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Do gender wage differences within households influence women's empowerment and welfare?

Evidence from Ghana

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Abstract: Using household data from the latest wave of the Ghana Living Standards Survey, this paper utilizes machine learning techniques to examine the effect of gender wage differences within households on women's empowerment and welfare in Ghana. The structural parameters of the post-double selection LASSO estimations show that a reduction in household gender wage gap significantly enhances women's empowerment. Also, a decline in household gender wage gap results meaningfully in improving household welfare. Particularly, the increasing effect on women's welfare resulting from decreases in household gender wage differences is much higher than for the household welfare. The findings showcase the need to vigorously adopt policies that both increase the quantity and quality of jobs for women and address gender barriers that inhibit women from accessing these jobs opportunities in sub-Saharan Africa.

Key words: household gender wage differences, women's empowerment, welfare, post-double selection LASSO, Ghana

JEL classification: C18, I32, J31

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1 Introduction

The empowerment and welfare of women have become a topical issue in economic development, particularly in the developing world. For instance, because of fewer sustainable economic opportunities, women in sub-Saharan Africa (SSA) on average achieve 87 per cent of male human development outcomes (UNDP 2016). This generally hampers the economic and social development in the region. Over the past two decades, issues of gender equality and related development outcomes such as the empowerment and welfare of particularly women have been recognized as a major global priority. The Millennium Development Goals and now the Sustainable Development Goals (SDGs) have highlighted the importance of gender equality and empowerment of women and girls (SDG 5) and also productive employment and decent work for both men and women in order to promote inclusive and sustainable economic growth (SDG 8). The evidence from studies on women's empowerment suggests that larger roles by women in decision making correlate positively with household well-being (Doss 2006; Doepke and Tertilt 2011; Cuberes and Teignier 2016; Annan et al. 2020). Women's empowerment, which largely connotes the ownership and control of household productive assets and resources by women, has been found to strengthen women's bargaining position within households and communities (Desai 2010; Doss 2013; Meier zu Selhausen 2016). It has therefore become important to provide more robust empirical evidence on what holds women back and what especially limits their ability to make autonomous decisions that can improve their livelihoods.

Recently, progress has been made in narrowing gender gaps in education, health, and political representation; however, these have not been matched by similar developments in labour market outcomes for women. Although there have been significant improvements in female labour force participation over the past 25 years, pervasive and persistent gender differences remain. Evidence from both developed and developing countries shows that women are paid 10–30 per cent less than men on average for the same work (ILO 2018). In SSA, women are significantly lagging in terms of their earning power and employment in professional and technical jobs (World Economic Forum 2017). The gender wage gap (outside agriculture) is pervasive across all labour markets in SSA. The unadjusted gender wage gap is estimated at 30 per cent on average. This means that, for every US$1 equivalent earned by men in manufacturing, services and trade, women earn 70 cents (UN Women 2016). Women typically occupy the worst-paid jobs with the least protection, while attitudes towards gender frequently inhibit entry to better opportunities.

The gender wage gap may inhibit women from having equal access to economic opportunities, thereby thwarting the development outcomes for women (Galor and Weil 1996; Lagerlöf 2003; Blau and Kahn 2006), whereas reductions in the gender wage gap may be beneficial to women and their families. However, gender differences in access to economic opportunities have been mostly debated in relation to gender differences in labour market participation (see World Bank 2012). This exclusive focus on labour force participation provides only a partial picture of women's and men's experience in the labour market. Given the concerns with the gender wage gap, it is imperative to look beyond labour force participation to focus on wage differences and look at how it affects related development outcomes for women. This leads us to the question: do the pervasive gender differences in wage impose significant costs on women's welfare and empowerment?

This question has not been directly answered in the literature. Most studies have focused on how gender inequality may or may not promote economic development at the aggregate level (see Barro and Lee 1994; Barro and Sala-i-Martin 1995; Forbes 2000; Seguino 2000; Klasen 2002; Knowles et al. 2002) whereas a few studies have looked at gender inequality, poverty, and domestic violence (Angel-Urdinola and Wodon 2006; Aizer 2010). It is worth noting that these studies on gender

inequality and economic development draw largely from cross-country macro-level comparisons and have frequently focused on economic growth. As a result, these types of studies are less able to speak generally to the role of gender gaps in shaping household level outcomes.

The other thread of studies has distinctly focused on understanding patterns influencing women's empowerment and welfare on the one hand and gender wage gap on the other. Many of the studies on women's empowerment and welfare have focused profoundly on how microcredit affects women's empowerment and livelihoods (see Pitt et al. 2006; Kabeer 2005; Kim et al. 2007; Garikipati 2008; Swain and Wallentin 2009; Rahman et al. 2017; Al-Shami et al. 2016, 2018). Some of the studies have also looked at explaining women's empowerment and welfare in agriculture (Alkire et al. 2013; Akter et al. 2017; Sell and Minot 2018) and also how access to basic services such as electricity explain women's welfare (Winther et al. 2017). In explaining women's empowerment and welfare, authors use other covariates such as demography and family characteristics, human capital, social norms and culture, and access to basic infrastructural services among others (see Sell and Minot 2018). The set of papers on gender wage gaps in the literature have essentially paid attention to the extent, trends, and explanations of associated factors that drive gender wage gaps (Eastough and Miller 2004; Ilkkaracan and Selim 2007; Casale and Posel 2011; Christofides et al. 2013; Langdon and Klomegah 2013; Bhorat and Goga 2013; Cardoso et al. 2016; Blau and Kahn 2017; Flinn et al. 2018). In explaining the gender wage gap, these papers have focused on differences in human capital, occupations, the industry of work, gender roles, and division of labour.

In this paper we seek to directly answer the question: do the gender differences in wage within households significantly influence women's welfare and empowerment? Here, we use the latest wave of a micro level household dataset from Ghana (Ghana Living Standards Survey 7; see Ghana Statistical Service 2018) that contains relevant information on women's empowerment and welfare and, more importantly, on occupation and ISIC sector of work.[1] In this way, we contribute to the literature on how gender gaps shape a very important household level outcome—women's empowerment and welfare—in SSA where such empirical studies are prominently lacking. To adequately explain the dependent variables and gender wage gap, we introduce as many as possible potential variables that reflect differences in women's empowerment and welfare as well as worker and job characteristics between men and women. The estimation exercise is done via a machine learning technique termed post-double selection (PDS) LASSO. In this case, PDS LASSO treats the issue of model selection, an important estimation concern that fraught many studies on this subject matter (Blau and Kahn 2000; Goldin and Katz 2008). In addition, we account for unconfoundedness—all variables affecting both gender wage gap and the outcome variables (women's empowerment and welfare) are observed. The structural parameters of the PDS LASSO estimations show that a unit reduction in the household gender wage gap significantly enhances women's empowerment by 4.8 per cent. Also, a unit decline in the household gender wage gap results meaningfully in improving household welfare by 5.3 per cent. Particularly, the increasing effect on women's welfare resulting from a unit decrease in household gender wage differences is much higher—about 14.5 per cent—than for household welfare. The findings showcase the importance of adopting policies that would increase the quantity and quality of jobs for women and also the urgent need to work assiduously on addressing gender barriers that inhibit women from accessing job opportunities.

The rest of the paper proceeds as follows. Section 2 introduces and explains how the PDS LASSO methodology is applied to the analysis. The description and source of data are also contained in

[1] The ISIC sector of work refers to the United Nations International Standard Industrial Classification (ISIC) of all economic activities.

Section 2. A detailed discussion of the empirical results is presented in Section 3. The conclusions and policy implications of the study are in Section 4.

2 Methodology and data

2.1 Methodology

In this paper, we employ a machine learning technique—PDS LASSO or double LASSO—for our analysis. PDS LASSO, which relies on the strength of LASSO as a prediction technique, is employed to examine the effect of household gender wage gap on women's empowerment and welfare. The PDS LASSO method in our case addresses high-dimensionality and, therefore, helps in model selection to account for omitted variable bias, given the many potential controls for both the outcome and treatment variables observed in our model.

We consider a model,

$$y_i = \tau d_i + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_k x_k + \varepsilon_i \quad (1)$$

where y_i represents the dependent variables at household i—women's empowerment proxied by share of household assets owned by women, household welfare, and women's welfare. d_i is gender wage gap at household i. $x_j j = 1, \ldots k$ are observable covariates; here, we introduce 103 variables capturing household and family characteristics, demographics, occupation, type of job, social norms, location, formality, and access to certain infrastructure and services at the household level. As we shall see later in the discussion, the variables introduced in Equation (1) include a set of potential variables explaining the dependent variables and another set explaining the gender wage gap. τ and the β_j are unknown parameters.

PDS LASSO is an appropriate fitting criterion compared with standard econometric techniques because of the need for model selection; for instance, in our case, we do not know perfectly which of the set $\{x_1, \ldots x_k\}$ is important for y. Also, given large k (i.e. high-dimensionality), there are concerns with issues of overfitting—some x would be significant by chance; that is, what is termed as false positive and, therefore, would not be significant out of sample.

PDS LASSO is built on the LASSO which exploits the sparsity assumption given a regression model—from a large number of potential covariates k, only a small set of covariates play an important role. Given the large number of covariates, the ordinary least square (OLS) estimates are not unique and an infinite set of solutions ensures that the sum of squared residuals is zero. The LASSO solves this problem by regularization (for detailed discussions on LASSO, see Tibshirani 1996; Zou et al. 2007; Belloni et al. 2012; Mullainathan and Speiss, 2017).

Following on from Equation (1), we can specify a PDS LASSO model in Equation (2) where we estimate the effect of a low-dimensional parameter d_i in the presence of a high-dimensional set of controls x. Following the specification by Belloni et al. (2014a, 2014b), we consider a model where the treatment indicator d_i is exogenous conditional on knowing x as

$$y_i = \tau d_i + \sum_j \beta_{yj} x_{ij} + r_{yi} + \varepsilon_i \quad (2)$$

where $\mathbb{E}\left[\varepsilon_i \middle| d_i, x_i r_{yi}\right] = 0$; x is a k-dimensional vector of controls, r_{yi} is an approximation error, and τ is the average treatment effect.

The unconfoundedness (i.e. the selection on 103 observables of x_j) is done using LASSO while excluding the coefficient $\hat{\tau}$ on the treatment indicator d_i. Therefore, d_i remains in the model. The variables x_y are selected and OLS is used to estimate the coefficients on the selected covariates. In this particular case, statistical inference following model selection is difficult because, at this point, we are *learning* the model. Although we can use the selected controls x_y and re-estimate Equation (2) using OLS, this can be problematic. This is because a variable that is strongly correlated with the treatment indicator d_i will be dropped and cannot add substantial predictive power given that the treatment indicator d_i is already included in the model. This implies that an omitted-variable bias in $\hat{\tau}$ is present if the omitted variable is correlated with d_i and y_i. This may render LASSO useless in *learning* about parameters.

We follow the approach by Belloni et al. (2014b) to resolve this issue. First, we introduce a reduced form relationship between the treatment indicator d_i and the controls x_j. This can be specified as

$$d_i = \sum_j \beta_{dj} x_{ij} + r_{di} + v_i \text{ with } \mathbb{E}[v_i | x_i, r_{di}] = 0 \tag{3}$$

This reduced form model can now *learn* how the controls affect the treatment. This seems very important as it is integral to the conditional mean independence assumptions $E[\varepsilon_i | d_i, x_i]$.

In essence, the reduced form in Equation (3) allows us to control additionally for the factors that are correlated with d_i.

Substituting Equation (3), the reduced form of d_i into Equation (2), infers a prediction rule for y_i given d_i and exogenous x_i as

$$\begin{aligned} y_i &= \tau d_i + \sum\nolimits_j \beta_{yj} x_{ij} + r_{yi} + \varepsilon_i \\ &= \tau \left(\sum_j \beta_{dj} x_{ij} + r_{di} + v_i \right) + \sum\nolimits_j \beta_{yj} x_{ij} + r_{yi} + \varepsilon_i \\ &= \sum_j \pi_j x_{ij} + r_{ci} + \omega_i \end{aligned} \tag{4}$$

$\mathbb{E}[\omega_i | x_i r_{ci}] = 0$, and r_{ci} is a combined approximation error.

Second, a double selection procedure is employed in order to apply variable selection methods to both reduced forms of y_i and d_i, and use the union of the selected predictors ($\boldsymbol{x}_y$ and $\boldsymbol{x}_d$) as controls in the estimation of τ.

The PDS estimator $\hat{\tau}$ is, therefore, the OLS estimator of regressing y_i on d_i and the union of the selected control terms x_{ij} with $\mathrm{j} \in \hat{I} \supseteq \hat{I}_d \cup \hat{I}_y$

$$\left(\hat{\tau}, \widehat{\beta}\right) = \underset{\tau \in \mathbb{R}, \beta \in \mathbb{R}^p}{arg\min}\, \mathbb{E}_n \left[\left(y_i - d_i \tau - \sum_j \beta_{y,j} x_{i,j} \right)^2 \right]$$

$$\beta_{y,j} = 0, \forall j \notin \hat{I}$$

This is done by partialling-out all selected controls from both y_i and d_i via the Frisch–Waugh–Lovell theorem. As a result, we can draw inferences on the causal variable d_i, but not on the selected high-dimensional controls (see Belloni 2014b). Following the PDS LASSO re-estimation with OLS, inference on τ can be drawn using conventional methods.

Practically, our basic set up for estimating the PDS LASSO model involves three steps. In Step 1, we regress y_i on $\boldsymbol{x_j j}$ using LASSO and the set of LASSO-selected controls are denoted by $\boldsymbol{x}_y$. In Step 2, we regress d_i on $\boldsymbol{x_j j}$ using LASSO and the LASSO selected controls are designated as $\boldsymbol{x}_d$. Using the LASSO to select our controls, we avoid researcher 'degrees of freedom' and 'p-hacking' which may occur when researchers consciously or unconsciously choose controls to generate the results they want. In the final step, Step 3, of our modelling, we regress y_i on d_i and $\boldsymbol{x_y} \cup \boldsymbol{x_d}$, the union of the selected controls from Steps 1 and 2 using OLS.

2.2 Description and source of data

The study relied on the latest wave of the Ghana Living Standards Survey (GLSS 7; see Ghana Statistical Service 2018). GLSS 7 is a nationally representative household survey dataset that contains information on a wide range of demographic and socio-economic factors, aggregated at both the individual and household levels. GLSS 7 was conducted in 2016/17. Unlike the earlier rounds of the GLSS, wave 7 captures variables on main occupation as well as the ISIC sector of work. As a result, we were able to obtain detailed information on men's and women's jobs across sectors, industries, and occupations. This is very important as differences in jobs—whether across industries, sectors, and occupations—may primarily explain gender wage differences (see World Bank 2012). We constructed all the set of variables employed in the empirical analysis using this cross-sectional dataset. In the ensuing paragraph, we discuss briefly how the main variables of interest were constructed.

Approach used in computing main variables

Following earlier studies in the literature, we computed the share of total household assets owned by female adult members of a household as a proxy for women's empowerment (see Doss 2006, 2013; Allendorf 2007; Friedemann-Sánchez and Lovatón 2012; Oduro et al. 2015). Household welfare is attained by using the daily expenditure of the household per adult equivalent, regionally deflated, whereas women's welfare is the total household expenditure per adult equivalent for female-headed households.

In this paper, we follow the methodological approach used by OECD (2021) in the computation of gender wage gaps within households. Accordingly, we compute the gender gaps in earnings as the difference between the mean earnings of male and female adult household members relative to the mean earnings of male adult household members. Functionally, this is expressed as:

$$gap\_w = \frac{mean\_earnings_{male} - mean\_earnings_{female}}{mean\_earnings_{male}}$$

The computed mean gender wage gap within households is around 27 per cent. This implies that for every 1 Ghanaian cedi equivalent earned by men within households, women earn 73 pesewas.[2]

[2] 1 Ghanaian cedi=100 pesewas.

The high-dimensional controls used in the study include variables that explain household gender wage gap as well as covariates that also explain the dependent variables as indicated in the PDS LASSO methodology. Following the literature, we include several variables that portray household and family characteristics, human capital, occupation, ISIC sector of work, social norms and culture, formality, location, and household access to basic services and infrastructure (see Ñopo et al. 2011; World Bank 2012; Langdon and Klomegah 2013; Blau and Kahn 2017; Sell and Minot 2018). In all, we have 103 high-dimensional variables in our estimation. See Appendix Table A1 for description and summary statistics of all variables.

3 Discussion of empirical results

In this section, we discuss in detail the results of the structural parameters of PDS LASSO estimations for the effect of household gender wage differences on women's empowerment, household welfare, and women's welfare. As we specify the *rlasso* we get to see the 'rigorous' LASSO results for Step 1 (selected controls for the dependent variables of women's empowerment, household welfare, and women's welfare) and Step 2 (selected controls for household gender wage difference). These sets of controls obtained using LASSO are shown in Appendix Tables A2–A4. PDS LASSO reports three sets of estimations of the structural model. First, the OLS regression is presented using Chernozhukov–Hansen–Spindler (CHS) LASSO-orthogonalized variables. Second, the OLS using CHS post-LASSO-orthogonalized variables are also estimated. The CHS method essentially partials-out from the dependent variables (y_i) only the selected controls $\boldsymbol{x}_y$ in Step 1, and partials-out from gender wage gap only the selected controls $\boldsymbol{x}_d$ in Step 2. Finally, the OLS regression using the PDS-selected variables and all selected controls are presented.

Table 1 presents the structural parameters of the PDS LASSO estimations on the effect of household gender wage difference on women's empowerment. Out of 103 high-dimensional variables, the post-regularization with LASSO selected five controls as important determinants of women's empowerment. These include a regional dummy, mother's education, an ethnic dummy, the age cohort, and an occupation dummy. The six selected controls for the household gender wage differences include father's occupation, ethnic dummies, dummies for ISIC sector of work (wholesale and retail) and for social services, and access to basic infrastructure (electricity) (see Appendix Table A2). It is important to note that statistical inference cannot be drawn from these LASSO residuals. Turning our attention to Table 1, the OLS using CHS LASSO-orthogonalized variables (women's empowerment and household gender wage difference) shows that a reduction in the household gender wage gap significantly increases the share of household assets owned by women. The results for the OLS using CHS post-LASSO-orthogonalized variables are consistent with the estimates of the LASSO-orthogonalized version. The final estimation of the structural parameter using the PDS-selected variables and the full set of selected controls also significantly shows the positive impact of reducing household gender wage gap on the share of household assets owned by women, and thereby women's empowerment. Specifically, a unit decrease in the gender wage gap within households significantly boosts women's empowerment by 4.8 per cent. The findings seem consistent and connected to the literature on women's empowerment. The decline in gender wage gap within the household may enhance the decision-making roles of women, thereby strengthening their bargaining ability and empowering them within the household and community (see Doss 2006, 2013; Meier zu Selhausen 2016; Annan et al. 2020).

Table 1: PDS LASSO estimations for women's empowerment and household gender wage differences

Dependent variable: women's empowerment	Coefficient	Robust SE
Structural equation: OLS using CHS LASSO-orthogonalized variables		
HH gender wage difference	**–0.052*** **	**0.003**
OLS using CHS post-LASSO-orthogonalized variables		
HH gender wage difference	**–0.047*** **	**0.002**
OLS with PDS-selected variables and full regressor set		
HH gender wage difference	**–0.048*** **	**0.002**
Region (Volta)	0.264	0.058
Mother's education (tertiary)	–0.109	0.027
Age cohort (24–35 years)	–0.160	0.014
Occupation (craft and related workers)	0.156	0.078
Father's occupation (services)	0.032	0.008
Ethnicity (Dagomba)	0.108	0.037
Ethnicity (Ewe)	–0.101	0.019
ISIC sector of work (wholesale and retail)	–0.116	0.054
ISIC sector of work (social work)	–0.073	0.007
No access to electricity	0.033	0.019
Observation	880	
High-dimensional controls	103	
No. of selected controls	10	

Note: HH, household; SE, standard error; OLS, ordinary least square; CHS, Chernozhukov–Hansen–Spindler; PDS, post-double selection. Variables represented in italics; main variables of interest represented in bold. Robust SE and test statistics valid for only the *HH gender wage difference* variable. ***p<0.01, **p<0.05, *p<0.1.

Source: authors' estimation based on GLSS 7.

The PDS LASSO estimates for the effect of household gender wage gap on household welfare is presented in Table 2. The selected controls for household welfare and household gender wage gap using the post-regularization with LASSO are shown in Appendix Table A3. The post-regularization with LASSO selected variables such as the number of children under 12 years in a household, father's and mother's education, father's occupation, educational attainment, an ethnic dummy, and access to basic services (cooking fuel) as controls for household welfare. With regard to gender wage gap, the selected controls include time (in minutes) taken by households to get to general use water and back, father's education and occupation, religion and ethnic dummies, occupation, and access to basic infrastructure and services (electricity and cooking fuels). The PDS results report consistent structural parameters for OLS using the CHS LASSO-orthogonalized variables, CHS post-LASSO-orthogonalized variables, as well as the PDS-selected variables and the full set of controls. The results indicate that a decline in household gender wage difference significantly improves household welfare. A unit decline in the gender wage gap within households results in a 5.3 per cent increase in household welfare. In effect, the decrease in the gender wage gap provides better economic opportunities for both men and women in the household. This finding indicates that decreases in gender wage gap within households will contribute to poverty reduction (see Angel-Urdinola and Wodon 2006).

Table 2: PDS LASSO estimations for household welfare and household gender wage differences

Dependent variable: HH welfare	Coefficient	Robust SE
Structural equation: OLS using CHS LASSO-orthogonalized variables		
HH gender wage difference	**–0.047*** **	**0.005**
OLS using CHS post-LASSO-orthogonalized variables		
HH gender wage difference	**–0.048*** **	**0.009**
OLS with PDS-selected variables and full regressor set		
HH gender wage difference	**–0.053*** **	**0.007**
Children <12 years	–0.026	0.006
Father's education (none)	0.031	0.036
Mother's education (none)	–0.155	0.046
Mother's education (secondary)	0.226	0.054
Mother's education (tertiary)	0.321	0.172
Father's occupation (Services)	0.176	0.014
Educational attainment (basic)	–0.122	0.006
Cooking fuel (wood)	–0.325	0.001
Cooking fuel (gas)	0.325	0.021
Time_drinking water	–0.001	0.001
Father's education (tertiary)	0.292	0.102
Religion (Islam)	0.025	0.154
Ethnicity (Ashanti)	0.188	0.097
Ethnicity (Nankasi)	–0.112	0.027
Occupation (skilled agriculture/fishery workers)	–0.067	0.024
Access to electricity	0.239	0.071
Observation	1,709	
High-dimensional controls	103	
No. of selected controls	16	

Note: variables represented in italics; main variables of interest represented in bold. Robust SE and test statistics valid for only the *HH gender wage difference* variable. ***p<0.01, **p<0.05, *p<0.1.

Source: authors' estimation based on GLSS 7.

With respect to the effect of household gender wage gap on women's welfare, the LASSO residuals for women's welfare show variables such as marital status, father's education, religion, and access to basic services (cooking fuel) as the selected controls. The selected controls for gender wage gap are marital status, regional dummy, father's occupation, religion, and ISIC sector of work. The PDS estimates in this case also show that decreases in the household gender wage gap result in significant increases in women's welfare (see Table 3). Here, we find that the percentage increase in women's welfare (around 14.5 per cent) resulting from a unit decrease in household gender wage difference is much higher than that for the entire household welfare. Here again, the decrease in gender wage gap may enhance the ability of women to make independent decisions (such as investing in education, small enterprises, etc.) that may facilitate their access to better economic prospects (Doss 2006; Doepke and Tertilt 2011; Annan et al. 2020).

Table 3: PDS LASSO estimations for women's welfare and household gender wage differences

Dependent variable: women's welfare	Coefficient	Robust SE
Structural equation: OLS using CHS LASSO-orthogonalized variables		
HH gender wage difference	**–0.086*** **	**0.019**
OLS using CHS post-LASSO-orthogonalized variables		
HH gender wage difference	**–0.099*** **	**0.037**
OLS with PDS-selected variables and full regressor set		
HH gender wage difference	**–0.145*** **	**0.075**
Married	0.031	0.128
Region (northern)	–0.222	0.059
Father's education (tertiary)	0.355	0.005
Father's occupation (services)	0.118	0.066
Religion (Islam)	0.113	0.042
Religion (other)	–1.202	0.074
ISIC sector of work (professional and technical activities)	–0.099	0.037
Cooking fuel (wood)	–0.394	0.020
Cooking fuel (gas)	0.744	0.129
Observations	295	
High-dimensional controls	103	
No. of selected controls	12	

Note: variables represented in italics; main variables of interest represented in bold. Robust SE and test statistics valid for only the *HH gender wage difference* variable. ***p<0.01, **p<0.05, *p<0.1.

Source: authors' estimation based on GLSS 7.

4 Conclusions and policy implications

In this paper, we explain the effect of gender wage differences within households on women's empowerment, household welfare, as well as women's welfare using the latest wave of a micro household dataset from Ghana. Given the many issues fraught with econometric estimation with respect to model selection, we use PDS LASSO, a machine learning technique, to carry out the estimations in this study. The findings from the PDS LASSO estimations for the structural parameter—gender wage gap—shows that a unit reduction in household gender wage gap substantially improves women's empowerment by 4.8 per cent. Similarly, a unit decrease in household gender wage gap results in a significant increase in household welfare by 5.3 per cent. The increasing effect on the welfare of women stemming from a unit decrease in household gender wage differences within household is greater—about 14.5 per cent—than that of total household welfare.

These findings speak greatly to the literature on how gender gaps shape development outcomes at the household level. The context of the study—Ghana—is also insightful as such empirical studies on SSA are notably lacking. Largely, the decline in gender wage gap within the household may empower women by improving their decision-making roles and therefore bolstering their bargaining power within the household. Some of these decisions may augment the ability of women to make independent decisions that are beneficial to their well-being. For instance, women may choose to invest in education or set up small enterprises to boost their incomes. Also, the decrease in gender wage gap may facilitate the entry of both men and women to better and sustainable economic possibilities.

The analysis indicates the significance of addressing women's constraints to accessing decent work. There is therefore the need for policy makers to develop strategies that can expand the choices of women and remove the barriers they face in the quest to work. Initiatives under such projects may include well-designed skills development programmes that equally meet the differing demands of men and women.

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Appendix A

Table A1: Description of regression variables and summary statistics

Variable	Description	Mean	SD	Range
HH gender wage gap	Continuous: measures gender gaps in earnings within households	−0.269	5.437	−99–0.964
Women's empowerment	Continuous: measures female empowerment and it is computed as the share of total household assets owned by female adult members of the household	0.437	0.379	0–1
Women's welfare	Continuous: captures the total household expenditure per adult equivalent for female-headed households	10.499	9.879	0.259–245.676
HH welfare	Continuous: captures the daily expenditure of the household per adult equivalent, regionally deflated	9.144	9.841	0.107–546.967
Investment in girl child	Continuous: captures the total amount of expenditure incurred by households towards the schooling of girls aged below 18 years	1,073.234	2,054.17	0–62,220
HH size	Continuous: captures the total number of members of the household	6.276	3.622	1–31
Nationality status	Binary: captures the nationality status of the respondent; it assumes a value of 1 if non-Ghanaian and zero otherwise	0.015	0.122	0–1
Religion	Categorical: measures the religious affiliation of the respondent; it consists of five distinct categories with the following values and associated labels: 0 if 'No religion', 1 if 'Christian', 2 if 'Islam', 3 if 'Traditionalist', and 4 if 'Other'	1.306	0.638	0–4
Ethnicity	Categorical: measures the ethnic group of the respondent; it consists of nine distinct categories with the following values and associated labels: 0 if 'Fante', 1 if 'Dagomba', 2 if 'Nzema', 3 if 'Asante', 4 if 'Nankansi', 5 if 'Dagarte', 6 if 'Ewe', 7 if 'Ga', and 8 if 'Other'	5.571	2.799	0–8
Sex	Binary: measures the gender of the individual; it assumes a value of 1 if 'male' and 0 otherwise.	0.484	0.500	0–1
Age cohort	Categorical: measures the age cohort of the individual; this includes five distinct age groups, namely, '15–24 years cohort', '25–34 years cohort', '35–44 years cohort', '45–54 years cohort', and '55–64 years cohort'	1.375	1.329	0–4
Father's education	Categorical: measures the highest educational attainment of the individual's father; it assumes a value of 0 if 'None', 1 if 'Basic', 2 if 'Secondary', 3 if 'Tertiary', and 4 if 'Don't Know'	0.948	1.247	0–4
Mother's education	Categorical: measures the highest educational attainment of the individual's mother; it assumes a value of 0 if 'None', 1 if 'Basic', 2 if 'Secondary', 3 if 'Tertiary', and 4 if 'Don't Know'	0.514	0.994	0–4
Educational attainment	Categorical: measures the highest educational attainment of the individual. It assumes a value of 0 if 'None', 1 if 'Basic', 2 if 'Secondary', 3 if 'Tertiary' and 4 if 'Don't Know'.	1.348	0.648	0–4
Father's occupation	Categorical: measures the occupation of the individual's father; it assumes a value of 0 if 'Agriculture', 1 if 'Industry/Manufacture', 2 if 'Services', 3 if 'Other', and 4 if 'Don't Know'	0.763	1.069	0–4
Mother's occupation	Categorical: measures the occupation of the individual's mother; it assumes a value of 0 if 'Agriculture', 1 if 'Industry/Manufacture', 2 if 'Services', 3 if 'Other', and 4 if 'Don't Know'	0.820	1.030	0–4

Region	Categorical: measures the region of residence of the individual; it assumes a value of 1 if 'Western', 2 if 'Central', 3 if 'Greater Accra', 4 if 'Volta', 5 if 'Eastern', 6 if 'Ashanti', 7 if 'Brong Ahafo', 8 if 'Northern', 9 if 'Upper East', and 10 if 'Upper West'	5.891	2.890	1–10
Urban	Binary: measures the locality of the individual; it assumes a value of 1 if 'urban' and 0 otherwise	0.363	0.481	0–1
Married	Binary: measures the marital status of the individual; it assumes a value of 1 if 'married'	0.263	0.440	0–1
Children <6 years	Continuous: captures the number of household members aged below 6 years	1.046	1.150	0–11
Children 6–12 years	Continuous: captures the number of household members aged between 6 and 12 years	1.354	1.362	0–10
Public	Binary: measures the sector of employment of the individual; it assumes a value of 1 if 'employed in the public sector' and 0 otherwise	0.051	0.219	0–1
Phone	Binary: measures whether at least one individual owns a cell phone within the household; equal to 1 if yes	0.990	0.101	0–1
Receipt of remittance	Binary: measures whether any member of the household received remittances; equal to 1 if yes	0.046	0.210	0–1
Migrant in HH	Binary: measures whether a household has an out-migrant; equal to 1 if yes	0.071	0.256	0–1
Health	Binary: measures whether the individual consulted a health practitioner in the past two weeks; equal to 1 if yes	0.086	0.280	0–1
Sick	Binary: measures whether the individual reports being sick in the past two weeks; equal to 1 if yes	0.133	0.339	0–1
Formality	Binary: measures whether the individual is employed in the formal sector; equal to 1 if yes	0.178	0.383	0–1
Sex of head	Binary: measures the gender of the household head; it assumes a value of 1 if 'male' and 0 otherwise	0.747	0.435	0–1
Non-poor	Binary: measures the poverty status of the household; it assumes a value of 1 if 'not poor' and 0 otherwise	0.636	0.481	0–1
Distance to get drinking water	Continuous: measures the time (in minutes) taken to get drinking water and back	6.738	3.736	1–16
Distance to get general water	Continuous: measures the time (in minutes) taken to get to general use water and back	5.967	3.952	1–16
Type of dwelling	Categorical: captures the type of dwelling used by the individual; it assumes a value of 1 if 'Separate house', 2 if 'Semi-detached house', 3 if 'Flat/Apartment', 4 if 'Compound house (rooms)', 5 if 'Huts/Buildings (same compound)', 6 if 'Huts/Buildings (different compound)', 7 if 'Tent', 8 if 'Improvised home (kiosk/container, etc.)', 9 if 'Living quarters attached to office/shop', 10 if 'Uncompleted building', and 11 if 'Other'	3.211	1.600	1–11
Number of rooms	Continuous: captures the number of rooms in the household	2.780	1.978	1–33
Number of sleeping rooms	Continuous: captures the number of sleeping rooms in the household	2.368	1.584	1–16
Main source of electricity	Categorical: captures the main source of electricity used by the household; it assumes a value of 1 if 'National grid connection', 2 if 'Local mini grid', 3 if 'Private generator', 4 if 'Solar home system', 5 if 'Solar lantern/Lighting system', 6 if 'Rechargeable battery', 7 if 'Other', and 8 if 'No electric power'	3.142	3.171	1–8
Main source of cooking fuel	Categorical: captures the main source of fuel used by the household; it assumes a value of 1 if 'None, no cooking', 2 if 'Wood', 3 if 'Charcoal', 4 if 'Gas', 5 if 'Electricity', 6 if 'Kerosene', 7 if 'Crop residue', 8 if 'Sawdust', 9 if 'Animal waste', and 10 if 'Other'	2.609	0.986	1–10

ISCO_work	Categorical: captures the category of work done by the individual; it assumes a value of 0 if 'Armed forces', 1 if 'Managers' 2 if 'Professionals' 3 if 'Technicians and associate professionals', 4 if 'Clerical support workers', 5 if 'Service and sales workers', 6 if 'Skilled agricultural, forestry and fishery workers', 7 if 'Craft and related trades workers', 8 if 'Plant and machine operators, and assemblers', and 9 if 'Elementary occupations'	5.612	1.400	0–9
ISIC_work	Categorical: captures the primary sector within which the individual is employed; it assumes a value of 1 if 'Agriculture, forestry and fishing', 2 if 'Mining and quarrying', 3 if 'Manufacturing', 4 if 'Electricity, gas, stream and air conditioning supply', 5 if 'Construction', 6 if 'Wholesale and retail; repair of motor vehicles and motorcycles', 7 if 'Transportation and storage', 8 if 'Accommodation and food service activities', 9 if 'Information and communication', 10 if 'Financial and insurance activities', 11 if 'Real estate activities', 12 if 'Professional, scientific and technical activities', 13 if 'Administrative and support service activities', 14 if 'Public administration and defence; compulsory social security', 15 if 'Education', 16 if 'Human health and social work activities', 17 if 'Arts, entertainment and recreation', 18 if 'Other service activities', and 19 if 'Activities of extraterritorial organisations and bodies'	4.805	5.652	1–19
Main occupation	Categorical: captures the type of work done by the individual; it assumes a value of 1 if 'Legislators/managers', 2 if 'Professionals', 3 if 'Technicians and associate professionals', 4 if 'Clerical support workers', 5 if 'Service/sales workers', 6 if 'Skilled agriculture/fishery workers', 7 if 'Craft and related trades workers', 8 if 'Plant machine operators and assemblers', 9 if 'Elementary occupations', and 10 if 'Other occupations'	5.881	1.399	1–10

Source: authors' compilation based on GLSS 7.

Table A2: LASSO estimations for women's empowerment and household gender wage differences

Selected controls	LASSO	Post-estimation OLS
PDS LASSO Step 1—*y* (share of household assets owned by women)		
Region (Volta)	0.051	0.163
Mother's education (tertiary)	–0.075	–0.166
Ethnicity (Dagomba)	0.019	0.013
Age cohort (24–35 years)	–0.126	–0.169
Occupation (craft and related workers)	0.102	0.172
PDS LASSO step2—*d* (household gender wage difference)		
Father's occupation (services)	0.058	0.067
Ethnicity (Dagomba)	0.121	0.285
Ethnicity (Ewe)	0.044	0.082
ISIC sector of work (wholesale and retail)	0.300	0.379
ISIC sector of work (social work)	–0.133	–0.825
No access to electricity	–0.272	–0.564

Note: OLS, ordinary least square; PDS, post-double selection.

Source: authors' compilation based on GLSS 7.

Table A3: LASSO estimations for household welfare and gender wage differences

Selected controls	LASSO	Post-estimation OLS
PDS LASSO Step 1—*y* (household welfare)		
Children <12 years	–0.031	–0.016
Father's education (none)	–0.095	–0.020
Mother's education (none)	–0.143	–0.216
Mother's education (secondary)	0.132	0.169
Mother's education (tertiary)	0.418	0.446
Father's occupation (services)	0.015	0.210
Ethnicity (Nankasi)	–0.163	–0.066
Educational attainment (basic)	–0.187	–0.152
Cooking fuel (wood)	–0.436	–0.298
Cooking fuel (gas)	0.023	0.316
PDS LASSO Step 2—*d* (household gender wage difference)		
Time_drinking water	0.001	0.001
Father's education (tertiary)	0.046	–0.019
Father's occupation (services)	0.039	0.023
Religion (Islam)	0.208	0.162
Ethnicity (Ashanti)	0.104	0.091
Ethnicity (Nankasi)	–0.214	–1.308
Occupation (skilled agriculture/fishery workers)	–0.084	–0.242
Access to electricity	0.052	0.109
Cooking fuel (gas)	0.037	0.267

Source: authors' compilation based on GLSS 7.

Table A4: LASSO estimations for women's welfare and gender wage differences

Selected controls	LASSO	Post-estimation OLS
PDS LASSO Step 1—*y* (women's welfare)		
Married	0.235	0.261
Father's education (tertiary)	0.267	0.259
Religion (Islam)	0.017	0.044
Religion (Other)	−1.236	−1.269
Cooking fuel (wood)	−0.190	−0.308
Cooking fuel (gas)	0.571	0.612
PDS LASSO Step 2—*d* (household gender wage difference)		
Married	−0.468	−0.724
Region (northern)	0.142	0.825
Father's occupation (services)	0.018	0.187
Religion (Islam)	0.511	(Omitted)
Ethnicity (Dagomba)	0.002	(Omitted)
ISIC sector of work (professional and technical activities)	0.088	0.321

Source: authors' compilation based on GLSS 7.