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Gender Inequality: One of the Greatest Drivers of World Hunger

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Gender inequality is consistently left out of the conversation about global hunger, with most literature focusing on poverty, conflict, natural disasters, or governance as driving factors. We theorize, however, that gender inequality is in fact one of the greatest drivers of world hunger. We find that gender inequality has an associated relationship with a country level measure of hunger, the Global Hunger Index, almost three times that of other driving factors in hunger using a country fixed effects regression. Our findings suggest that programs targeted toward improving gender equality may have higher rates of return for reducing hunger.

Key Words: Global Hunger Index, Gender
JEL Codes: J16, O2

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1. Introduction

Women account for 60% of the world's hungry (World Food Programme, 2009). However, when discussing the issue of global hunger, the disparity between men and women's hunger is often omitted. A study by Cooperative for Assistance and Relief Everywhere (CARE) shows that nearly half of reports on solutions to the hunger crisis do not refer to women or girls and less than 7% of reports propose actions to resolve the hunger disparity between genders (Fuhrman et al., 2020). This paper addresses this gap in the literature by investigating the connection between gender inequality and food insecurity relative to other country-level factors such as GDP per capita, conflict, effective governance, climate change, and natural resource rents that have been shown to affect hunger around the world. We find that gender inequality may have the greatest magnitude of influence over global hunger out of these six factors.

For the past 16 years, the Global Hunger Index (GHI) has measured the level of hunger in over 100 low-income countries with what is called a "GHI score" to aid policymakers in allocating hunger-fighting resources where they are needed most. Each GHI score is made up of four component indicators: undernourishment, child stunting, child wasting, and child mortality (von Grebmer et al., 2021). Every year, the GHI report has a different theme related to factors that impact hunger, such as gender inequality, conflict, governance, or climate change. In each report, field experts provide case studies to explore these themes in relation to hunger.

This paper expands upon these case studies by estimating the magnitude of association between gender inequality and other potential factors that affect hunger with a cross-country panel regression. We find that gender inequality has the strongest association with GHI score, with a one-standard-deviation increase in gender inequality impacting GHI score 2-3 times more than other variables for similar magnitude changes. We also find an increase in government effectiveness or GDP per capita decreases hunger as measured by GHI, though by a smaller magnitude than gender inequality. On the other hand, we do not find a clear relationship between GHI score and natural resource rents or deaths from natural disasters.

2. Literature Review

The annual GHI report provides both GHI scores for countries and discussion related to an important factor related to global hunger. The last report to cover gender inequality was the 2009 GHI, which highlights that women's status significantly influences women's food security and child nutrition (von Grebmer et al., 2009). The report also investigates the correlation between the 2009 GHI scores and the Gender Gap Index[2]. The Gender Gap Index has four subindices: education, health, economic, and political. The GHI team finds that the education subindex has the strongest relationship to the GHI (von Grebmer et al., 2009). A Human Rights Council report published in 2012 also suggests that improving the education of women is the "single most important determinant of food insecurity" (De Schutter, 2012).

The 2017 GHI country case study on Sierra Leone also stresses the importance of gender equality for improving food security (Grønborg-Helms et al., 2017). In 2013, Welthungerhilfe and Concern Worldwide launched a program in Sierra Leone to provide over 1,400 women with training on nutritional needs for themselves and their children and more equal management of household resources. This program showed significant improvements, with the number of

[2] The Gender Gap Index is similar to the index we use to measure gender inequality called the Gender Inequality Index.

children breastfed within one hour after their birth increasing from 60% to 94% and the percentage of fathers who received the best parts of the meat during meals fell over 30% (Grønborg-Helms et al., 2017),

Women's high level of food insecurity is partially due to their limited access to land in patriarchal societies. According to the World Food Program, while women are responsible for 60-80% of food production in developing countries and 50% of food production globally, they own less than 10% of the land (World Food Program USA, 2022). Much of this disparity is due to laws restricting women's inheritance rights. Patri-linearism is the most common societal system in countries with poor gender equality, meaning sons, not daughters, inherit land from their fathers. Furthermore, according to the United Nations Human Rights Council, there is a correlation between land ownership and access to credit, seeds, and farming equipment, leaving landless women farmers with less resources to earn income and achieve food security (De Schutter, 2015).

The second factor that largely contributes to women's food insecurity is intra-household patriarchal dynamics. For example, in patriarchal societies, though women generally prepare the food, they eat last and the least. This, combined with the limited land ownership discussed above, contributes to about 30% of women of reproductive age and 36.5% of pregnant women experiencing anemia, which increases their likelihood of birthing underweight children who have an increased chance of dying before the age of five (World Health Organization, 2021).

Addressing these barriers to women achieving food security is predicted to greatly improve hunger on a global scale. The International Food Policy Research Institute finds that between 1970 and 1995, increases in women's status and empowerment accounted for 55% of the 15% reduction in child malnutrition (Smith & Haddad, 2000). Consequently, according to the World Food Program, improving women agricultural workers' access to seeds, fertilizers and equipment could feed up to 150 million more people each year (World Food Program USA, 2022).

Recent GHI reports have also examined the effects of conflict, governance, and climate. The 2021 GHI report focuses on conflict's connection to hunger, stating that food systems in conflict-affected areas often have "a high level of informality, structural weakness, and vulnerability to shocks" (von Grebmer et al., 2021). According to the World Food Programme, "conflict is still the biggest driver of hunger, with 60 percent of the world's hungry living in areas afflicted by war and violence" (World Food Programme, n.d.). This is because conflict has a negative effect on every aspect of the food system, from harvesting to consumption (*FAO et al., 2021)*. The presence of conflict also reduces governments' ability to mitigate hunger by distributing aid to affected areas.

Additionally, quality of governance has proven to be an indicator of hunger. According to the 2022 GHI report, governance has a strong influence on food security, as consumer preferences, natural resource management practices, and transnational development networks are often persuaded by local government (von Grebmer et al., 2022). This is exemplified by Ethiopia and Bangladesh who both experienced devastating famines in the early 1970s but made tremendous progress when their government invested in agriculture and infrastructure, which curbed the shortage of food and allowed citizen's greater mobility to higher wage areas (Dorosh, 2017).

According to the 2019 GHI report, climate change is also a threat to food security. Extreme weather events, rising temperatures, and a rising sea level all negatively impact food

production and availability, access, quality, and stability of food systems (von Grebmer et al., 2019).

3. Descriptive Statistics & Econometric Model

We link data from 7 sources: Concern Worldwide & Welthungerhilfe's Global Hunger Index (GHI)[3], the UN Development Programme's Gender Inequality Index[4], the Centre for Research on the Epidemiology of Disasters' International Disaster Database (EM-DAT)[5], The Worldwide Governance Indicators (WGI) project[6], the Correlates of War (COW) project[7], and data from the World Bank[8] to construct a data set of over 100 countries and their corresponding levels of hunger, gender inequality, wealth, governance, climate change susceptibility, conflict, and corruption. The descriptive statistics for these variables are presented in Table 1 below. We use a country and time fixed effects regression shown in equation (1) below to measure the influence of country-level factors on a measure of hunger. To compare relative influence of each variable we standardize the country-level factors to create z-scores.

The outcome measure of hunger, GHI Score (*GHI*), is taken for a country, j, in a year, t, and is on a potential scale of 0 to 100. Countries range from below 10, signifying low hunger levels, to scores above 50, signifying extremely alarming hunger levels (von Grebmer et al., 2021). The GHI was calculated for four different years (2000, 2006, 2012, and 2020), so each country has four observations.[9] The mean GHI score of our dataset is about 19, meaning the average country almost surpasses the border of moderate hunger into serious hunger. The GHI score has decreased over time, from 24.8 (severe) in 2000 to 16.1 (moderate) in 2020.

GHI scores are calculated from four different measures: undernourishment, child stunting, child wasting, and child mortality. Undernourishment refers to the percent of a country's population with insufficient caloric intake. Child stunting and wasting refer to the percent of children under age five who have a height or height to weight proportion for their age (respectively) below two standard deviations of international norms, reflecting chronic or acute undernutrition. Lastly, child mortality refers to the under-five mortality rate. The components are scaled from 0 to 100 with 0 representing the lowest level possible and 100 representing the maximum observed level for that country since 1988 (see von Grebmer et al., 2021 for more details). In our dataset, the average score for stunting is 32.7, wasting is 18.4, undernourishment is 17.45, and under-five mortality is 13.6.

The measure of gender inequality (*Gender Inequality*) comes from the UN Development Programme's Gender Inequality Index, which rates countries based on women's reproductive health, empowerment, and participation in the labor market (United Nations, n.d.). The scale ranges from 0 to 1, with 1 representing the greatest inequality. The average Gender Inequality score for the countries in our dataset is 0.47.

To control for the effect of income on hunger we use GDP per capita (*GDPpc*)**.** The sample average is about $11,000 with a standard deviation of $12,500 reflecting that countries included in the GHI reports are relatively poor but are sometimes middle income.

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[3] (von Grebmer et al., 2021)
[4] (United Nations, n.d.)
[5] (Centre for Research on the Epidemiology of Disasters' Emergency Events Database, n.d.)
[6] (Kaufmann, D., & Kraay, A., n.d.)
[7] (Correlates of War, n.d.)
[8] (World Bank, n,d,)
[9] The GHI is recalculated every year based on three or four five-year periods of data. Although the GHI index goes back 20 years, because the data is calculated differently each year, we cannot construct a full panel (von Grebmer et al., 2021).

Quality of governance (*Government Effectiveness*) is measured by the Worldwide Governance Indicators project, which averages data from over 30 existing sources to "rank" countries' governments with values ranging from about -2.5 to 2.5 (equivalent to standard deviations from 0, the mean), with higher values indicated more effective governance (Kaufmann & Kraay, 2021). The average for countries in our dataset is -0.4, reflecting the sample of lower income countries that have GHI scores also have poorer governance on average. We measure the negative effects of climate change with climate deaths per 1,000 persons (*Climate Deaths Per 1000*), measured with data from the EM-DAT which documents deaths caused by natural disasters (The International Disaster Database, n.d.). The average number of deaths from natural disasters is 0.1 per thousand, with a standard deviation of about 1.1.

Conflict in a country is measured with data from the COW project which details if a country has experienced a war in the last 10 years (Correlates of War, n.d.). A value of 1 indicates a country has experienced a war in the last 10 years, while a score of 0 indicates it has not. Almost one-third of the countries in our dataset have experienced a war in the last 10 years.

Lastly, countries' percent of GDP from natural resource exports, which we abbreviate *rents* are measured by the World Bank database (n.d.). For countries with high GDP per capita from natural resources, the relationship between income and hunger is likely weaker. Additionally, we include the difference between current rents and the maximum over the four observations (*Difference in Rents)* to test for the impacts of slumping resource prices, which also have the potential to limit government funds for social safety nets. Finally, we include controls for the GHI years (2006, 2012, 2020) with 2000 omitted for comparison, country fixed effects (*Country*), and an unknown error term ($\mathcal{E}$) .

$$GHI_{jt} = \beta_0 + \beta_2 Z\text{-}genderinequality_{jt} + \beta_1 Z\text{-}GDPpc_{jt} + \beta_6 Z\text{-}effective_{gov}{}_{jt} + \beta_7 Z\text{-}climatedeathpc_{jt} + \beta_5 war_{jt} + \beta_3 Z\text{-}rents_{jt} + \beta_4 Z\text{-}rentdiff_{jt} + \beta_9 2006_j + \beta_{10} 2012_j + \beta_{11} 2020_j + \propto_j \sum_{n=1}^{n-1} country_j + \mathcal{E} \quad (1)$$

One potential threat to the estimation is multicollinearity, given the potential correlation between gender inequality and other influencing factors. We do not find evidence of multicollinearity as the variance inflation factor (VIF) is below 2.4 for all variables. We also show the model is relatively similar with and without country fixed effects (see Appendix A). Country fixed effects control for time invariant omitted variables at the country level such as culture and geography, though time variant changes would be a threat to the estimation.

4. Results

Our results suggest that gender inequality has the strongest relationship to GHI with GDP per capita, conflict, and government effectiveness also having meaningful effects on a country's GHI score (see Table 2 below). Gender inequality has the strongest relationship on all four components of the index. On the other hand, we do not find a statistically significant relationship between GHI score and deaths from natural disasters or difference in rents, and only find a statistically significant relationship between GHI score and rents in our regression without country fixed effects (see Appendix A).

Gender inequality is shown to have the greatest impact on global hunger, with a one-standard-deviation increase in gender inequality increasing a country's GHI score or hunger

severity by about 6.7 points in the main regression, which is about half of a standard deviation in GHI. This is roughly 2-3 times the impact of a similar increase in government effectiveness, conflict, or GDP per capita.

We find that GDP per capita has only a slight impact on GHI score. A one-standard-deviation increase in GDP per capita (which, to contextualize, is roughly the difference between Uganda and Costa Rica's GDP per capita) only lowers GHI score by about 2.5 points in regression.

Government effectiveness is shown to have slightly less of an impact on GHI score as GDP per capita, with a one-standard deviation increase in effectiveness lowering GHI score by roughly 1.3 points. Lastly, conflict is shown to have a similar increase in GHI scores, with countries who experienced a war in the last 10 years having about 1.5 points higher GHI scores, statistically significant at the 5% level. Results are similar with non-fixed effects (see Appendix A).

Gender inequality appears to have the greatest influence out of any variable in our analysis on each of the four components making up the GHI. A one-standard deviation increase in gender inequality increases undernourishment by almost 5 points on a 0-100 scale. Gender inequality is the only variable included in our analysis to appear statistically significant for wasting or child mortality, with a one-standard deviation increase in gender inequality increasing child mortality by 7.69 points and wasting by 4.53 points. On the other hand, GDP per capita, war in the last ten years, government effectiveness, rents, and difference in rents only influence undernourishment by a magnitude of 1.48 to 2.51 points. Similarly, a one-standard deviation increase in gender inequality increases stunting by 9.66 points on a 0-100 scale, while GDP per capita and war only influence stunting by -5.31 and 2.49 points respectively.

5. Conclusion

We find that gender inequality's association with GHI score is roughly two to three times that of other factors. GDP per capita, effective governance, and conflict are shown to have lesser impacts. A limitation of this study is that similar to most cross-country analyses, establishing a causal link is difficult, so we are cautious to interpret beyond correlations. In closing, our findings are suggestive of the importance of improving gender inequality as part of addressing global hunger.

6. Tables

Table 1. Summary Statistics

Variable	Mean	Std. Dev.	Min	Max
GHI Score	18.86	12.35	1.7	64.3
Gender Inequality	0.47	0.15	0.09	0.8
Climate Deaths Per 1000	0.1	1.13	0	21.81
War	0.3	0.46	0	1
Government Effectiveness	-0.35	0.64	-2.03	1.34
Rents	8.01	11.68	0.001	67.92
Difference in Rents	3.57	5.49	0	27.46
GDP Per Capita	$10,926	$11,586	$631	$96,262
Undernourishment	17.45	14.74	0.25	67.75
Stunting	32.74	20.79	1.29	91.43
Wasting	18.37	13.54	1	71
Under-5 Mortality	13.56	12.16	0.57	65.14

Observations: 385, Countries: 110

Table 2. GHI Score Regression Results

VARIABLES	(1) Fixed Effects	(2) Undernourishment	(3) Stunting	(4) Wasting	(5) Child Mortality
Z-Gender inequality	6.651***	4.998***	9.661***	4.533***	7.692***
	(0.527)	(0.734)	(0.876)	(0.833)	(0.596)
Z-GDPpc in 1000s	-2.460***	-2.512**	-5.312***	-1.522	-1.431*
	(0.714)	(1.024)	(1.245)	(1.167)	(0.791)
War in the last ten years	1.532**	1.879*	2.494**	1.175	0.335
	(0.749)	(1.005)	(1.175)	(1.136)	(0.878)
Z-Deaths from natural disasters	-0.0438	0.152	-0.269	-0.291	-0.0962
	(0.237)	(0.311)	(0.360)	(0.351)	(0.285)
Z-Government effectiveness	-1.340**	-2.442***	-1.208	0.0178	-0.768
	(0.596)	(0.829)	(0.988)	(0.941)	(0.676)
Z-Rents	0.879	2.160**	0.237	1.110	-0.151
	(0.612)	(0.913)	(1.145)	(1.046)	(0.661)
Z- Difference in rents	0.549	1.481***	0.382	0.141	0.0260
	(0.393)	(0.558)	(0.683)	(0.636)	(0.445)
Constant	18.45***	17.17***	31.74***	18.41***	13.26***
	(0.628)	(0.956)	(1.213)	(1.097)	(0.667)
Observations	385	385	385	385	385
Number of countries	110	110	110	110	110
R-squared	0.68	0.49	0.60	0.21	0.60

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Z- “Standardized values of-”

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Appendix A: Comparison of Main Regression and Single Variable Regressions

We first reproduce the main regression (Table 3, Column 1)[10] and compare it to running single variable regressions (Table 3, Column 2) in case of multicollinearity. We see an increase in the effect of GDP per capita, war in the last 10 years, and government effectiveness on GHI by about 3-4 times, but gender inequality still has the largest effect. Next, we run the main regression, but with non-fixed effects (Table 3, Column 3), and compare it to running single variable regressions also with non-fixed effects (Table 3, Column 4). Again, gender inequality shows to have the largest effect on GHI in both regressions.

Table 3. Main Regression, Non-Fixed Effects, & Single Variable Regressions

VARIABLES	(1) Fixed Effects w/ GDPpc	(3) Fixed Effects w/o GDPpc	(2) Non-Fixed Effects w/ GDPpc	(4) Non-Fixed Effects w/o GDPpc
Z-Gender Inequality	6.651***	7.415***	6.519***	7.500***
	(0.527)	(0.485)	(0.479)	(0.460)
Z-GDP per capita	-2.460***		-3.280***	
	(0.714)		(0.602)	
War in last ten years	1.532**	1.370*	2.443***	2.327***
	(0.749)	(0.756)	(0.823)	(0.853)
Z-Deaths from natural disasters	-0.0438	-0.0684	0.226	0.0852
	(0.237)	(0.238)	(0.335)	(0.346)
Z-Government Effectiveness	-1.340**	-2.234***	-1.683***	-3.214***
	(0.596)	(0.540)	(0.544)	(0.483)
Z-Rents	0.879	-0.0759	1.312***	-0.166
	(0.612)	(0.564)	(0.503)	(0.440)
Z-Difference in Rents	0.549	0.271	0.0901	-0.0942
	(0.393)	(0.392)	(0.459)	(0.474)
Constant	18.45***	18.41***	18.22***	18.21***
	(0.628)	(0.653)	(0.444)	(0.460)
Observations	385	385	385	385
R-squared	0.68	0.65	0.680	0.66
Number of countries	110	110		

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Z- "Standardized values of-"

[10] Table 3, Column 1 is the same regression as Table 2, Column 1

Appendix B: Comparison of Results with and without GDP Per Capita

We first reproduce the main regression for comparison (Table 4, Column 1)[11] and then compare it to an identical regression omitting GDP per capita given its potential strong effects on the other variables. (Table 4, Column 2). We observe similar results between the two regressions. Next, we reproduce the main regression with non-fixed effects (Table 4, Column 3)[12] and compare it to an identical regression again omitting GDP per capita (Table 4, Column 4). The main difference we see between these two regressions is that government effectiveness shows to have twice the effect on GHI in the regression without GDP compared to the regression with GDP. Although, government effectiveness still has less than half the effect of gender inequality on GHI.

Table 4. Fixed Effects & Non-Fixed Effects with and without GDP Per Capita

VARIABLES	(1) Fixed Effects w/ GDPpc	(3) Fixed Effects w/o GDPpc	(2) Non-Fixed Effects w/ GDPpc	(4) Non-Fixed Effects w/o GDPpc
Z-Gender Inequality	6.651***	7.415***	6.519***	7.500***
	(0.527)	(0.485)	(0.479)	(0.460)
Z-GDP per capita	-2.460***		-3.280***	
	(0.714)		(0.602)	
War in last ten years	1.532**	1.370*	2.443***	2.327***
	(0.749)	(0.756)	(0.823)	(0.853)
Z-Deaths from natural disasters	-0.0438	-0.0684	0.226	0.0852
	(0.237)	(0.238)	(0.335)	(0.346)
Z-Government Effectiveness	-1.340**	-2.234***	-1.683***	-3.214***
	(0.596)	(0.540)	(0.544)	(0.483)
Z-Rents	0.879	-0.0759	1.312***	-0.166
	(0.612)	(0.564)	(0.503)	(0.440)
Z-Difference in Rents	0.549	0.271	0.0901	-0.0942
	(0.393)	(0.392)	(0.459)	(0.474)
Constant	18.45***	18.41***	18.22***	18.21***
	(0.628)	(0.653)	(0.444)	(0.460)
Observations	385	385	385	385
R-squared	0.68	0.65	0.680	0.66
Number of countries	110	110		

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Z- "Standardized values of-"

[11] Again, this is the same regression as Table 2, Column 1
[12] This regression mirrors Table 3, Column 3