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Feeding Peace: An Investigation of the Relationship between Food Insecurity and Violence

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Abstract

Violence has increased drastically over the last few years. Research has shown that a more violent population leads to an area with unpredictability which is linked with lower GDPs and higher amounts of instability. This paper attempts to address the effect of *food insecurity on violence within a population. Using data from World Bank and the Global Peace Index it is believed that there is a positive correlation/causation of food insecurity on violence throughout the world. The paper will look at the aggregate effects caused by food insecurity on violence by looking at over 160 countries during a six year period. This paper conducts a regression using OLS, OLS with fixed effects, multi-probit model, and instrumental variables. Overall, it was found there was no statistically significant relationship between food insecurity and violence.*

Introduction

Food insecurity is a health problem that has increased since the beginning of this century. The United States Department of Agriculture (USDA) defines the term "food security" as "access by all people at all times to enough food for an active, healthy life" (USDA 2011).[1] Additionally, there was a steady increase in food prices starting in 2001 and increasing at the fastest rate seen in history, with a peak in 2007-2008 (Food Agriculture Organization 2008). Recently, outbreaks of war and other forms of violence have become more prevalent in society. Whether the area is on the streets of Chicago, Syria during the civil war, or the Arab Spring in 2011, one particular variable has been connected to this violence; food insecurity. Substantial amounts of the civil unrest that occurred during 2007 in the Middle East was due to the rise in food prices that left individuals in those countries food insecure (FAO 2011). In 2011, The Food and Agriculture Organization (FAO) recorded the highest increase in the cost of food that has ever recorded. Furthermore, research has shown that higher rates of violence are due to a lack in food security (Per Pinstrup-Andersen and Shimokawa (2008).

Maslow (1970) said that each individual looks to complete a hierarchy of needs. Those needs include basic needs for survival (i.e. food, water, and shelter). Therefore, when an individual is deprived of a basic need there is an increased amount of economic, physical, mental, and emotional stress that the individual feels. When a large group is denied these rights- including continuous access to food, access to clean drinking water, access to shelter - the marginal benefit to follow the law significantly diminished, while the incentives to break the law increases (Becker 1968).

The United Nations (UN) and FAO have both published goals to help diminish food insecurity. According to the FAO (2008), when there is an increase in food insecurity due to food prices there is an increased risk of conflict and violence. When a country is more violent we see an overall decline in quality of life within that country. Goal two of the United Nations Sustainable Development Goals of 2030 was to take action to end hunger. With a decrease in the quality of life there is also a multitude of

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[1] The World Health Organization, has a similar definition "when people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life", places the concept of food security on the three pillars: food availability, food access, and food use (WHO 2009).

negative economic implications. Subsequently, both the UN and the FAO has found connections between quality of life and food security.

This paper will look at indicators specific to food insecurity and at their effect on violence across countries. The primary objective will be to look at all the countries and see if any pattern emerges between the level of food insecurity and violence. This is important because it allows for further potential grouping between countries with a high amount of food insecure and violence versus countries with less hunger and violence issues. The data for violence will be taken from the Global Peace Index. The data for food insecurity and the rest of the indicators will be from World Bank. The connections between countries allows for further exploration and affirmation of the previous research before it. The methods used within this research will be a logit probit model based off of a paper conducted by Per Pinstrup-Andersen and Shimokawa in 2008, as well as, OLS, OLS with fixed effects, and instrumental variable to look at potential causality. This will allow me to see the effect of food insecurity on a country deemed to have violence.

When there are similar countries it is important to figure out what important changes were experienced by one country and not another. I will not only look at the regions within the world but I will also look at the effect of aid within a country. This data will also be from the World Bank and the Global Peace Index. Establishing a reason as to why one country succeed while another failed will lead to more evidence of policies that can be enacted because it will paint a better picture of food insecurity's effect on violence.

I hypothesize that the relationship between food insecurity and violence is not only correlated, but there exists a causational relationship with more food insecurity leading to increasing levels of violence. If this study shows a strong correlation between hunger and its relationship to violence it gives even more incentives to country officials and global organization like the UN and the FAO to allocate more funds towards and assist in providing sustainable food systems. Furthermore it validates organizations like the United Nations objectives to end world hunger not just for moral reasons but for economic reasons as well. The UN also claims that a nation with higher rates of food insecurity is correlated with higher rates of poverty. Living in constant

fear of having a lack access to basic human rights has been shone to lead to a higher level of violence. This, then, would cause lower productivity of a nation and a lower GDP as well.

In this paper we will examine the relationship between hunger and violence. This will be accomplished in multiple sections. The next section will examine some of the past literature presented on these two topics. Then there will be an exploration of theoretical and empirical framework. This will be followed by a brief discussion of the data, as well as summary statistics. Finally, the results, limitations, and future recommendations will be discussed.

Literature Review

The relationship between food insecurity and violence has not been well established within the economics community. However, there is some research on food insecurity and violence from non-economics fields that observe a positive correlation: (Per Pinstrup-Andersen and Shimokawa (2008); Sobek and Boehmer (2009); World Food Programme (2011)).Therefore this section will look at two concepts: food insecurity and violence.

Research on food insecurity/poverty

Poverty leads to an inability to effectively maintain a strong quality of life. A lower quality of life leads to more civil unrest within a country and civil unrest usually leads to higher levels of violence. It has been seen that poor nutrition leads to more civil conflict (Per Pinstrup-Andersen and Shimokawa 2008). Also, in 2011 the World Food Programme (WFP) released a report, and one of the major findings talked about the effects that food insecurity has on violence through-out countries. It further goes on to say that food insecurity leads to an increase of rioting, violence, civil conflict, and can lead to a lot of sociological, psychological, and economic distress upon an individual or in a family dynamic (WFP 2011). The WFP report concluded that food insecurity is "both a cause and a consequence of violence, contributing to vicious cycle or conflict trap." It can also lead to a strong dissociation within a community and when it leads to a higher amount of inequality. An area with lower GDPs and higher amounts

of governmental and economic instability has resulted in a higher amounts of violence within a community (Thorbecke and Charumilind 2002).

Additionally, food insecurity is multi-faceted in that no single variable can fully summarize it at a country or even an individual level; it can be reflected by rates of malnutrition, food production index, prevalence of stunting, prevalence of underweight, and life expectancy. For example, according to the World Bank and the World Health Organization (2014), the 43 countries with highest levels of malnutrition are from sub-Saharan Africa. Sub-Saharan countries contribute to about 2% of the world's GDP, and they suffer from some of the worst food insecurity issues. The average life expectancy in these countries is 57, which is 22 years less than that of the United States. It also has some of the worst civil conflict happening around the world today.

Since there is high amount of food insecurity and low amounts of income, evidenced by the low levels of GDP per capita, some relationships can be seen between food insecurity and income (Arora 2001). Food insecurity not only causes malnutrition, but can have a multitude of other effects. When an individual has an increased amount of food insecurity there is also higher risks of illness due to secondary malnutrition (Foster 2009). Therefore, it is important to note that disease prevalence caused by the increase in food insecurity issues leads to a high economic burden on any economy. It can be seen in Cole and Neumayer (2003) that health in general affects economic growth through total factor productivity (TFP). They found that poor health has a significant and robust negative effect on TFP. Therefore we see a relationship between food insecurity and violence, as well as food insecurity and poverty.

Research on violence

Mehlum et al (2005) looked at the effect of poverty traps and the tendency towards higher crime rates. The authors talked about the dangers of poverty traps, the consequences of having an impoverished country with a higher level of crime and the reoccurring cycles it can create. Furthermore, they also discuss the effect of economic stagnation, its relationship to poverty, and how it leads individuals into crime. Crime can also lower business profitability, as well as reduces the effectiveness of the economy and reduces growth.

There has been studies within economics that show the relationship between similar issues like crime and inequality. Demombynes and Ozler (2005) looked at the effects of crime and inequality in South Africa in the 1990's. They found that overall there was a direct and positive relationship with an increase in crime and inequality. It was also presumed that there was a relationship with incentives for criminal activity in areas that had higher levels of the inequality. More studies done by Fajnzlber et al. (2002) also found a positive relationship between violence, armed conflict, and inequality. They looked at panel data to find factors that help contribute to violent crime. They also analyzed homicide and robbery rates within multiple developing and developed countries from 1970-1994. The overall results given saw an increase in crime when there is an increase in income inequality. This is important when attempting to look at my research because it shows relationships between crime and other basic needs.

To establish strong productivity it is important to have the basic human needs met. An increase of the basic human needs increases the quality of life. When the individuals of a country have a better quality of life they become overall more productive. If an individual has a lack of food and resides in a war torn country there is a delay in the development of productivity (Perry 2006, Alesina, & Perotti 1996). Both the concepts of quality of life and productivity can be seen as important on a micro and macro level. Individuals want a decent quality of life while a country usually wants a more productive workforce.

Moreover, there have been many articles that claim that economic growth and quality of life are interlinked. Also, it can be seen that as quality of life increases, productivity of a nation increases. Jorgenson (1991) reported that productivity accounts for about 21.6% of growth in the United States. In addition to increases in labor productivity which might result directly from a healthier workforce, it is important to note that an increase in life expectancy means extra years of working.

After looking at the literature, this research can contribute to the literature in a multitude of ways. Since there is a lacking within the economic literature to support this relationship it has caused a need for this research to be conducted. My study looks at

the relationship between food insecurity and violence by taking multiple data sets to create my food insecurity as well as my violence variable.

Theoretical Specification

Becker (1968) wrote a paper in order to look at the effect of crime and punishment in a society. He looked at crime as a breaking of rules created by the governing body of that country. Then he looked at how crime affects the national budget as well as the amount spent because of crime. This increases both private costs (for example buying a security system for your home) and public costs (increasing the number of police in order to arrest people breaking the law). His work has provided a framework of a cost-benefit analysis on crime. The marginal effects are broken down into two equations.

$$H_i = H_i (0) \; H_i'>0$$

$$G_i = G_i (0) \; G_i'<0$$

In the first equation stated above, H represents the harm to a victim. When H is greater than zero we see an increasing marginal harm to the victims. This can cause harm to a society, because the greater harm done to a population the less productive the population can become. The second equation uses G to represent the offender, as G becomes less than zero we see a decrease in marginal gain. This means that at some point the crime is no longer worth what a criminal receives. This could mean the crime is more dangerous or it has a longer sentence if the person is caught.

Further, he continues to build a model for the effects of crime and what are potential reasons for committing such crimes. Since there is some evidence to show a benefit to commit a crime, the negative effects of the crime must be compared with the positive effects. According to this model, the marginal cost of a crime must be compared as less than its marginal benefit in order for a crime to take place. The sum of the person's income and the other social and financial responsibility that this person may have can lead to a higher marginal benefit to commit such crime. Now at some point Becker argues that eventually there is a diminishing marginal gain from each additional level of crime that an individual commits.

Therefore the marginal benefit of committing a crime is greater than the likelihood of getting caught and the severity of the punishment. It can also been seen within the political and sociological realms that there are connections between food insecurity and violence. The marginal benefit of violence increases when basic needs, like food security, are not being met in a society. While there has been an established relationship between violence and its effect on investment and income inequality, there has been few studies on the effect of food insecurity on violence on an aggregate level (Morenoff 2001). The offender's expected utility in committing a crime can be represented as the following equation:

$$E\ (U_j) = p_j U_j\ (Y_j - f_j) + (1 - p_j)\ U_j\ (Y_j)$$

This equation looks at the overall expected utility from a crime that they would commit. Also included in the equation are the benefits that the individual will receive in committing the crime, while F represents the marginal cost or the punishment for the offense.

Empirical Specification

Countries that are developing have an increase of individuals in poverty. This relates back to what Becker (1968) called the incentive of criminal activity or violence. When the cost of living increases to the point where non-criminal activity does not support all of the necessary needs of survival, Becker's theory says that those individuals will do what they must in order to provide for themselves. Furthermore, Ehrlich (1973) stated there is also higher payoffs with crime when the median income of the community is low. In this paper the goal is to provide causation between the independent variable and the dependent variable of interest. In connection with past literature and with the theoretical there is strong evidence to suggest some form of causal relationship. In order to test for a causal relationship several tests should be conducted one of which is instrumental variables. The use of instrumental variables allows to test for a one way causal relationship. This is important because it means that a higher amount of food insecurity causes an increase in the amount of violence a country experiences. Another test that will be run in my research will look at the

probability of food insecurity if violence falls within certain levels. This test was also conducted in the past literature to look at the effects of food insecurity on violence.

Different than the Becker equations, my model incorporates the violence aspect, instead of crime, and also adds my food insecurity variable (FOODINSER) to account for hunger. It will incorporate the effects of other indicators like food insecurity (food deficit and undernourishment), population, GDP per capita, and amount of individuals that live in an urban area. According to the theoretical model this equation will be based on the OLS estimator to run my model. Therefore, the equation for this paper will be based off of the Per Pinstrup-Andersen and Shimokawa (2008) model and will be written as follows:

$$GPI_{it} = B_0 + B_1 \text{logfinsec}_{it} + B_2 \text{pop}_{it} + B_3 \text{GDPgrowth}_{it} + B_5 \text{Urban}_{it} + U_{it}$$

In this equation my main focus will be the impact of food insecurity on violence. Since that relationship is my primary focus, B_1 will be the coefficient of interest. Since the original model takes the logs of the violence I will also take the logs within my equation. Whereas the logs will create elasticities meaning that I can see the effects of food insecurity and violence as percentages with the equation. This will look at the effects of food insecurity on violence. The equation will also be broken down to look at two aspects of food insecurity; undernourishment and food deficit.

Within this equation it is expected to have a positive relationship between the main variables violence and food insecurity. This first test of correlation will allow some type of relationship to be stated between my independent and dependent variables. A positive and statistically significant sign would mean that there is a strong relationship between violence and food insecurity. This can be determined by using a test using instrumental variables. Unlike a basic OLS regression, the use of instrumental variables allows for causality to be determined. Therefore it is extremely important to test with instrumental variables in order to provide causality that food insecurity causes violence. In order to test for instrumental variable, two different indicators will be used in order to conduct a robustness check. In order for an instrumental variable to be a good instrumental variable it must fulfill three characteristics: it must be endogenous, statistically insignificant with the independent variable, and strongly correlated with

your indicator of interest. When looking for an instrumental variable, I decided to use aid per capita and neighboring aid. Theory suggests that the variables have a strong relationship with food insecurity but little relationship with violence. When tested these two indicators fit the characteristics stated above. The last type of estimation type that will be used is a probit model. This model will breakdown the amount of violence into three categories and allow for more inferences on the degree of violence that is experienced by food insecure nations. This type of estimation has been used in past literature and therefore will allow me to test my results even further. This is the fundamental contribution I will have made to the literature. If there is a positive relationship that means there is a connection between food insecurity and violence. This is because as the population increases the amount of food needed increases. There is also a negative relationship between GDP and violence. The more a country makes the lower the amount of violence is found.

Data and Descriptive Statistics

 Data

 This panel data will be taken from the World Bank and the Global Peace Index from 2008-2014. The World Bank will provide the data for hunger indicators and the global peace index will provide the indicators for violence.

 The dependent variable within the equation will be violence. Therefore, I will use multiple factors in order to account for violence. In order to account for violence I use the Global Peace Index data from 2008-2014. The specific indicators that the GPI uses to determine if a country is peaceful are stated as follows: perceived criminality in society, security officers and police, homicides, jailed population, access to weapons, organized conflict (internal), violent demonstrations, violent crimes, political instability, political terror, weapon imports, terrorist activity, deaths from conflict (internal), military expenditures, armed services personnel, UN peacekeeping funding, number of nuclear and heavy weapons, weapon exports, displaced people, and neighboring country relations. These categories are scored and ranked from 1 (most peaceful) to 5 (extreme violence). The mean of the GPI is 2.02 with a minimum of 1.07 and a maximum number being 3.498. The numbers are not based off of other countries'

rankings but have a separate judging as criteria. This is beneficial because it looks not only at cross-sectional data but it also at every year from 2008-2014 so there is a strong time-series that has been established. In the appendix, Figure 1 shows a map demonstrating the breakdown of violence in 2013 per country. The bluer the countries the more peaceful, yellow is moderately peaceful, and red is considered violent.

The data on food insecurity was collected and observed by World Bank. The food insecurity variable was tested with two different indicators; food deficit and undernourishment. Food deficit refers to the amount of calories under the daily total needed for individuals in a particular country. Food deficit is represented as kilocalories (Kcals) and a lack of Kcals mean that an individual is not consuming enough calories. When an individual is undernourished that is considered food insecure. The undernourishment variable looks at the percentage of the population that is considered undernourished. Since this two variables represent similar characteristics then, instead of combining them into one equation, I broke my equation down into two separate equations. Overall the data used in this sample has either 753 total observations for the undernourishment model or 757 total observations for the food deficit model. Within the literature it is postulated that there is a positive relationship between GPI and the food insecurity variables.

The other indicators used in my model are the GDP growth rate, total population of a country, and the amount of individuals living within an urban population and were used from World Bank data. GDP growth rate looks at the economy growth from year to year. Total population is the number of individuals living within a country, represented in thousands. Urban population looks at the amount of individuals living within a country that live in urban areas. The last variables I will use in order to test using instrumental variables is aid per capita and neighboring aid. Aid per capita is how much foreign aid a country is receiving per capita. Neighboring aid looks at the amount of aid that the countries surrounding that particular country are receiving. This two variable are not used in my original model but will be added later in order to test for causality. Figure 2 shows the descriptive statistics for the model that includes food deficit. The descriptive statistics include 757 data points for the model for the amount of years.

Figure 3 shows the descriptive statistics for the model that includes undernourishment. This model has a total of 753 data points.

The sample for this paper was chosen in order to paint a strong picture between the relationship between food insecurity and violence. According to the past literature, the population and the economy are necessary indicators in the model in order to provide an accurate result of the data. My dependent variable is the Global Peace Index countries. My independent variables will be the food insecurity indicators, undernourishment and food deficit, GDP per capita, urban population, and total population.

Findings/Results

The empirical model was then tested using several different estimation techniques. Those techniques include a basic OLS (ordinary least squares) regression to establish a baseline of the potential effects. At first, I found the results for OLS to be insignificant; however, there are five main assumptions that must be met in order to use OLS without spurious results. The fourth assumption for OLS is zero conditional mean. This means that the error terms are not correlated with my independent variable, violence. However, there are some reasons to believe that there are some potential variables that have not been accounted for that are being transferred to the error term. One potential example could be income inequality. In reading the past literature it was found that income inequality is a potential factor in effecting violence. However, due to a lack of data the income inequality was not able to be included. This would have led to potentially spurious results using OLS. Therefore OLS is not a sufficient method in testing my model. One way to correct this test is to use fixed effects.

The fixed effects assume that the individual specific effect is correlated to the independent variable. The test for seeing if fixed effects are a good test for the equation is the Hausman test. Then I ran a Hausman test and found that my model needed to be tested with fixed effects. I ran the results with a fixed effects model and found that my results were still statistically insignificant (see figures 4 and 5). However, when testing with fixed effects there can be issues in testing the causation and correlation of my model. In a model, in order to prove causation, the model must show a one way

directional. Furthermore, even though fixed effects can help hold some of my model constants, like country or year, it will not hold other variables that are not included in the model constant. In my model the country, region (broken down into North America, Europe, Africa, South America, Oceanic, and Asia), as well as the years (2008-2014) were testing being held constant. However, when conducting the fixed effects I also found my results to be insignificant. While this could have been because my results are truly insignificant it could also lead to further issues of endogeneity. Furthermore since my experiment cannot be truly random the use of instrumental variables can help with controlling for those issues. The use of the instrumental variables can help prove causation and will allow the other variables to be help constant.

Then, I ran my model using a 2 staged least square (2SLS) in order to test my instrumental variable and see the relationship of causality and endogeneity. The first stage is where I tested to see if my instrumental variables (aid per capita per country/neighboring country aid) were good instrumental variables. There are some reasons to use two different variables. The neighboring country aid is used as a robustness check for the aid per capita per country. The first stage provided evidence that aid was a strong instrumental variable. The two conditions that must be satisfied are that my instrumental variable is uncorrelated with the error term and is correlated with my food insecurity variable. When testing my instrumental variables I found that it was uncorrelated with the error term and have high correlation with the food insecurity variable. However, when testing my variables, I found a positive relationship between my aid variables and my food insecurity variables. The justification is that aid is given to countries that are food insecure; this means that as my aidpercapita or neighboringaid variables might increase in order to provide additional aid to countries that are food insecure. This can lead to a positive relationship, versus a negative relationship that one might expect. This is the first stage of the two stage least square.

Then the second stage of the least square looks at the effect in my model. This was tested using both the countries aid and the neighboring countries aid variables. When testing my model using the instrumental variables it also provided insignificant results. I tested two different instrumental variables, the amount of aid per capita a country receives and the average aid the neighboring countries received for the second

part of the least square. I tested both of the instrumental variables and found that they both fulfilled the requirements of being a strong instrumental variable (uncorrelated with the error and highly correlated with food insecurity). I also decided to test the two variables in separate equations because of potential biasness. Both of the instrumental variables are highly correlated with each other and I did not want to skew the results and cause endogeneity issues in the model. I did this because there was some concern with potential endogeneity between the Global Peace Index and my food insecurity variables. Furthermore, the GPI has a vast amount of factors that make the number for the Global Peace Index and that can cause potential endogeneity.

Once I tested my model with fixed effects and instrumental variables, I proceeded to test using a multi-probit model. This is following the article of Per-Pinstrup Andersen and Shimokawa and attempts to address the issues of food insecurity and violence by looking at the probability of the multi probit model. In order to run the multi-probit model, I broke down the GPI into three sections. This was broken down by the Global Peace Index definition of most peaceful down to least peaceful. This is important because it allows my model to test the probability of a country having more violence with higher rates of food insecurity. The first section grouped countries that were considered peaceful, second was countries considered to experience moderate levels of violence, and finally I looked at countries that were considered violent. This test is used to look at the probability of outcome with an increase in the total amount of violence. When testing my model using a multi-probit test, while I received the frequency results, I again found my results to be statistically insignificant. This means that my model shows no major increases in probability from a peaceful country to a violent one with the data I used in my economic model.

In all of my tests my main variables, food deficit and undernourishment, proved to be not statistically significant. This could be for a multitude of reasons. The first is that there is no relationship, disproving what the past research has said that there is a relationship between violence and food insecurity. It could also mean that there are some variables that play a bigger role that I did not account for, leading my research to be spurious, or there was some potential issues with the amount of data that was included in the Global Peace Index that caused endogeneity.

When testing for instrumental variables, there is usually an ability to make a policy recommendation. However, with my results being insignificant I do not have enough information to make any policy implications about the connection between food insecurity and violence. There are some policies that have been put forward by the United Nations and the World Food Programme for the purpose of ending world hunger but the results I have found have not provided enough information to support those decisions past a basic humanitarian effort.

However, the GPI is a good dataset to use and this is the first paper that incorporates it. The GPI has a lot of useful data in order to look at indicators of violence. It allows for a current global picture about the current state of violence on a multitude of fronts. However, future research may consider picking a few of the indicators that the index uses in order to create a more concise picture of the violence. For example militarization is one of the variables used in creating the index but that can skew some more peaceful nations to have higher violence numbers. This could lead to a change in the results. Furthermore there are a few recommendations I have for future research on this subject. First would be to look at potential other factors that could be included within this model. The results can lead to several different conclusions. There does not appear to be a relationship between violence and food insecurity, population, total population, and GDP growth. Subsequently there might be a relationship in the addition of other variables like income inequality, like the GINI coefficient, which is not included in my model, another potential indicator to look at including is the amount of government instability/ corruption. The more corruption the less likely it is that individuals have access to resources without having to bribe government officials in order to see results.

The results I found were inconclusive; however, these results would contradict the current literature in the academic community. There is no statistically significant way to support that food insecurity, population, urban development, and GDP growth affect violence in a country according to the model which I am currently using. While there was no statistical significance my results were consistent across all of the research that I conducted.

Conclusion

This paper attempted to address the relationship between food insecurity and violence. Its aim was to see if there was a positive relationship between violence and food insecurity as well as looking at other factors that include population, GDP, and urban population. This was done by compiling data from World Bank and the Global Peace Index. The Global Peace Index is a new form of data that has not been used in the academic community. This new piece of data allows a broader picture of what violence can include. A broad form of methods were used that include OLS, fixed effects, multi-probit, and two staged least squares, with aid and neighboring aid acting as instrumental variables. There overall findings show no connection between the variables and therefore no relationship can be concluded.

This study focused on multiple countries in order to determine the correlation between food insecurity and violence. The results show a different result than researchers in the past. While the general consensus says that there is a positive relationship between food insecurity and violence, I did not find that to be the result. For all countries, there was no statistically significant relationship between food insecurity and violence. Although the results are somewhat surprising, there are a lot of potential factors that could contribute to this result. One example could be that the Global Peace Index simply had too many factors to capture a clear and concise representation of violence. The overall relationship between these two main variables is still undefined. That is because the models failed to have any statistically significant results. While this study does not give more understanding to the true relationship between food insecurity and violence, it does allow future researchers to look at the GPI variable more deeply and see different potential methodologies used in testing violence and food insecurity. Another potential effect could be not including an inequality variable. There is some past research that suggests a causation between income inequality and violence. The exclusion of this variable could have also caused a different result.

This study should be used as a spring board for future research on this topic in the realm of economics. Even though this study is inconclusive there are a lot of studies that suggest a relationship between food insecurity and violence by other disciplines.

There is also another potential answer as to why there was no statistical significance; there could be an indirect effect. This study is also limited due to the fact that it focuses on 160 countries from 2008-2014. The analysis is also limited to the countries that are included in the global peace index. Another additional study should be performed to see the effect in a certain country, such as the United States. Studies could also examine the relationship between a few of the factors that create the global peace index. If there end up being a positive relationship between food insecurity and violence it could lead to a lot of policy implications towards the improvement of food systems world-wide.

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Appendix

Figure 1

Global Peace Map-2013
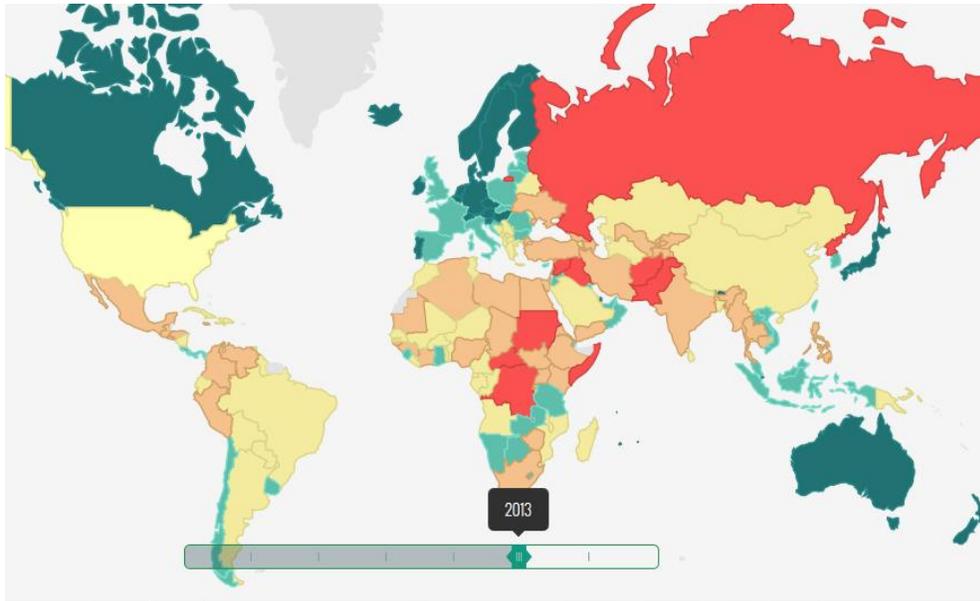
Figure 2

Descriptive Statistics

With the inclusion of food deficit as the food insecurity variable

Variable	Obs	Mean	Std. Dev.	Min	Max
GPI	757	2.030635	0.4657776	1.07	3.498
aidpercap	757	490327.2	1182140	-153129.6	1.20E+07
Region	757	2.336856	1.192515	1	5
Urban	757	56.36352	22.06758	9.092	97.818
GDPgrowth	757	3.732366	4.225818	-36.04708	21.02065
Totalpop	757	5.33E+07	1.76E+08	317414	1.36E+09
Fooddeficit	757	92.321	101.8383	0	566

Figure 3

With the inclusion of undernourishment as the food insecurity variable

Variable	Obs	Mean	Std. Dev.	Min	Max
GPI	753	2.024328	0.4588077	1.07	3.498
aidpercap	753	485393.5	1183058	-153129.6	1.20E+07
Region	753	2.343958	1.191679	1	5
Urban	753	56.4874	22.06039	9.092	97.818
GDPgrowth	753	3.735532	4.229288	-36.04708	21.02065
Totalpop	753	5.34E+07	1.76E+08	317414	1.36E+09
Undernourishment	753	12.55179	12.3656	0	54.4

Figure 4: Results

GPI Results with Undernourishment				
Variables	OLS	Fixed Effects	IV Aid per Capita	IV Neighboring Aid
GDP growth	0.00037	0.00041	0.00268	0.00267
	[0.0012]	[0.00101]	[0.0079]	[0.0079]
Region	0.0935	.	2.2448	2.546
	[0.0546]	.	[9.990]	[9.102]
Total Pop	1.03E-09	1.37E-09	1.00E-09	1.03E-09
	[0.0000]	[8.78e-10]	[2.23e-9]	[2.23e-9]
Urban	0.00219	0.00588	0.0386	0.0439
	[0.0061]	[0.0050]	[0.1180]	[0.1213]

Undernourishment	0.1131	0.00763	0.01408	0.0123
	[0.0507]	[0.0028]	[0.0198]	[0.0102]
Year				
2009	0.03787	0.03846	0.04049	0.09778
	[0.0159]	[0.0125]	[0.0130]	[0.1934]
2010	0.07177	0.06143	0.0644	0.1641
	[0.0130]	[0.0126]	[0.0146]	[0.3025]
2011	0.06245	0.05218	0.05687	0.20795
	[0.0176]	[0.0134]	[0.01884]	[0.46997]
2012	0.07191	0.05679	0.06293	0.27405
	[0.0917]	[0.0143]	[0.02289]	[0.6519]
2013	0.09167	0.07098	0.07789	0.33992
	[0.0210]	[0.0154]	[0.0254]	[0.8004]
2014	0.06457	0.06798	0.07552	0.3896
	[0.0343]	[0.01676]	[0.02767]	[0.96223]

Figure 5: Results

GPI Results with Food Deficit				
Variables	OLS	Fixed Effects	IV Aid per Capita	IV Neighboring Aid
GDP growth	0.00033	0.00041	0.00103	0.000217
	[0.0012]	[0.00101]	[0.00191]	[0.0009599]
Region	0.09383	.	0.0384	0.0435
	[0.0436]	.	[0.0534]	[0.0345]
Total Pop	1.37E-09	1.37E-09	6.01E-10	1.50E+09
	[8.78e-10]	[8.78e-10]	[1.38e-9]	[8.68e-10]
Urban	0.0004	0.00482	-0.00158	0.0082
	[0.0060]	[0.0050]	[0.00802]	[0.00769]
Food Deficit	-0.05826	0.00033	-0.7127	0.001518
	[0.0346]	[0.00030]	[1.164]	[0.002167]
Year				
2009	0.03374	0.03674	0.00734	0.03917
	[0.0159]	[0.0010]	[0.05057]	[0.01241]
2010	0.06302	0.05914	0.01131	0.06339
	[0.0164]	[0.0127]	[0.09400]	[0.014]
2011	0.04934	0.0484	-0.02518	0.05469
	[0.0178]	[0.0134]	[0.1342]	[0.01683]
2012	0.05358	0.05194	-0.05129	0.07605
	[0.0195]	[0.0143]	[0.18787]	[0.02358]
2013	0.06866	0.06572	-0.0659	0.073668

	[0.0216]	[0.0155]	[0.2402]	[0.0258]
2014	0.06333	0.06228	-0.09884	0.073668
	[0.0239]	[0.0168]	[0.2896]	[0.02585]