income for GRUSI, MOLE DAGBANI and MANDE is lower than average income for other ethnic group and the position of the ethnic group GRUSI is much worse off than other ethnic group. Households in which parent's education is graduate and above have higher average income and asset as compared to those households where parent's education is below the graduation level.

Table 4 Regression Coefficients of circumstances: all regions

Circumstances	Gross household income	Wage income	Total asset
Intercept	8.53***	8.48***	7.27***
Gender			
Female	-0.01	-0.12***	-0.07***
Religion			
Catholic	0.28***	0.34***	0.38***
Protestant	0.34***	0.37***	0.47***

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[2] People in Traditional religion worship gods like "akonedi", "antoa nyama", "tegare", in Ghana. Other religion includes Eckankar, Bahai, Hinduism, Buddhism, Hare-Khrisna, Yoga and all Transcendental Meditation religions

Pentecostals	0.41***	0.30***	0.33***
Other Xtian	0.19***	0.26***	0.10***
Islam	0.60***	0.18***	0.54***
Ethnic group			
AKAN	0.36***	-0.01	0.38***
GA DANGME	0.52***	0.07	0.30***
EWE	0.37***	-0.11	0.13***
GUAN	0.18***	-0.07	0.17***
GURMA	-0.03	-0.37***	0.29***
MOLE DAGBANI	-0.47***	-0.14*	-0.33***
GRUSI	-0.56***	0.07	-0.07
MANDE	-0.24***	-0.10	-0.25***
Parent's education			
Father graduate	0.47***	0.51***	1.16***
Mother graduate	0.35	1.24***	1.65***

Note: *** significant at less than 1% level, * significant at 10% level, the rest are insignificant

Source: Author's estimates using GLSS 7 unit level data

5.2 Inequality of opportunity in income and asset

The estimated results in Table 4 reveal that the mean income and asset level varies significantly because of the variation in circumstances. As circumstances affect household's gross income, wage income and asset level, inequality of opportunity presents in the distribution. Any measure of inequality of the counterfactual distribution obtained from the estimated values of income and asset by using equation (8) provides a measure of unequal opportunity. In this study, the ex-ante concept of inequality of opportunity is used which is easier to implement than the ex-post approach. The inherent weakness of this approach is that it provides the lower bound estimates of inequality of opportunity (Ramos and Van de gaer 2012). We use Shapley decomposition to find out how much each circumstance contributes to total inequality of opportunity. Table 5 shows the relative measure of inequality of opportunity across regions without a scale obtained by following the method proposed by Ferreira and Gignoux (2014) with bootstrap standard errors shown in parentheses.

In Ghana, 6 per cent of inequality in household's income appears because of unequal opportunity or observed circumstances which is considered to be ethically offensive. The unethical part of inequality is much less for asset and wage income in the country as a whole. The bootstrap standard error based on 100 replications is very small implying the robustness of the estimates. In the less developed regions like Upper East and Upper West, the unequal

opportunity in household's gross income is higher than the developed regions like Greater Accra. In asset distribution, inequality of opportunity is very high in the Eastern region. In wage income, on the other hand, inequality of opportunity is much high in Upper East and Northern part as compared to other parts of Ghana.

Table 5 Inequality of opportunity of household's income, asset and wage income

	Gross household income		Total asset		Wage income	
Western	0.02	(0.004)	0.05	(0.008)	0.04	(0.017)
Central	0.02	(0.004)	0.02	(0.004)	0.06	(0.017)
Greater Accra	0.02	(0.005)	0.02	(0.005)	0.06	(0.016)
Volta	0.04	(0.005)	0.04	(0.006)	0.06	(0.018)
Eastern	0.03	(0.005)	0.08	(0.006)	0.05	(0.017)
Ashanti.	0.02	(0.004)	0.04	(0.005)	0.02	(0.012)
Brong Ahafo	0.03	(0.005)	0.05	(0.006)	0.07	(0.022)
Northern	0.04	(0.004)	0.05	(0.005)	0.13	(0.029)
Upper East	0.06	(0.005)	0.05	(0.005)	0.14	(0.024)
Upper West	0.05	(0.005)	0.04	(0.006)	0.08	(0.023)
All regions	**0.06**	**(0.002)**	**0.03**	**(0.001)**	**0.03**	**(0.005)**

Note: Figures in parentheses indicate bootstrap standard error

Source: As for Table 4.

Tables 6, 7 and 8 provide the results for Shapley decomposition of the estimated inequality of opportunity in percentage form. In estimating inequality of opportunity, we have considered 4 circumstance groups, namely gender, religion, ethnicity and parents' background. The decomposition provides the relative contributions of these circumstances to inequality of opportunity. Differences in ethnicity contributes more than 70 per cent of unequal opportunity in households' gross income in Ghana, while the contribution of religious heterogeneity is nearly one fourth. Parents' education and gender difference contribute a little. In Greater Accra, over 80 per cent of inequality of opportunity appears because of the heterogeneity in ethnic groups. This part of unequal opportunity is relatively in Volta region and Upper East Ghana where unequal opportunity appears mainly because of religious differences among the people in those regions. Although the contribution of parents' education to inequality of opportunity is low, it is notable in Ashanti region.

Table 6 Decomposition of IOP of household income by circumstance groups

	Gender	Religion	Ethnic group	Parents education
Western	0.4	63.8	30.4	5.4

Central	0.2	34.2	62.6	3.0
Greater Accra	0.5	18.0	80.9	0.6
Volta	0.3	70.7	28.2	0.8
Eastern	0.1	57.4	38.5	4.0
Ashanti	1.0	21.3	63.5	14.3
Brong Ahafo	0.3	40.6	58.3	0.8
Northern	0.7	38.7	58.9	1.7
Upper East	0.0	69.7	28.9	1.5
Upper West	3.2	61.0	31.5	4.3
All regions	0.02	24.8	72.6	2.6

Source: As for Table 4.

In asset distribution also the contribution of ethnic diversity is more than 60 per cent to unequal opportunity. The contribution of this group is much higher in Brong Ahafo and Northern region as compared to other regions in Ghana. Unequal opportunity in holding assets is much higher because of religious difference among the people in Upper East, Central and Upper West regions. Differences in parental education, whether graduate or not, contribute nearly one fourth of inequality of opportunity in asset inequality in Greater Accra region, while its contribution at the national level is around 10 per cent.

Table 7 Decomposition of IOP of total asset by circumstance groups

	Gender	Religion	Ethnic group	Parents education
Western	0.03	24.2	61.5	14.3
Central	0.8	59.3	29.1	10.9
Greater Accra	0.3	43.9	31.2	24.7
Volta	5.1	49.6	44.9	0.4
Eastern	0.1	39.6	51.5	8.9
Ashanti.	0.5	49.8	37.3	12.5
Brong Ahafo	1.2	16.3	80.2	2.4
Northern	0.3	26.4	73.2	0.1
Upper East	0.6	67.1	30.6	1.7
Upper West	3.5	56.6	34.8	5.1
All regions	1.1	26.6	62.1	10.2

Source: As for Table 4.

In wage income, on the other hand, the role of all circumstance groups is prominent. Parental background in terms of education contributes to one third of inequality of opportunity in wage earnings. The relative role of this circumstance group is much higher in the Eastern part, Greater Accra region and Western region. Religion contributes 28.9 per cent to unequal opportunity in wage earnings at the national level, but it varies widely across regions. In the

Northern part of Ghana, the contribution of religious difference to inequality of opportunity in wage income is around 50 per cent, while in Brong Ahafo region it is just above 15 per cent. Ethnic diversity also has contributed 27.5 per cent to unequal opportunity in wage showing a greater variation across the region. In Upper East, Central part and Brong Ahafo, the contribution of ethnic diversity is above 70 per cent to total unethical part of wage inequality. Although gender has very little contribution to inequality of opportunity in household's gross income and asset holding, gender difference plays a notable role in explaining unequal opportunity in wage earning. Gender gap contributes to 10 per cent of inequality of opportunity in wage income at the national level. Gender discrimination in wage is relatively high in Ashanti and Volta region, while it is very low in Upper East region.

Table 8 Decomposition of IOP of wage income by circumstance groups

	Gender	Religion	Ethnic group	Parents education
Western	4.6	19.4	34.4	41.6
Central	3.4	15.6	70.4	10.6
Greater Accra	1.7	30.3	24.9	43.1
Volta	11.8	44.8	35.7	7.7
Eastern	9.8	19.6	23.7	46.9
Ashanti.	13.2	41.6	29.1	16.1
Brong Ahafo	8.4	15.2	70.1	6.3
Northern	4.9	50.1	39.1	5.9
Upper East	0.2	18.3	71.6	9.9
Upper West	1.8	36.4	55.4	6.3
All regions	10.0	28.9	27.5	33.6

Source: As for Table 4.

6. Summary and conclusions

This paper sets out to make a detailed analysis of inequality of opportunity for income, wage and asset across different regions of Ghana by using household level information by using GLSS 7 data. The study also provides an objective measure of contribution of different circumstance variables to inequality of opportunity. As circumstances affect household's gross income, wage income and asset level, inequality of opportunity presents in the distribution. In this study, the ex-ante concept of inequality of opportunity is used. We use Shapley decomposition to find out how much each circumstance contributes to total inequality of opportunity.

Rising trend in inequality has been clearly documented in different rounds of living standard surveys (GLSS) conducted in Ghana since 1991. We have calculated Theil's T index of gross household income, wage income and total asset across regions by using GLSS 7 unit level data. Asset inequality is observed to be significantly higher than income inequality. The decomposition of Thail's T index into "within region" and "between region" components highlights that the major part of total inequality in income and asset distribution is originated from the variation of them within the region.

This study focuses on the unethical part of inequality to analyse the rising trend in inequality. Estimating inequality of opportunity of different outcome indicators may take care of the problem of overestimation or underestimation of inequality in terms of a single indicator. We analyse regional pattern of inequality of opportunity and relative contributions of the constituent factors behind it across 10 regions as defined in GLSS.

We have used counterfactual distribution of income and asset in measuring unequal opportunity. OLS estimates suggest that gender discrimination is clear in the case of asset holding. Christian and Muslim are in better position than the Traditional and other religion in Ghana both in terms of income and asset. The average asset holding is the highest for ethnic group AKAN as compared to others. Households in which parent's education is graduate and above have higher average income and asset as compared to those households where parent's education is below the graduation level.

In Ghana, 6 per cent of inequality in household's income appears because of unequal opportunity which is considered to be ethically offensive. In the less developed regions like Upper East and Upper West, the unequal opportunity in household's gross income is higher than the developed regions like Greater Accra. Differences in ethnicity contributes more than 70 per cent of unequal opportunity in households' gross income in Ghana, while the contribution of religious heterogeneity is nearly one fourth. In asset distribution also the contribution of ethnic diversity is more than 60 per cent to unequal opportunity. Parental background in terms of education contributes to one third of inequality of opportunity in wage earnings. Although gender has very little contribution to inequality of opportunity in household's gross income and asset holding, gender difference plays a notable role in explaining unequal opportunity in wage earning.

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