The Correlation Between Economic Freedom and Malnutrition: An empirical analysis

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Econometrics I – Multivariate Analysis

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I. INTRODUCTION

Nutrition and health status play a large role in economic and social prosperity across the globe. Improvements in both are linked with substantial personal development and can provide a means to escape the effects of poverty (Brown & Pollitt, 1996). Two sectors of individuals have been studied the most aggressively in terms of malnutrition, and they are women and children – with an even greater focus on pregnant women and children under the age of five. This is due to the importance and demonstrated long-standing effects of prenatal and early childhood development. Maternal undernutrition can lead to fetal growth restriction and low-birthweight, which have been shown to increase rates of neonatal mortality and other indicators of poor health and nutrition during early childhood (Black et al., 2013). Malnutrition during phases of early childhood development has been linked to irreversible physical and mental health conditions, with significant impacts on learning and future work capabilities.

The United Nations set Millennium Development Goals at the Millennium Summit in 2000, half of which are directly associated with decreasing issues associated with health and malnutrition, with targets set for 2015. While these goals, along with the aid of international community action, have helped greatly in reducing the number of people affected by poor health and nutrition, over 159 million out of 667 million children under the age of five still have inadequate height-for-age scores[1] (United Nations, 2015). The regions with the highest prevalence of low height-for-age scores are South-Central Asia, East Africa and West Africa, which each exhibit levels of stunting at over 30% of the preschool child population (Onis, Frongillo, & Blössner, 2000).

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[1] A nutritional indicator known as "stunting" that will be addressed in more detail in the following section.

Economic freedom at its most basic level, as defined by the Heritage Foundation, is: "The fundamental right of every human to control his or her own labor and property" (2017). The rights making up economic freedom are personal choice, voluntary exchange coordinated by markets, freedom to enter and compete in markets, and the protection of persons and their property from aggression by others. Economic freedom across the globe has been generally increasing since 1980, with the exception of a few countries. In the same period, poverty has decreased, life expectancy has risen, the infant mortality rate has declined, and other quality of life indicators have improved. Higher economic freedom has been linked with higher per-capita income, and increases in economic freedom are positively correlated with growth of per-capita income (Fraser Institute 2007).

II. INDICATORS OF HEALTH AND NUTRITION

Indicators of population health and nutrition have been measured for decades using information on height, age, weight, and gender. Achievements in decreasing infant and early childhood mortality levels have not always been seen in conjunction with increasing health levels of surviving children. This brings an even greater importance to growth data as an indicator for health and nutritional status. A respected author on the subject of growth and nutrition states:

> "The average values of children's heights and weights reflect accurately the state of a
> nation's public health and the average nutritional status of its citizens (Onis 2000, p. 1271)"

Children initially adapt to inadequate diets and disease through reduced growth rates and physical activity, but the effects of short-term nutritional deficiencies will be rectified once the cause is no longer present. If the situation of poor health is prolonged, growth rates are affected to a degree that cannot be reversed (Onis 2000). Three of the most common indicators are height-for-

age, weight-for-age and weight-for-height. Low weight-for-age is referred to as *undernutrition*, and can be due to both *wasting* (low weight-for-height) and *stunting* (low height-for-age). Body weight can be influenced by a number of factors that provide short-term changes, whereas height in children is primarily influenced by nutritional deprivation, thereby making stunting the most highly regarded measure of child malnutrition. Stunting prevalence is measured using height-for-age z-scores, found by comparing a child's height with the height distribution of a well-nourished, same age, same sex reference population. Those with z-scores falling two or more standard deviations below the median are declared stunted. Due to research supporting the idea that growth-potential and variance of pre-school students does not differ between ethnic groups, the idea of a single global reference population for calculating height-based anthropometric indicators has become almost universally accepted (Eveleth & Tanner, 1990).

Other factors that attempt to measure nutrition and health in adults or general population lack both timeliness and credibility, therefore making stunting and related anthropometric factors the most widely accepted measure of a country's nutritional status (Heltberg, 2009).

III. FACTORS AFFECTING MALNUTRITION

A multitude of factors go into nutrition, and in 1998 UNICEF developed a framework of the causes of child malnutrition, including quantity of resources & how they are controlled, insufficient access to food, inadequate maternal and childcare practices, and poor health services. These then lead to disease and inadequate dietary intake which have a synergistic relationship, and are the two fundamental aspects of malnutrition (UNICEF, 1998).

From this framework, three main theories have risen as to what the main underlying factor is in predicting undernourishment. The first, and perhaps most variable in statistical support, is

economic inequality. The second is government support of the social-sector, including health and education spending aimed at increasing equality for women and the health of the poor. The third is food prices, as increased income for the poor does not necessarily mean increased purchasing of nutritious food if at the same time food prices are rising.

Economic inequality

While there is conflicting evidence on the effect of economic inequality on health status, studies have shown that the difference may be attributed to variables being measured at different scales (Lochner et al., 2001). Studies done in Europe and the developing world have found no correlation between income inequality and population health. A study from Denmark found that when individual income was held constant, income inequality had no impact on self-rated health, and a similar study from Japan found no relation between income inequality and mortality[2] (Mackenbach, 2002).

In a study of Ecuador, economic inequality was shown to have an effect on childhood malnutrition, measured in the form of stunting[3] and in the United States, multiple studies have shown that there is a correlation between state income inequalities and health. However, results differ on whether poverty plays a role in this effect (Larrea & Kawachi 2005, Kennedy et al. 1998, Lochner et al. 2001) . Lochner et al. (2001) found a correlation between state income inequality levels and individual mortality risk, but no effect was found when the individual's family income

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[2] The researchers in Denmark attributed their results to the Danish welfare state evening out the effect of income inequality between regions

[3] The researchers had prior knowledge of studies such as the ones conducted on Denmark and Japan previously mentioned, and hypothesize that the reason an effect was seen in this study but not the others is that those wealthy nations have a much more egalitarian society, thus making positive externalities of governmental universal improvement obtained easier.

fell below the poverty line[4]. On the other hand, Kennedy et al. (1998) found that inequalities in the statewide distribution of income were associated with lower self-rated health scores and the effects were not limited based on which income group the participant fell into. Those in the lowest income groups in states with the greatest inequalities rated their health lower than those in the lowest income groups in states with the smallest inequalities, and the same comparison was seen between middle income groups. Both studies controlled for various socio-economic factors.

Government support of health, education and gender equality

Increases in government social-sector spending, including on health and education, and focuses on equal opportunity for women have been empirically shown to decrease undernutrition. The opposite is true as well, as in areas of Europe that underwent drastic transitions into more market-based economies, thereby cutting down on government run social programs, women and children saw a drastic effect on nutritional status. But government programs' correlation with nutrition is not one-directional, as approximately half of the growth in many Western European countries from 1790 – 1980 has been attributed to better nutrition and health due to social investments (United Nations, 2015). Additional studies have shown that both increased health and education spending have a significant impact on the two sectors, supporting capital growth and decreases in nutrition issues (Ssozi & Amlani 2015, Baldacci et al. 2008).

In areas where poverty was relatively constant or even increasing, nutritional improvements have been seen, showing a positive effect of nutrition specific government intervention independent of economic or income growth (UNICEF 1998, Lechtig 2001). Gains in

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[4] The authors hypothesized that for such persons, poverty is a stronger determinant of mortality.

national nutrition levels can then be attributed to health services and education, along with female empowerment through education and fiscal responsibility (Lechtig, 2001). In nations where nutrition has not increased at significant rates but economic growth has, this disparity can often be linked with social discrimination against women. South-central Asia, a region classified by widespread sex bias and discrimination against women, has the largest number of stunted children in the world (over 70 million) (Onis, Frongillo & Blössner 2000, Miller 1997). Thailand, a nation with high female literacy and participation in the workforce and in familial decisions, has decreased the prevalence of nutrition issues substantially throughout the last 30 years.

Food prices

Food prices, while often short-term in nature, can have a potentially long-term effect on nutrition in children due to the significant effects of prenatal and early childhood nutrient intake on future childhood development. Increases in food prices lead to a reduction in the quality and quantity of food consumed, particularly for those who typically spend the majority of their income on food (Hunger, 2009). While caloric intake for these households may not change substantially, nutrient intake is impacted at a greater level due to the supplementation of higher priced, more nutrient rich food with cheaper, higher calorie food. In most developing countries, it is not only poor families[5] who are at great risk for being impacted by rising food prices. Banerjee and Duflo (2008) found that in most developing countries, the middle class makes less than $10 per capita per day, and for a middle class family spending $6-$10 per capita per day, up to 65% is on food.

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[5] Poor families in developing countries are estimated to spend 50-80% of their incomes on food. As mentioned above, those who are at greatest risk for being affected by food price volatility are those who spend the majority of their income on food

One measurement of consumption is the Food Consumption Score (FCS), which measures diversity and frequency of food consumed. Brickman et al. (2010) used multiple methods to assess the relationship of changes in food prices with food consumption and access. In a study of Haiti, Nepal and Niger they found that a 100% increase in food prices would result in a reduction of the FCS of up to 23%. Larrea and Kawachi (2005) also found that diet composition was correlated with stunting in Ecuadorean children.

When food prices increase, families will first resort to cheaper products typically equating to reducing micronutrient consumption, and as the price changes persist will then start decreasing the size and frequency of meals, leading to decreased macronutrient and calorie intake (Bloem et al. 2005, Torlesse, Kiess & Bloem 2003). If disposable income is not increased, the food price does not lower, or some other factor affecting one of the two does not change, then long-term deprivation effects will occur including stunting.

Why poverty isn't enough

Studies have shown that malnutrition disproportionately affects the poor, however there is an abundance of evidence suggesting that significant nutritional advancements can be made without reductions in poverty (Van de Poel et al. 2008, Brickman et al. 2010, Black et al. 2013). In Brazil, the percent of underweight children dropped from 17% to under 6% while poverty rates almost doubled. Strategies that are focused solely on increasing economic growth rates and per capita income have not performed well in terms of improving health status. The majority of the evidence supporting the effects of the three aforementioned factors affecting malnutrition is found to be significant even when income is held constant, showing that while income may be a basic factor contributing to malnutrition there are other factors that play a more significant role.

IV. ECONOMIC FREEDOM AS IT RELATES TO EACH OF THE AFFORMENTIONED FACTORS

As mentioned earlier, economic freedom is a complex subject and thereby difficult to quantify. It was not until 1996 that J. Gwartney, R. Lawson, and Loyola's own Dr. Walter Block published the first Economic Freedom of the World (EFW) report, developing the Economic Freedom Index (EFI), breaking economic freedom into five measurable components whose summary statistic would reasonably represent the idea of economic freedom (Gwartney, Lawson & Block, 1996). This summary statistic is measured by: 1. Size of government, 2. Legal structure and security of property rights, 3. Access to sound money, 4. Freedom to trade internationally, and 5. Regulation of credit, labor and business. The effects of the summary statistic itself have been studied greatly, as well as those of the individual parameters. Economic freedom has been shown to have significant impact on the factors or factors relating to those just mentioned to affect malnutrition, though no analyses have been found looking at the correlation between stunting and economic freedom or the subset of parameters set forth by the Fraser Institute.

Economic inequality

There are two main empirical studies done on the effects of economic freedom on income inequality using the EFW index. The first, a study looking at data from years 1975-1985 by Berggren (1999), found a somewhat conflicting result that positive *changes* in economic freedom were correlated with lower levels of income inequality, while 1985 *levels* of economic freedom were higher yet associated with greater income inequality. The second (Scully, 2002) found that higher *levels* of economic freedom resulted in less inequality, as the share of income held by the lowest two quintiles increased while the share held by the highest two quintiles decreased. Scully justifies this difference by stating that Berggren failed to account for different ways countries

report income statistics, for which Scully created dummy variables in his regressions. In 1992, Scully also conducted a study in which he concluded that:

> "income is more equally distributed within countries that are politically open, that have private property and market allocation of resources, and that are committed to the rule of law than in countries where these rights are abridged (184)."

He also found that in societies with restrictions on individual rights, income inequality was over 50% higher than societies that emphasize personal liberties. These factors all go into determining the Economic Freedom index.

In contrast to these studies that looked at lowest and highest income groups to determine inequality, a study in 1997 by Hanke and Walters used the percent of income received by the 20th – 80th percentiles (middle 3 quintiles). They found that multiple factors used in calculating economic freedom were significantly correlated with economic inequality – higher values for economic freedom factors correlated with higher income in the middle quintiles.

Government support of health, education and gender equality

The Fraser Institute has recently added a provision in the calculation of the Economic Freedom Index, that accounts for the disparity between men and women in terms of legal and regulatory rights. The data is obtained from the World Bank, and was developed in 2009 (Hallward-Driemeier, Hasan & Rusu, 2013). For most of the countries in the Economic Freedom of the World dataset, adding in the effect of the gender disparity didn't alter the overall summary score (economic freedom). However, the quartile with the lowest economic freedom scores pre-adjustment experienced the largest negative difference in average score when adjusted. The difference in score pre- and post- adjustment decreases with each subsequent quartile. The quartile

with the highest economic freedom scores pre-adjustment even saw an increase in average score post-adjustment. This shows that economically freer countries have more equal treatment of men and women from a legal standpoint (Fraser Institute, 2017).

It is important to note that this adjustment doesn't factor in any social or cultural norms and beliefs that may have disproportionately harmful effects on other aspects of a woman's life, including access to education and health care. There is very little empirical research into how spending on health and education specifically outside of general government spending is affected by economic freedom, and while higher levels of government spending can decrease a nation's Economic Freedom score, it has been shown that nations with higher Economic Freedom scores have higher fertility rates, longer life expectancies, higher literacy scores, higher education completion rates, and more (Heritage Foundation 2015, Fraser Institute 2017, Stroup 2007).

Food Prices

While no empirical evidence can be found detailing the correlation between the Economic Freedom Index and food prices, countries that are consistently ranked lowest in the Economic Freedom of the World ratings experience high food prices and food price volatility. Venezuela, who has rounded out the bottom the EFW ratings list since 2010, is experiencing food prices increasing by more than 1,400% in a year (Santos, 2017). Food price volatility is greater in places where food cannot be traded across borders due to a very inelastic and slow-changing demand, playing into the economic freedom due to the "freedom to trade internationally" and "sound money" parameters. Low-income African nations tend to be affected most by this volatility due to their food production methods as well as monopoly control of food transportation and distribution. To reaffirm this connection, they are also historically at the bottom of the EFW rankings.

V. OBJECTIVE OF THIS PAPER

Based on the information showing how nutrition is affected, and the ways that economic freedom affects these same factors, it is valid to predict that low scores of economic freedom would be associated with a high prevalence of stunting (low nutrition status). This paper seeks to examine as many countries as there are data for, to determine if there is such a relationship around the world. Data will be used from various sources such as the World Bank, Fraser Institute and Food & Agriculture Organization of the United Nations. Factors such as GDP per capita, poverty, region of the world, and other socio-economic factors will be controlled for, to see the direct role of economic freedom.

VI. DATA

Data for 24 variables was obtained from three separate sources, then merged using Stata 15.0. The names, labels and sources of all the variables and their corresponding data can be found in Table 1 below. Natural log variables were created for variables that were not an index or already a percentage to assist with future econometric modeling. No polynomial variables were created after viewing scatter plots of stunting with each variable. The Consumer Price Index (CPI) measures the price change between the current and reference periods of the average food basket purchased by households. The base (reference) for this dataset is $2010 = 100$. Therefore, numbers less than 100 indicate lower food basket prices and numbers greater than 100 indicate higher prices. The Gini coefficient measures the extent to which the distribution among income (in some cases consumption) deviates from a perfectly equal distribution. A Gini coefficient of 0 indicates perfect equality, and 100 indicates perfect inequality. The Gender Parity Index (GPI) is the ratio of girls to boys enrolled in both public and private schools. This dataset measures the combined ratio for

primary and secondary education. A GPI less than 1 suggests girls are disadvantaged in learning opportunities, and a GPI greater than 1 suggests the opposite. Again, the Economic Freedom index is calculated for each country by the Fraser Institute, and takes an average of 5 different parameters: Size of Government, Legal System and Property Rights, Sound Money, Freedom to Trade Internationally, and Regulation. Each of these is calculated on a scale of 1-10, then the Economic Freedom Index is the average of these, still on a scale of 1-10 with 10 being completely free. More will be discussed in the conclusion on some of the parameters used in calculating Economic Freedom, and more detailed information on calculations of all indexes can be found on the websites of their corresponding data sources.

TABLE 1: Data Sources & Labels			
Variable	**Description**	**Source**	**Unit**
stunting	Prevalence of stunting	World Bank	% of children under 5
economicfreedom	Economic freedom	Fraser Institute	index, 1-10
sizeofgovernment	Size of Government	Fraser Institute	index, 1-10
legalsystempropertyrights	Legal System and Property Rights	Fraser Institute	index, 1-10
soundmoney	Sound Money	Fraser Institute	index, 1-10
freedomtotradeinternationally	Freedom to Trade Internationally	Fraser Institute	index, 1-10
regulation	Regulation	Fraser Institute	index, 1-10
gdppcap	Per capita GDP	World Bank	current USD
gini	Gini coefficient	World Bank	index, 0-100
healthspend	Health expenditure	World Bank	% of GDP
eduspend	Education expenditure	World Bank	% of GDP
undernourishment	Prevalence of undernourishment	World Bank	% of population
poverty	Population living in extreme poverty	World Bank	% of population
gpi	Gender Parity Index	World Bank	index, ratio x:1
arableland	Arable land	World Bank	hectares per person
unemployment	Unemployment rate	World Bank	% of working population
cpifood	Consumer Price Index - Food Prices	FAO *	index, base 100
LCN	Latin American and Carribbean	World Bank	dummy
SAS	South Asia	World Bank	dummy
SSF	Sub-Saharan Africa	World Bank	dummy
ECS	Europe & Central Asia	World Bank	dummy
MEA	Middle East & North Africa	World Bank	dummy
EAS	East Asia & Pacific	World Bank	dummy
NAC	North America	World Bank	dummy
lngdp	ln of Per capita GDP	n/a	n/a
lnarableland	ln of Arable land	n/a	n/a

*FAO is the Food and Agriculture Organization of the United Nations

Geographical regions (i.e. Latin America and the Carribbean, South Asia, Sub-Saharan Africa, etc.) were coded into dummy variables. A value of 1 denotes that a country is in the region, with a value of 0 (zero) given otherwise. All regions were listed and coded, but at least one region will be excluded or dropped from each regression to avoid collinearity.

Table 2 displays summary statistics for each of the variables. Data was obtained for 228 countries, and values are the average of all data available for the years ranging 2000 – 2014. Economic freedom data could be calculated for 158 countries, and stunting data was available for 142 countries. Figure 1 displays a preliminary scatter plot of the relationship between Economic Freedom scores and stunting prevalence.

TABLE 2: Summary Statistics					
Variable	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
stunting	142	25.27427	14.99454	1.3	59.43333
economicfreedom	158	6.690588	0.8608179	4.14	8.743334
sizeofgovernment	158	6.412809	1.144846	3.538	8.62
legalsystempropertyrights	158	5.192249	1.59208	1.726667	8.927333
soundmoney	158	7.951888	1.338222	2.450667	9.698
freedomtotradeinternationally	158	7.026392	1.075225	3.696	9.318
regulation	158	6.869108	0.9634131	4.432	8.770666
gdppcap	206	13470.5	20480.63	191.5531	130851.1
gini	154	39.00715	8.210125	22.88333	62.6
healthspend	188	6.342219	2.452501	1.598043	18.29049
eduspend	179	4.578095	1.878997	1.23236	11.587
undernourishment	114	17.04778	11.90993	5	54.04
poverty	154	17.12242	21.61455	0	85.55
gpi	186	0.9625662	0.0991558	0.53682	1.126703
arableland	206	0.2084372	0.2623826	0.0001544	2.224249
unemployment	189	9.798986	7.791814	0.3444445	59.5
cpifood	194	159.8835	339.8147	56.18515	4233.292
LCN	211	0.1848341	0.389086	0	1
SAS	211	0.0379147	0.1914442	0	1
SSF	211	0.2227488	0.4170806	0	1
ECS	211	0.2654028	0.4425975	0	1
MEA	211	0.0995261	0.300079	0	1
EAS	211	0.1563981	0.3640962	0	1
NAC	211	0.014218	0.1186701	0	1
lngdp	206	8.43864	1.574377	5.255165	11.78182
lnarableland	206	-2.197392	1.322605	-8.775709	0.7994193
countrynumber	228	114.5	65.96211	1	228

Figure 1: Stunting vs Economic Freedom
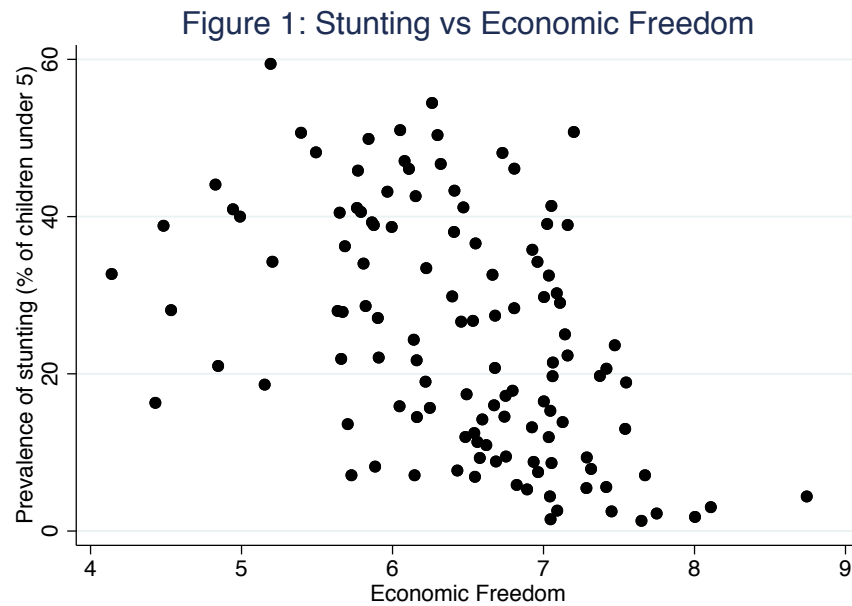
While there are a large number of observations for each variable, in many circumstances a country is missing one of the variables, thereby preventing the country from being used in the large-scale analysis. The averaging of values over a 14-year time span allowed for as much information on each country as possible to be included, as the World Bank, FAO, Fraser Institute and individual countries collect and report data at different times. In the dataset, the majority of the values for gdppcap (GDP per capita in current US$) fall within one standard deviation below the mean (Figure 2). This could add a bias to the econometric model if gdppcap is found to be significantly correlated with stunting, but will be addressed again in the following section.

Figure 2: GDP per capita Frequencies
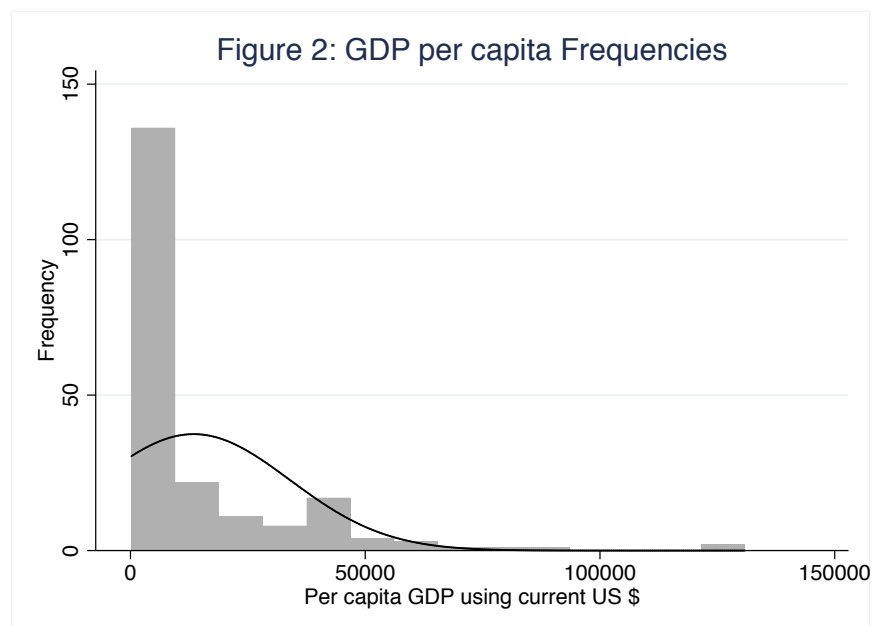
VII. PRELIMINARY REGRESSION ANALYSIS

Since the Economic Freedom Index is an aggregate of five different parameters, multiple linear regression equation estimations were run to determine both the aggregate and individual effects, if any. The preliminary regression estimate used solely the aggregate variable, the Economic Freedom score, in an attempt to estimate the following equation:

$$Stunting = c + \beta_1*economicfreedom + \beta_2*gini + ... + \beta_{17}*lnarableland + e$$

Table 3 shows this estimation process. In an attempt to include all relevant variables and avoid omitted-variable bias, a top down approach was used. Model 1 regressed stunting against all of the listed variables, then subsequent models omitted the least significant variable so long as adjusted-R^2 increased (Note: R^2 for each regression is displayed at the bottom of the table, but for variable omission purposes adjusted-R^2 was looked at). Once Model 3 was calculated, Ramsey RESET and Breush-Pagan / Cook-Weisberg tests were done to check for omitted variables and heteroskedasticity, respectively. For both cases the null hypotheses could not be rejected (Prob > F = 0.0706, Prob > chi^2 = 0.8966), indicating no omitted variables or heteroskedasticity was probable. The variables poverty, gpi, and lngdp were significant at the 95% Confidence Level. The natural log of the variable gdppcap was used to determine the effect of a percent change in GDP per capita, rather than of a specific dollar amount. Calculating a percent change is beneficial considering the distribution of GDP per capita displayed earlier, as a 10% change in the average GDP per capita is the dollar equivalent of a 100% change in all GDP per capita values in the bottom quartile and some in the 2nd quartile as well. Based on these results, the equation to predict the percentage of children under 5 stunted in a given country is as follows:

(1)

Stunting = 84.7 + 0.25*poverty – 26.4*gpi – 6.46*lngdp + ê

Table 3: Preliminary Economic Freedom Regression

VARIABLES	(1) Model 1	(2) Model 2	(3) Model 3
economicfreedom	1.379	1.395	1.164
	(1.704)	(1.688)	(1.410)
gini	0.263	0.265	0.191
	(0.186)	(0.184)	(0.176)
healthspend	-0.443	-0.404	-0.654
	(0.544)	(0.475)	(0.452)
eduspend	0.769	0.770	1.060*
	(0.638)	(0.634)	(0.599)
poverty	0.195**	0.194**	0.254***
	(0.0868)	(0.0856)	(0.0783)
gpi	-26.58**	-26.71**	-26.43**
	(12.91)	(12.79)	(12.63)
unemployment	-0.0714	-0.0714	-0.0716
	(0.141)	(0.140)	(0.139)
imports	-0.0965*	-0.0978*	-0.0636
	(0.0547)	(0.0536)	(0.0481)
cpifood	-0.000388	-0.000388	
	(0.00187)	(0.00185)	
LCN	-6.308	-5.046	-4.758
	(9.147)	(3.970)	(3.865)
SAS	3.150	4.537	3.563
	(10.08)	(4.420)	(4.323)
SSF	-5.567	-4.228	-6.553
	(9.771)	(4.361)	(4.106)
ECS	-4.082	-2.798	-4.067
	(9.094)	(3.537)	(3.358)
MEA	-2.571	-1.247	-2.294
	(9.629)	(4.243)	(4.139)
EAS	-1.457		
	(9.498)		
lngdp	-6.979***	-6.991***	-6.462***
	(1.413)	(1.400)	(1.234)
lnarableland	-1.168	-1.160	-1.012
	(1.057)	(1.048)	(1.020)
Constant	86.74***	85.33***	84.67***
	(18.63)	(16.09)	(15.79)
Observations	85	85	89
R-squared	0.804	0.804	0.807

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

This equation is to be interpreted as the base percentage of children under the age of 5 who are stunted in any country is 84.7%, with that percentage increasing by .25 for every 1% increase in the percentage of the population living in extreme poverty, decreasing by 26.4 if a country has 1 girl enrolled in primary or secondary education for every boy enrolled, and decreasing by 6.46 for every 1% increase in GDP per capita. While the null hypothesis that Economic Freedom has no effect on stunting cannot be rejected, this shows that in two countries where income and poverty rates are equal, if one country has equal enrollment of boys and girls in school and the other has twice as many boys as girls enrolled, the country with equal education opportunities for both genders has a 13% lower prevalence of stunting.

According to Heckleman and Stroup (2000), summary indexes such as economic freedom may result in a misspecification bias. To account for this, it is recommended to also run a regression to predict an equation using the individual parameters. The results of these broken-down analyses are shown in Table 4. Model 1 displays the results of a regression using all five parameters that make up economic freedom, and Models 2 – 6 display results of regressions with each one individually. In none of these 6 models is a component of economic freedom significant at the 95% level, nor does the coefficient on any of the components change by more than one standard deviation from Model 1 to the appropriate subsequent model. All models pass the RESET and Breush-Pagan / Cook-Weisberg tests, showing no omitted variables or heteroskedasticity.

Since the regression controlling for all five of the economic freedom parameters separate from each other returned a higher adjusted-R^2 than using the summary term of economic freedom, a top-down regression procedure was performed starting with the same regression used in Model 1 of Table 4. The full regression process can be found in Table 5. This model was again attempting to predict an equation to estimate the prevalence of stunting by estimating the following equation:

Table 4: Preliminary Regressions of 5 Parameters

VARIABLES	(1) Model 1	(2) Model 2	(3) Model 3	(4) Model 4	(5) Model 5	(6) Model 6
sizeofgovernment	1.472	1.955				
	(1.308)	(1.211)				
legalsystempropertyrights	-1.011		-0.975			
	(1.354)		(1.129)			
soundmoney	1.338			1.195		
	(1.012)			(0.813)		
freedomtotradeinternationally	-1.002				0.0521	
	(1.826)				(1.524)	
regulation	-0.130					0.0816
	(1.597)					(1.263)
gini	0.257	0.240	0.279	0.269	0.282	0.282
	(0.191)	(0.184)	(0.184)	(0.182)	(0.189)	(0.187)
healthspend	-0.259	-0.322	-0.230	-0.481	-0.359	-0.357
	(0.564)	(0.526)	(0.552)	(0.534)	(0.549)	(0.536)
eduspend	1.249*	1.096	0.746	0.867	0.655	0.655
	(0.697)	(0.672)	(0.631)	(0.632)	(0.634)	(0.627)
poverty	0.182**	0.212**	0.197**	0.176**	0.199**	0.199**
	(0.0894)	(0.0859)	(0.0867)	(0.0872)	(0.0871)	(0.0871)
gpi	-24.56*	-26.17**	-23.12*	-26.20**	-25.42*	-25.52*
	(13.18)	(12.66)	(13.10)	(12.70)	(12.90)	(12.95)
unemployment	-0.0529	-0.0385	-0.0874	-0.0761	-0.0754	-0.0759
	(0.147)	(0.141)	(0.142)	(0.140)	(0.142)	(0.142)
imports	-0.116*	-0.114**	-0.0846	-0.0973*	-0.0844	-0.0855
	(0.0592)	(0.0549)	(0.0526)	(0.0528)	(0.0530)	(0.0565)
cpifood	-0.000355	-0.000102	-0.000575	-0.000499	-0.000415	-0.000418
	(0.00191)	(0.00185)	(0.00187)	(0.00185)	(0.00188)	(0.00188)
LCN	-5.645	-5.396	-7.427	-6.814	-7.209	-7.031
	(9.621)	(9.022)	(9.079)	(8.986)	(9.135)	(9.469)
SAS	6.432	4.141	3.490	4.155	2.413	2.506
	(10.44)	(9.950)	(10.11)	(9.995)	(10.09)	(10.21)
SSF	-2.129	-3.167	-5.904	-5.238	-6.710	-6.601
	(10.24)	(9.780)	(9.705)	(9.612)	(9.731)	(9.917)
ECS	-1.301	-1.977	-3.916	-4.312	-4.668	-4.520
	(9.674)	(9.091)	(9.101)	(8.971)	(9.132)	(9.321)
MEA	-2.152	-0.851	-3.650	-3.620	-3.785	-3.627
	(10.34)	(9.549)	(9.500)	(9.402)	(9.604)	(10.00)
EAS	1.678	0.580	-0.898	-1.304	-1.926	-1.837
	(9.862)	(9.474)	(9.548)	(9.386)	(9.528)	(9.615)
lngdp	-5.976***	-6.137***	-6.086***	-7.173***	-6.661***	-6.662***
	(1.587)	(1.370)	(1.499)	(1.384)	(1.420)	(1.377)
lnarableland	-1.092	-1.270	-1.253	-0.956	-1.294	-1.309
	(1.148)	(1.028)	(1.044)	(1.058)	(1.123)	(1.048)
Constant	73.84***	72.28***	88.18***	88.17***	91.21***	91.01***
	(23.07)	(21.10)	(18.09)	(17.67)	(18.44)	(18.69)
Observations	85	85	85	85	85	85
R-squared	0.817	0.809	0.804	0.808	0.802	0.802

Standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

$$Stunting = c + \beta_1*sizeofgov't + \beta_2*legalsystem + \beta_3*soundmoney \ldots + \beta_{21}*lnarableland + e$$

The same process was applied as was to the regressions from Table 3, and the natural log of GDP per capita was used for the same reason. The results of the RESET and Breush-Pagan / Cook-Weisberg tests for omitted variables and heteroskedasticity on Model 9 were again to reject the null hypotheses for each (Prob > F = 0.4437, Prob > chi^2 = 0.8605). Model 9 gives the information for the new equation to predict stunting prevalence to be:

(2)

$$Stunting = 75.6 + 1.73*soundmoney + 1.61*eduspend + 0.24*poverty + 11.2*SAS - 5.63*lngdp + \hat{e}$$

This equation is to be interpreted as the base percentage of children under the age of 5 who are stunted in any country not in South Asia is 75.6%, with that percentage increasing by 1.73 for every unit increase in the Sound Money index created by the Fraser Institute, increasing by 1.61 for every additional 1% of GDP spent on education, increasing by 0.24 for every 1% increase in the population living in extreme poverty, and decreasing by 5.63 for every increase in GDP per capita. For countries located in South Asia, the constant (base percentage of children under 5 who are stunted) is 86.8, with the same changes due to the other variables as all other countries.

While it appears an element of Economic Freedom is correlated with stunting, the positive coefficient raises a red flag. The "Sound Money" index measures money growth, the standard deviation of inflation, the inflation of the most recent year, and the freedom to have foreign currency bank accounts. Again, this is measured on a scale of 1-10. High ratings indicate a country has policies that create low and stable inflation rates, and doesn't have regulatory laws limiting the use of foreign currencies. The positive coefficient is indicating that policies leading to stable prices increase the prevalence of stunting, and based on how volatility of food prices has been shown to affect stunting it would have been predicted that this coefficient would be negative. Another possible red flag is that in the final model, at the 90% Confidence Level another element of

Table 5: Preliminary Top-Down Regression 5 Parameters

VARIABLES	(1) Model 1	(2) Model 2	(3) Model 3	(4) Model 4	(5) Model 5	(6) Model 6	(7) Model 7	(8) Model 8	(9) Model 9	(10) Model 10	(11) Model 11
sizeofgovernment	1.472	1.462	1.489	0.514	0.520	0.503	0.500				
	(1.308)	(1.293)	(1.262)	(1.089)	(1.081)	(1.072)	(1.066)				
legalsystempropertyrights	-1.011	-1.060	-1.068	-1.532	-1.529	-1.636	-1.703*	-1.684*	-1.779*	-1.477	-1.734*
	(1.354)	(1.199)	(1.188)	(1.126)	(1.118)	(1.040)	(1.013)	(1.007)	(0.993)	(0.926)	(0.897)
soundmoney	1.338	1.316	1.319	1.650*	1.617*	1.500*	1.564**	1.678**	1.780**	1.676**	1.734**
	(1.012)	(0.969)	(0.961)	(0.939)	(0.900)	(0.787)	(0.758)	(0.714)	(0.694)	(0.682)	(0.681)
freedomtotradeinternationally	-1.002	-1.020	-1.037	-0.483	-0.403						
	(1.826)	(1.798)	(1.779)	(1.600)	(1.472)						
regulation	-0.130										
	(1.597)										
gini	0.257	0.256	0.258	0.198	0.194	0.188	0.161	0.179	0.197	0.120	
	(0.191)	(0.188)	(0.186)	(0.179)	(0.175)	(0.173)	(0.151)	(0.145)	(0.142)	(0.110)	
healthspend	-0.259	-0.253	-0.226	-0.456	-0.454	-0.462	-0.448	-0.415	-0.468	-0.513	-0.545
	(0.564)	(0.554)	(0.500)	(0.481)	(0.477)	(0.473)	(0.468)	(0.461)	(0.451)	(0.448)	(0.447)
eduspend	1.249*	1.253*	1.261*	1.481**	1.464**	1.493**	1.522**	1.407**	1.367**	1.415**	1.607***
	(0.697)	(0.690)	(0.682)	(0.653)	(0.636)	(0.623)	(0.613)	(0.558)	(0.552)	(0.548)	(0.521)
poverty	0.182**	0.182**	0.182**	0.221**	0.223**	0.224***	0.211***	0.198***	0.197***	0.219***	0.243***
	(0.0894)	(0.0886)	(0.0879)	(0.0845)	(0.0822)	(0.0817)	(0.0712)	(0.0657)	(0.0654)	(0.0602)	(0.0560)
gpi	-24.56*	-24.56*	-24.60*	-23.10*	-22.78*	-22.54*	-21.90*	-21.81*	-21.85*	-23.59*	-18.87*
	(13.18)	(13.07)	(12.97)	(12.84)	(12.53)	(12.42)	(12.18)	(12.12)	(12.07)	(11.88)	(11.08)
unemployment	-0.0529	-0.0549	-0.0567	-0.0927	-0.0934	-0.0970	-0.0963	-0.105	-0.108	-0.0602	-0.0542
	(0.147)	(0.144)	(0.142)	(0.139)	(0.137)	(0.136)	(0.135)	(0.133)	(0.132)	(0.120)	(0.120)
imports	-0.116*	-0.118**	-0.119**	-0.0836*	-0.0819*	-0.0845*	-0.0853*	-0.0833*	-0.0778*	-0.0737*	-0.0818*
	(0.0592)	(0.0552)	(0.0535)	(0.0480)	(0.0460)	(0.0447)	(0.0444)	(0.0439)	(0.0429)	(0.0426)	(0.0420)
cpifood	-0.000355	-0.000374	-0.000383								
	(0.00191)	(0.00188)	(0.00187)								
LCN	-5.645	-5.408	-4.469	-3.265	-3.063	-3.253	-2.642	-2.511	-2.669		
	(9.621)	(9.095)	(4.235)	(4.107)	(3.792)	(3.704)	(3.174)	(3.144)	(3.123)		
SAS	6.432	6.608	7.654	9.210**	9.438**	9.400**	10.04***	10.46***	10.96***	11.44***	11.20***
	(10.44)	(10.13)	(4.711)	(4.605)	(4.246)	(4.217)	(3.712)	(3.581)	(3.486)	(3.434)	(3.432)
SSF	-2.129	-1.933	-0.896	-1.525	-1.298	-1.223					
	(10.24)	(9.874)	(4.301)	(4.178)	(3.789)	(3.755)					
ECS	-1.301	-1.073									
	(9.674)	(9.188)									
MEA	-2.152	-1.867	-0.851	-0.535							
	(10.34)	(9.647)	(4.130)	(4.008)							
EAS	1.678	1.841	2.871	4.257	4.414	4.403	4.770	4.897	5.040	5.537*	4.920*
	(9.862)	(9.578)	(3.723)	(3.562)	(3.337)	(3.315)	(3.098)	(3.070)	(3.050)	(2.989)	(2.939)
lngdp	-5.976***	-5.959***	-5.939***	-5.797***	-5.767***	-5.794***	-5.771***	-6.056***	-5.978***	-5.976***	-5.627***
	(1.587)	(1.560)	(1.538)	(1.433)	(1.406)	(1.394)	(1.384)	(1.237)	(1.226)	(1.224)	(1.183)
lnarableland	-1.092	-1.103	-1.108	-0.734	-0.684	-0.653	-0.622	-0.618			
	(1.148)	(1.132)	(1.122)	(1.055)	(0.979)	(0.967)	(0.956)	(0.951)			
Constant	73.84***	73.31***	71.89***	73.36***	72.48***	71.63***	71.32***	75.58***	75.34***	77.86***	75.61***
	(23.07)	(21.94)	(18.17)	(17.88)	(16.52)	(16.12)	(15.99)	(13.08)	(13.03)	(12.66)	(12.51)
Observations	85	85	85	89	89	89	89	89	89	89	89
R-squared	0.817	0.817	0.817	0.818	0.818	0.818	0.818	0.817	0.816	0.814	0.811

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

economic freedom, legal system and property rights, is significantly correlated with stunting where $\beta_{legalsys} = - (\beta_{soundmoney})$. This result could be explained by legalsystempropoertyrights and soundmoney being too correlated with each other, as they have a correlation coefficient of 0.5902. If these coefficients are correct, the counteractive effects of these two parameters could be contributing to the null effect of the summary variable economicfreedom on stunting.

The positive correlation between stunting and education spending is also puzzling. Since the majority of the countries in the dataset have GDP per capita values below the mean, this positive correlation could be a result of people in low GDP countries being negatively affected by any type of government expenditure. To test this, the dataset was divided into "Low GDP" and "High GDP" countries. When doing this, the question of whether using mean gdppcap or median gdppcap as the divider is important. For this dataset the median of $4,383.78 was chosen, because as stated in the data section most of the data falls between the mean and one standard deviation below. For Low GDP countries, the coefficient on eduspend was +1.94, while for High GDP countries the coefficient was -2.08. This variance in coefficients shows the possibility of an interaction effect between education spending and GDP per capita. To test this, the variable *edugdp* was generated and equal to eduspend*gdppcap, then regressed in a top-down regression similar to that of Table 5. This interaction variable was immediately removed for having the highest p-value, and therefore cannot explain the reason for the difference in effect of education spending on stunting between High GDP and Low GDP countries.

VIII. ADDITIONAL ANALYSIS

In each regression above, an increase in GDP per capita was significantly correlated with a decrease in stunting, while economic freedom had no correlation. A possible explanation is that

economic freedom influences GDP, and that influence on GDP in turn has a greater effect on stunting than economic freedom alone. There are have been numerous findings of higher economic freedom being linked with higher and faster growing GDP per capita (Farr & Gwartney 1999, Ashby & Sobel 2008, Heritage Foundation 2015). In order to test for this effect and its correlation with stunting, GDP per capita was regressed on economic freedom, then stunting was regressed on the predicted values of GDP. The coefficient on economic freedom to predict GDP was significant and non-zero, but when the predicted values of GDP and the residuals were used in the top-down regression, the equation to predict stunting contained the same variables as Equation 1 and all coefficients were within one standard deviation.

VI. CONCLUSION

The null hypothesis that economic freedom has no correlation with stunting prevalence could not be rejected while controlling for a range of other economic and socioeconomic variables. However, once broken down into its five main components, sound money displayed a negative effect (positive coefficient) on nutrition. Future research could be done, perhaps by breaking sound money down even further using the data provided by the Fraser Institute to figure out which measurement that goes into calculating the value for "Sound Money" has the greatest effect on stunting levels.

In terms of the factors mentioned in the Literature Review shown to affect stunting levels, only gender equality, education spending and poverty were seen to have significance in any of these models; economic inequality and food prices showed no correlation. This study also seems to support the idea that other factors affect stunting more so than poverty. While poverty was significant in every model, the coefficient was never greater than 0.4, where other factors

such as the Gender Parity Index had a magnitude greater than 20. This suggests that provisions to try and decrease stunting levels should be aimed less reducing poverty and more at increasing opportunity for women. Additional research should also be done examining the difference in how education spending as a percentage of GDP affects stunting in poor versus rich countries, as the preliminary analysis in this paper shows that policy recommendations on how to improve nutritional status need to be tailored to the wealth status of each particular country.

While more research is still needed on the relationship between "freedom," economic or personal, and nutrition, this paper provides a strong basis for a deeper investigation of the factors that affect economic freedom and societal success indicators.

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// DATA MERGE //

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* EFW data: year ____
use "EFWdataset2015.dta" , clear
rename countries country
rename summaryindex economicfreedom
label variable economicfreedom "Economic freedom"
drop if country == "Hong Kong"
sort country year
countrynames country
drop _changed
replace country = "Cabo Verde" if country == "Cape Verde"
save "EFWforpaper.dta" , replace

* World Bank data
drop _all
wbopendata, indicator(NY.GDP.PCAP.CD; SI.POV.GINI; SH.XPD.TOTL.ZS; SH.STA.STNT.ZS; ///
       SE.XPD.TOTL.GD.ZS; SN.ITK.DEFC.ZS; SI.POV.DDAY; SE.ENR.PRSC.FM.ZS;
AG.LND.ARBL.HA.PC; ///
       SL.UEM.TOTL.NE.ZS; NE.IMP.GNFS.ZS) clear long

rename ny_gdp_pcap_cd gdppcap
rename si_pov_gini gini
rename sh_xpd_totl_zs healthspend
rename sh_sta_stnt_zs stunting
rename se_xpd_totl_gd_zs eduspend
rename sn_itk_defc_zs undernourishment
rename si_pov_dday poverty
rename se_enr_prsc_fm_zs gpi
rename ag_lnd_arbl_ha_pc arableland
rename sl_uem_totl_ne_zs unemployment
rename ne_imp_gnfs_zs imports

rename countryname country

drop if region == "Aggregates"
drop region
drop if country == "Arab World"
drop if country == "Caribbean small states"
drop if country == "Early-demographic dividend"
drop if country == "East Asia & Pacific"
drop if country == "East Asia & Pacific (IDA & IBRD countries)"
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drop if country == "Europe & Central Asia (IDA & IBRD countries)"
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drop if country == "European Union"
drop if country == "Fragile and conflict affected situations"
drop if country == "Heavily indebted poor countries (HIPC)"
drop if country == "High income"
drop if country == "Hong Kong SAR, China"
drop if country == "IBRD only"
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drop if country == "Least developed countries: UN classification"
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drop if country == "Middle East & North Africa (IDA & IBRD countries)"
drop if country == "Middle East & North Africa (excluding high income)"
drop if country == "Middle income"
drop if country == "North America"
drop if country == "Not classified"
drop if country == "OECD members"
drop if country == "Other small states"
drop if country == "Pacific island small states"
drop if country == "Post-demographic dividend"
drop if country == "Pre-demographic dividend"
drop if country == "Sint Maarten (Dutch part)"
drop if country == "Small states"
drop if country == "South Asia (IDA & IBRD)"
drop if country == "South Asia"
drop if country == "St. Martin (French part)"
drop if country == "Sub-Saharan Africa"
drop if country == "Sub-Saharan Africa (IDA & IBRD countries)"
drop if country == "Sub-Saharan Africa (excluding high income)"
drop if country == "Upper middle income"
drop if country == "World"
drop if country == "Central African Republic"
drop if country == "Central Europe and the Baltics"

countrynames country
drop _changed

* Making Regions Dummy Variables"
gen LCN = 0
replace LCN = 1 if regioncode == "LCN"
gen SAS = 0
replace SAS = 1 if regioncode == "SAS"
gen SSF = 0
replace SSF = 1 if regioncode == "SSF"
gen ECS = 0
replace ECS = 1 if regioncode == "ECS"
gen MEA = 0
replace MEA = 1 if regioncode == "MEA"
gen EAS = 0
replace EAS = 1 if regioncode == "EAS"
gen NAC = 0
replace NAC = 1 if regioncode == "NAC"

save "wbdata.dta" , replace

* Merge WB & EFW Data
use "wbdata.dta" , clear
merge 1:1 country year using EFWforpaper.dta
sort country year
drop _merge
save "WBmerge.dta" , replace
summarize

* CPI data
drop _all
use "FAOdata.dta"
sort area year
rename area country
```

```
rename value cpifood
drop domain item note

collapse cpifood, by(country year)
replace country = "Cote d'Ivoire" if country == "CÃ´te d'Ivoire"
replace country = "Bolivia" if country == "Bolivia (Plurinational State of)"
countrynames country
drop _changed
sort country year

save "cpidata.dta" , replace

*Merge CPI data
use "cpidata.dta" , clear
merge 1:1 country year using WBmerge.dta
save "CPImerge.dta" , replace
sort country year

*twoway scatter stunting economicfreedom

drop if country == "Tuvalu"
keep if year >= 2000 & year <= 2014
collapse stunting economicfreedom sizeofgovernment legalsystempropertyrights
soundmoney freedomtotradeinternationally regulation gdppcap gini healthspend eduspend
undernourishment poverty gpi arableland unemployment imports cpi LCN SAS SSF ECS MEA
EAS NAC, by(country)

generate lngdp = ln(gdppcap)
generate lnarableland = ln(arableland)
egen countrynumber = group(country)

label variable gdppcap "Per capita GDP using current US $"
label variable gini "Gini coefficient"
label variable healthspend "Health expenditure (% of GDP)"
label variable stunting "Prevalence of stunting (% of children under 5)"
label variable eduspend "Government education spending (% of GDP)"
label variable undernourishment "Prevalence of undernourishment (% of population)"
label variable poverty "Percent of population living in extreme poverty (<$1.90/day
2011 PPP)"
label variable gpi "Gender Parity Index, school enrollment (primary & secondary,
gross)"
label variable arableland "Arable land (hectares per person)"
label variable unemployment "Unemployment, total (% of total labor force)"
label variable economicfreedom "Economic Freedom"
label variable sizeofgovernment "Size of Government"
label variable legalsystempropertyrights "Legal System and Property Rights"
label variable soundmoney "Sound Money"
label variable freedomtotradeinternationally "Freedom to Trade Internationally"
label variable cpi "Consumer Price Index"
label variable imports "Imports of goods and services (% of GDP)"
label variable regulation "Regulation"
label variable LCN "Latin America & Caribbean"
label variable SAS "South Asia"
label variable SSF "Sub-Saharan Africa"
label variable ECS "Europe & Central Asia"
label variable MEA "Middle East & North Africa"
label variable EAS "East Asia & Pacific"
label variable NAC "North America"

save PAPERdata.dta, replace

*****Summary Table*****
summarize
```

```
// ANALYSIS //

*****How to Outreg*****
*outreg2 using outreg1.doc, replace ctitle(Model 1)
*outreg2 using outreg1.doc, append ctitle(Model 2)

*****Regression w/ Economic Freedom*****
reg stunting economicfreedom gini healthspend eduspend poverty gpi unemployment
imports cpifood LCN SAS SSF ECS MEA EAS lngdp lnarableland
outreg2 using outreg1.doc, replace ctitle(Model 1)

reg stunting economicfreedom gini healthspend eduspend poverty gpi unemployment
imports cpifood LCN SAS SSF ECS MEA lngdp lnarableland
outreg2 using outreg1.doc, append ctitle(Model 2)

reg stunting economicfreedom gini healthspend eduspend poverty gpi unemployment
imports LCN SAS SSF ECS MEA lngdp lnarableland
outreg2 using outreg1.doc, append ctitle(Model 3)

estat ovtest

// Ramsey RESET test using powers of the fitted values of stunting
      // Ho:  model has no omitted variables
              // F(3, 70) =       2.45
              // Prob > F =      0.0706

estat hettest

// Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
      //   Ho: Constant variance
      //   Variables: fitted values of stunting

      //   chi2(1)     =      0.02
      //   Prob > chi2  =   0.8966


* file is outreg - economic freedom.docx (right now) *

*****Individual/Group Parameters of EF*****
*All
reg stunting sizeofgovernment legalsystempropertyrights soundmoney
freedomtotradeinternationally regulation gini healthspend eduspend poverty gpi
unemployment imports cpifood LCN SAS SSF ECS MEA EAS lngdp lnarableland
outreg2 using outreg11.doc, replace ctitle(Model 1)

estat ovtest
// Ramsey RESET test using powers of the fitted values of stunting
     // Ho:  model has no omitted variables
              // F(3, 60) =       1.60
              // Prob > F =      0.1980

estat hettest

// Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
      //   Ho: Constant variance
      //   Variables: fitted values of stunting

      //   chi2(1)     =      0.02
      //   Prob > chi2  =   0.8814

*Size of gov't
```

```
reg stunting sizeofgovernment gini healthspend eduspend poverty gpi unemployment
imports cpifood LCN SAS SSF ECS MEA EAS lngdp lnarableland
outreg2 using outreg11.doc, append ctitle(Model 2)

estat ovtest

// Ramsey RESET test using powers of the fitted values of stunting
    //  Ho:  model has no omitted variables
              //     F(3, 64) =      1.38
              //     Prob > F =      0.2561

estat hettest

// Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
      //   Ho: Constant variance
      //   Variables: fitted values of stunting

      //   chi2(1)      =     0.18
      //   Prob > chi2  =   0.6686




*Legal property
reg stunting legalsystempropertyrights gini healthspend eduspend poverty gpi
unemployment imports cpifood LCN SAS SSF ECS MEA EAS lngdp lnarableland
outreg2 using outreg11.doc, append ctitle(Model 3)

estat ovtest

// Ramsey RESET test using powers of the fitted values of stunting
    //   Ho:  model has no omitted variables
              //     F(3, 64) =      2.55
              //     Prob > F =      0.0638

estat hettest

// Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
      //   Ho: Constant variance
      //   Variables: fitted values of stunting

      //   chi2(1)      =     0.07
      //   Prob > chi2  =   0.7898


*Sound money
reg stunting soundmoney gini healthspend eduspend poverty gpi unemployment imports
cpifood LCN SAS SSF ECS MEA EAS lngdp lnarableland
outreg2 using outreg11.doc, append ctitle(Model 4)

estat ovtest

// Ramsey RESET test using powers of the fitted values of stunting
    //   Ho:  model has no omitted variables
              //     F(3, 64) =      1.10
              //     Prob > F =      0.3572

estat hettest

// Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
      //    Ho: Constant variance
      //    Variables: fitted values of stunting

      //    chi2(1)      =     0.01
```

```
                  //     Prob > chi2  =    0.9126


*Freedom to trade
reg stunting freedomtotradeinternationally gini healthspend eduspend poverty gpi
unemployment imports cpifood LCN SAS SSF ECS MEA EAS lngdp lnarableland
outreg2 using outreg11.doc, append ctitle(Model 5)

estat ovtest

// Ramsey RESET test using powers of the fitted values of stunting
    //   Ho:  model has no omitted variables
            //      F(3, 64) =       2.09
            //      Prob > F =       0.1104

estat hettest

// Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
      //    Ho: Constant variance
      //    Variables: fitted values of stunting

      //   chi2(1)      =       0.10
      //   Prob > chi2  =    0.7460


*Regulation
reg stunting regulation gini healthspend eduspend poverty gpi unemployment imports
cpifood LCN SAS SSF ECS MEA EAS lngdp lnarableland
outreg2 using outreg11.doc, append ctitle(Model 6)

estat ovtest

// Ramsey RESET test using powers of the fitted values of stunting
    //   Ho:  model has no omitted variables
            //      F(3, 64) =       1.95
            //      Prob > F =       0.1298

estat hettest

// Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
      //     Ho: Constant variance
      //     Variables: fitted values of stunting

      //   chi2(1)      =       0.11
      //   Prob > chi2  =    0.7410




*****Top-down regression w/out economic freedom*****
reg stunting sizeofgovernment legalsystempropertyrights soundmoney
freedomtotradeinternationally regulation gini healthspend eduspend poverty gpi
unemployment imports cpifood LCN SAS SSF ECS MEA EAS lngdp lnarableland
outreg2 using outreg2.doc, replace ctitle(Model 1)

reg stunting sizeofgovernment legalsystempropertyrights soundmoney
freedomtotradeinternationally gini healthspend eduspend poverty gpi unemployment
imports cpifood LCN SAS SSF ECS MEA EAS lngdp lnarableland
outreg2 using outreg2.doc, append ctitle(Model 2)

reg stunting sizeofgovernment legalsystempropertyrights soundmoney
freedomtotradeinternationally gini healthspend eduspend poverty gpi unemployment
imports cpifood LCN SAS SSF MEA EAS lngdp lnarableland
outreg2 using outreg2.doc, append ctitle(Model 3)
```

```
reg stunting sizeofgovernment legalsystempropertyrights soundmoney
freedomtotradeinternationally gini healthspend eduspend poverty gpi unemployment
imports LCN SAS SSF MEA EAS lngdp lnarableland
outreg2 using outreg2.doc, append ctitle(Model 4)

reg stunting sizeofgovernment legalsystempropertyrights soundmoney
freedomtotradeinternationally gini healthspend eduspend poverty gpi unemployment
imports LCN SAS SSF EAS lngdp lnarableland
outreg2 using outreg2.doc, append ctitle(Model 5)

reg stunting sizeofgovernment legalsystempropertyrights soundmoney gini healthspend
eduspend poverty gpi unemployment imports LCN SAS SSF EAS lngdp lnarableland
outreg2 using outreg2.doc, append ctitle(Model 6)

reg stunting sizeofgovernment legalsystempropertyrights soundmoney gini healthspend
eduspend poverty gpi unemployment imports LCN SAS EAS lngdp lnarableland
outreg2 using outreg2.doc, append ctitle(Model 7)

reg stunting legalsystempropertyrights soundmoney gini healthspend eduspend poverty
gpi unemployment imports LCN SAS EAS lngdp lnarableland
outreg2 using outreg2.doc, append ctitle(Model 8)

reg stunting legalsystempropertyrights soundmoney gini healthspend eduspend poverty
gpi unemployment imports LCN SAS EAS lngdp
outreg2 using outreg2.doc, append ctitle(Model 9)

reg stunting legalsystempropertyrights soundmoney gini healthspend eduspend poverty
gpi unemployment imports SAS EAS lngdp
outreg2 using outreg2.doc, append ctitle(Model 10)

reg stunting legalsystempropertyrights soundmoney healthspend eduspend poverty gpi
unemployment imports SAS EAS lngdp
outreg2 using outreg2.doc, append ctitle(Model 11)

estat ovtest

// Ramsey RESET test using powers of the fitted values of stunting
    //  Ho:  model has no omitted variables
            //  F(3, 74) =      0.90
            //  Prob > F =      0.4437

estat hettest

// Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
    //     Ho: Constant variance
    //     Variables: fitted values of stunting

    //    chi2(1)      =      0.03
    //    Prob > chi2  =    0.8605




*****Economic freedom affecting GDP affecting stunting*****
reg lngdp economicfreedom
outreg2 using outreg3.doc, replace ctitle(Model 1)
predict gdphat
reg stunting gdphat

**Using Residuals (GDP not explained?)**
gen resid = gdppcap - gdphat
gen lnresid = ln(resid)
reg stunting lngdphat lnresid gini healthspend eduspend poverty gpi unemployment
imports cpifood LCN SAS SSF ECS MEA EAS lnarableland
```

```
reg stunting lngdphat lnresid gini healthspend eduspend poverty gpi unemployment
imports cpifood LCN SAS SSF ECS MEA lnarableland

reg stunting lngdphat lnresid gini healthspend eduspend poverty gpi unemployment
imports  LCN SAS SSF ECS MEA lnarableland

reg stunting lngdphat lnresid gini healthspend eduspend poverty gpi unemployment
imports  LCN SAS SSF ECS lnarableland


*****Low vs High GDP*****
histogram gdppcap, frequency normal

summarize gdppcap, detail
summarize if gdppcap > 4383.775
summarize if gdppcap < 4383.775

*Low GDP median - economic freedom
reg stunting economicfreedom gini healthspend eduspend poverty gpi unemployment
imports cpifood LCN SAS SSF ECS MEA EAS NAC lnarableland if gdppcap < 4383.775
outreg2 using outreg7.doc, replace ctitle(Model 1)

estat ovtest

// Ramsey RESET test using powers of the fitted values of stunting
    // Ho:  model has no omitted variables
            //   F(3, 41) =      1.67
            //   Prob > F =      0.1894

estat hettest

// Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
    //   Ho: Constant variance
    //   Variables: fitted values of stunting

    //   chi2(1)       =     1.99
    //   Prob > chi2  =   0.1588


*LOW GDP median - no economic freedom
reg stunting sizeofgovernment legalsystempropertyrights soundmoney
freedomtotradeinternationally regulation gini healthspend eduspend poverty gpi
unemployment imports cpifood LCN SAS SSF ECS MEA EAS lnarableland if gdppcap <
4383.775
outreg2 using outreg7.doc, append ctitle(Model 2)

reg stunting sizeofgovernment legalsystempropertyrights soundmoney
freedomtotradeinternationally regulation healthspend eduspend poverty gpi unemployment
imports cpifood LCN SAS SSF ECS EAS lnarableland if gdppcap < 4383.775
outreg2 using outreg7.doc, append ctitle(Model 3)

*higher r-squared than economic freedom regression
            // shows breaking up the aggregate provides better predictor for
malnutrition

estat ovtest

// Ramsey RESET test using powers of the fitted values of stunting
    // Ho:  model has no omitted variables
            //   F(3, 38) =      1.35
            //   Prob > F =      0.2739
```

```
estat hettest

// Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
    //    Ho: Constant variance
    //    Variables: fitted values of stunting

    //    chi2(1)     =      1.00
    //   Prob > chi2  =    0.3184


*HIGH GDP median - economic freedom
reg stunting economicfreedom gini healthspend eduspend poverty gpi unemployment
imports cpifood LCN SAS SSF ECS MEA EAS NAC lnarableland if gdppcap > 4383.775
outreg2 using outreg9.doc, replace ctitle(Model 1)

reg stunting economicfreedom gini healthspend eduspend poverty unemployment imports
cpifood LCN ECS MEA EAS NAC lnarableland if gdppcap > 4383.775
outreg2 using outreg9.doc, append ctitle(Model 2)

reg stunting economicfreedom gini healthspend eduspend poverty imports cpifood LCN ECS
MEA EAS NAC lnarableland if gdppcap > 4383.775
outreg2 using outreg9.doc, append ctitle(Model 3)

reg stunting economicfreedom gini healthspend eduspend poverty imports cpifood LCN MEA
EAS NAC lnarableland if gdppcap > 4383.775
outreg2 using outreg9.doc, append ctitle(Model 4)

reg stunting economicfreedom gini healthspend eduspend poverty imports cpifood MEA EAS
NAC lnarableland if gdppcap > 4383.775
outreg2 using outreg9.doc, append ctitle(Model 5)

reg stunting economicfreedom healthspend eduspend poverty imports cpifood MEA EAS NAC
lnarableland if gdppcap > 4383.775
outreg2 using outreg9.doc, append ctitle(Model 6)

estat ovtest

// Ramsey RESET test using powers of the fitted values of stunting
    // Ho:  model has no omitted variables
            //  F(3, 12) =       0.39
            //  Prob > F =       0.7596

estat hettest

// Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
    //    Ho: Constant variance
    //    Variables: fitted values of stunting

    //    chi2(1)     =      0.31
    //   Prob > chi2  =    0.5782


*HIGH GDP median - no economic freedom
reg stunting sizeofgovernment legalsystempropertyrights soundmoney
freedomtotradeinternationally regulation gini healthspend eduspend poverty gpi
unemployment imports cpifood LCN SAS SSF ECS MEA EAS lnarableland if gdppcap >
4383.775
outreg2 using outreg10.doc, replace ctitle(Model 1)

reg stunting sizeofgovernment legalsystempropertyrights soundmoney
freedomtotradeinternationally regulation gini healthspend eduspend poverty gpi
unemployment imports cpifood LCN SSF MEA EAS lnarableland if gdppcap > 4383.775
outreg2 using outreg10.doc, append ctitle(Model 2)
```

```
reg stunting sizeofgovernment legalsystempropertyrights soundmoney regulation gini
healthspend eduspend poverty gpi unemployment imports cpifood LCN SSF MEA EAS
lnarableland if gdppcap > 4383.775
outreg2 using outreg10.doc, append ctitle(Model 3)

reg stunting sizeofgovernment legalsystempropertyrights soundmoney regulation gini
healthspend eduspend poverty gpi unemployment imports cpifood LCN MEA EAS lnarableland
if gdppcap > 4383.775
outreg2 using outreg10.doc, append ctitle(Model 4)

reg stunting sizeofgovernment soundmoney regulation gini healthspend eduspend poverty
gpi unemployment imports cpifood LCN MEA EAS lnarableland if gdppcap > 4383.775
outreg2 using outreg10.doc, append ctitle(Model 5)

reg stunting sizeofgovernment soundmoney regulation gini healthspend eduspend poverty
gpi unemployment imports cpifood LCN MEA lnarableland if gdppcap > 4383.775
outreg2 using outreg10.doc, append ctitle(Model 6)

reg stunting sizeofgovernment soundmoney regulation gini healthspend eduspend poverty
gpi unemployment imports cpifood LCN MEA if gdppcap > 4383.775
outreg2 using outreg10.doc, append ctitle(Model 7)

reg stunting soundmoney regulation gini healthspend eduspend poverty gpi unemployment
imports cpifood LCN MEA if gdppcap > 4383.775
outreg2 using outreg10.doc, append ctitle(Model 8)

reg stunting soundmoney regulation gini healthspend eduspend poverty unemployment
imports cpifood LCN MEA if gdppcap > 4383.775
outreg2 using outreg10.doc, append ctitle(Model 9)

reg stunting soundmoney regulation gini healthspend eduspend poverty unemployment
imports cpifood MEA if gdppcap > 4383.775
outreg2 using outreg10.doc, append ctitle(Model 10)

reg stunting soundmoney regulation gini eduspend poverty unemployment imports cpifood
MEA if gdppcap > 4383.775
outreg2 using outreg10.doc, append ctitle(Model 11)

estat ovtest

// Ramsey RESET test using powers of the fitted values of stunting
     // Ho:  model has no omitted variables
               // F(3, 13) =       0.60
               // Prob > F =      0.6257

estat hettest

// Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
     //     Ho: Constant variance
     //     Variables: fitted values of stunting

     //    chi2(1)      =      0.15
     //    Prob > chi2  =   0.6969

****Interaction of edu & gdp****
gen edugdp = eduspend*gdppcap

reg stunting gdppcap edugdp eduspend sizeofgovernment legalsystempropertyrights
soundmoney freedomtotradeinternationally regulation gini healthspend poverty gpi
unemployment imports cpifood LCN SAS SSF ECS MEA EAS lnarableland
outreg2 using outreg13.doc, replace ctitle(Model 1)
```