Food Security and Globalisation: A Quantitative Analysis

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Abstract

This paper investigates the relationship between globalisation and food security, utilising a quantitative panel data approach to explore how economic, social, and political dimensions influence food security across developed and developing regions. The study reveals significant positive associations between globalisation and food security. However, regional disparities emerge, with developed and politically stable countries experiencing greater benefits than their developing and politically unstable counterparts. While globalisation holds the potential to improve food security, policymakers must address the nuanced effects of economic growth, population dynamics, and environmental factors, calling for targeted interventions to enhance resilience in vulnerable regions.

Introduction

Agriculture is one of history's oldest industries, as early as 8500 BC humanity had moved from hunter/gatherers to domesticating crops and animals beginning in the Near East and China (Anderson, 2014). The long-distance agricultural trade of farm inputs like crop seeds and cuttings, breeding animals, and farm production technologies has led to an increase in productivity and geographic diffusion of farming. This has resulted in gradual urbanisation, industrialisation, global economic growth, reduced poverty, population growth, and increased food security (Anderson, 2014). However, despite these positive outcomes of agricultural trade, there are still significant challenges in ensuring food security for all people.

According to the United Nations Food and Agriculture Organisation (FAO, 2023), an estimated 735 million people worldwide faced hunger in 2022, which is 122 million more than 2019 pre-pandemic. The FAO describes food security as being *"when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life".* Economic globalisation can be described as the integration of national economies into international economies through trade, foreign direct investment (FDI), cross-border capital flows, labour flows, and technology flows (Bhagwati, 2004). Globalisation is one of the key drivers of food security, which is an important measure of human development, however, it is not uniform across the globe.

This paper aims to investigate the relationship of globalisation on food security for developed and developing regions of the world, taking a quantitative approach using panel data. Following this the reader can expect to find an overview of the current literature surrounding "globalisation and food security", followed by a conceptual framework, a review of the data and methodology, the analysis and discussion, and finally a conclusion. We argue that Globalisation is a key determinant of food security, with higher levels of globalisation associated with improved food security varying across income levels and political stability. Developed and politically stable countries benefit more from globalisation in terms of food security compared to their developing and politically unstable counterparts.

Literature Review

From the wide range of literature on globalisation and food security, two topics emerged most frequently. The first was neo-liberalised globalisation and the second was factors of food security.

Neoliberal Globalisation

Lawrence's (2017) paper on food systems and security from a global perspective investigates in-depth the effect of the current trajectory of globalisation being dubbed "neoliberal globalisation" and its effect on global food security. The paper begins by presenting the two food regimes which have always been most present throughout history, the first being the imperial regime which was the food trade between a primary country and its colonies. The intensive regime was based on the production and trade of manufactured or durable foods. Furthermore, a new third regime identified by Friedman and Michael (1989) is called "a financialised regime", which Lawrence argues is the result of neoliberalism. Lawrence then recontextualises the three food regimes into existing food systems as traditional, modernising, and industrial. Globalisation in this paper is defined as the compression of time and space, the growing connection between the global and local, and the growing presence and influence of multinational cooperation (MNC). Neoliberal ideologies and economic practices advocate for market rule, no state interference unless it is to assist in profit-making, and the justification of user pays and self-help, So, neoliberal globalisation is the influence of neoliberal ideologies and economic practices on globalisation.

Lawrence (2017) states that neoliberal globalisation has had five major consequences for the food and agriculture industries. First, it has spread the influence of large agricultural firms that supply farming inputs, which can use patent laws to supply genetically modified (GM) seeds that are tailored to proprietary agrichemicals. The advantage these firms have greatly disadvantages smaller farmers and food workers (Constance, Hendrickson and Howard, 2014). The second consequence is the growing interconnection of the global south in traditional food systems and the global north in modernising and industrialising food systems, which results in the global south providing out-of-season food to the north. While this can benefit poorer southern nations It can also affect local food provisioning (Sippel, 2015). The third consequence is the rise of high-tech or productivism agriculture on a global scale, which utilises artificial herbicides, pesticides, fertilisers, hybrid seeds, and GM seeds, to increase output and reduce labour inefficiencies (Lang and Heasman, 2015). The fourth consequence is the neo-liberalisation of the global economy and the increasing influence of MNCs, who advocate for policies to further their self-interest and to increase the barrier to entry of smaller firms. For example, private regulation to circumvent public regulation, intellectual property rights, and increasing cost of compliance, which results in a decreasing market share for smaller firms and overall weakening of environmental standards. The last consequence is "super marketisation" – the growing dominance of retail stores reconfigured into an agri-food chain firm (Lawrence, 2017)

Another aspect of neoliberal globalisation is its relationship to the globalisation of land or "land grabbing". Brown (et al., 2014) mentions that under neoclassical economic theory, globalisation underpinned by free trade will produce an optimal distribution of land uses so that goods and services are produced wherever it is most efficient and cheapest. This implies the separation of the location of which goods and services are produced and consumed will be determined by the market and that will have consequences for existing patterns of agricultural land uses. Brown argues that the maximisation of productivity and efficiency does not always ensure human and environmental well-being. Brown (et al, 2014) finds that globalisation can lead to insecurity in land use systems in the developed and developing world, which disproportionately affects the poorest members of society.

Amusan (2018) looks into the undesirable consequences of the globalisation of land and its effect on the quality of life for the local population. Amusan defines globalisation at a theoretical level as the forceful implementation of laissez-faire as a means of development. The rationale behind the land grabbing in Africa is due to the negative effects of climate change, the unsustainable use of arable land in Europe and America, the demand for animal feed, and the demand for fossil fuel alternatives.

The paper argues that the current environment of neoliberal globalisation policies has allowed MNCs to maximise the interest of their profits and shareholders, adopting agricultural practices that damage the local environment. Mono-cropping for example is the practice of planting only one type of crop on the same land for extended periods has the potential to put many other organic crops into extinction (Jacques and Jacques, 1970). The paper recognises the importance of African agricultural land and its role in providing global food security, but not at the cost of the local and indigenous people. The solution suggested in this paper is the theory of interdependence, for northern governments to intervene in food production in Africa to meet global demands while meeting local needs (Amusan, 2018).

Factors of Food Security

The high-level panel of experts (HLPE) on food security and nutrition keeps the Committee of World Food Security (CFS) updated on worldwide knowledge and emerging trends in food security which leads to more informed and higher-quality policy debates on global and local levels (FAO, 2023). The HLPE reports highlight the four most significant factors of food security in their reports as price volatility, land tenure, climate change, and social protection.

The HLPE reports on price volatility (HLPE, 2011) observe how the differential in food price elasticities across richer and poorer countries has been widening over the years. The growing incomes in most of the world paired with the inverse relation between income and food price elasticity, results in demand becoming less price elastic (Sridhar, 2012).

The HLPE report on land tenures (HLPE, 2011b) investigates the impact of large-scale cross-border investments in land, on land tenures and food security. It finds similar to Amusan (2018) that there is an issue with land grabbing especially in the continent of Africa. Globally, more than two billion small landowners depend critically on land, however, It is estimated that 50 million to 80 million hectares of land have been bought by international investors, and land is now being seen as a global asset to be traded like any other commodity. Although there is inadequate data on cross-border land transactions and terms of contracts, there is little evidence to show that such investment in land has resulted in improved productivity the report finds that more than 75% of land deals had not resulted in higher agricultural output. Instead, large-scale land investment has negative impacts on food security, incomes, quality of life, and environment for the local people.

The third report on climate change (HLPE, 2012) focuses on the global greenhouse gas emissions from agricultural crop production and livestock. Since the aim is to slow the pace of climate change the report calls for reduced conversion of non-agricultural land to reduce direct and indirect emissions. Of course, this will be at the cost of lower agricultural outputs which could weaken food security if emission policies are not properly managed.

The last report on social protection (HLPE, n.d.) focuses on the importance of widely available untargeted subsidies for increasing agricultural output and income, especially for female farmers. It argues against the prevailing orthodoxy of targeted subsidies as they are expensive and not cost-

effective. However, like Lawrence (2017), the report identifies that richer firms tend to benefit disproportionately from this regime.

Misselhorn (et al., 2012) investigated some of the supply and demand side factors that can put pressure on global food security. On the demand side, we have primarily the rising world population which is estimated to reach almost 9 billion by 2050 with much of the growth concentrated in Asia and Africa, which tend to have higher rates of environmental and social vulnerabilities. The southern half of Africa is set to reach a population of 2 billion by 2050 but is already a net importer of food. Other demand-side pressures include urbanisation, changing demand in food types and levels of processing, disease, and under-development factors like poverty, gender inequality, and the lack of healthcare and education. On the supply side, Misselhorn (et al., 2012) argues that climate change is likely to transform the geography of food production in a way that disproportionately affects developing countries resulting in lower levels of forecasted agricultural productivity. This will mainly be due to changing global temperatures, rainfall patterns, and an increase in extreme weather like droughts. Other supply-side pressures include urbanisation, globalisation, and land use change.

Conceptual Framework

The general idea throughout the literature is that both globalisation and food security are multifaceted variables and that current globalisation policies disproportionately advantage MNCs and developed countries while disadvantaging pooper people in less developed regions. It is this aspect of disproportion between regions which this research aims to investigate. Does globalisation disproportionately benefit the food security of developed countries over developing countries?

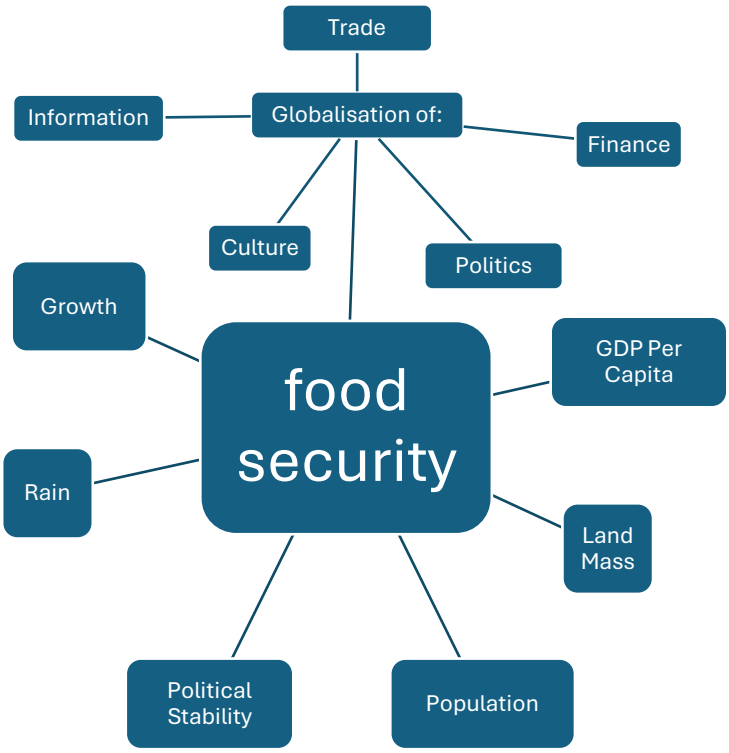

Figure 1: Conceptual Framework

The Data

Food Security

The measure of food security we will be using for our dependent variable is the Global Food Security Index (GFSI) from the Economist Impact (Anon., 2022), this index is constructed by considering four main pillars of a country's food systems. The first is affordability which measures the ability of consumers to purchase food and looks at the effects of programs and policies during price shocks to gauge variability. Affordability is comprised of sub/composite indicators like agricultural trade, trade freedom, and agricultural import tariffs. The second is availability which measures the agricultural production and the capabilities of farms, which are a function of national research and development efforts into agricultural output and supply chain disruptions. The composite indicators used for availability are the largest in number and depth, but the main themes can be summarised as; (1) access to finance and financial products, (2) access to technology, information, and market data, (3) farming infrastructure (storage and irrigation) and transportation infrastructure (roads, rails, and ports), (4) supply chain disruptions and prices of agricultural inputs. The third is quality and safety which measures the nutritional quality, safety, and variety of food in the average diet, with composite indicators of sugar consumption and food safety legislation to reflect these aims. Lastly, we have sustainability and adaptation which aims to measure a country's exposure to climate change and its reliance on natural resources. This pillar has composite indicators which include organic content in soil (soil fertility), political commitment to adaptation (government finances allocated for climate change and natural resource management), and disaster risk management. The GFSI includes 113 countries across Asia Pacific, Europe, Latin America, North America, Middle East, and Africa across a 10-year span (2012-2022). Although this index doesn't include all countries, the countries that it does have offer enough global coverage for a reliable perspective. The pillars listed above aim to show a comprehensive understanding of the multiple dimensions of food security and the data is reviewed and validated by a panel of industry experts to ensure its accuracy.

Globalisation

The KOF Globalisation Index (Gygli *et al.*, 2019) is a widely used measure of globalisation that assesses economic, social, and political dimensions across nearly every country in the world. The index combines three key dimensions: economic globalisation, which evaluates integration through trade, foreign direct investment, and capital flows; social globalisation, which captures interactions among people, including international communication, cultural exchange, and migration; and political globalisation, which assesses political cooperation, international organizations, and diplomatic relations. Each dimension is scored on a scale from 1 (least globalised) to 100 (most globalised). The KOFGI spans from 1970 to 2021 and covers almost every country globally. As of the latest data, globalisation has moderately increased in 2021 but remains below its 2019 level due to the impact of

the COVID-19 pandemic. Switzerland is the most globalised country, followed by Belgium and the Netherlands.

Control Variables

The control variables we will be using are GDP per capita, land area, population,precipitation, and political stability, which will all be collected from the World Bank Open Data, which has data on most countries for the last 20 years.

Methodology

Panel data is appropriate due to the nature of the data being spread across multiple countries, and the software used was Stata. The data is limited by the overlapping observations for GFSI and KOFGI which are from 2012-2021, so the control variables will only include observations from this period as well. The dataset is comprised of 93 countries after the omission of countries with missing data resulting in a highly balanced panel. We use Stata to model a quantitative approach to investigate the relationship between globalisation, economic factors, political stability, and food security. We utilized is fixed-effects regression, augmented with Driscoll-Kraay robust standard errors to account for serial correlation, group-wise heteroskedasticity, and cross-sectional dependencies within the panel data (Hoechle, 2007).

$$fs_{it} = \beta_1 \mathrm{kof}_{it} + \beta_2 \mathrm{growth}_{it} + \beta_3 \mathrm{lgdp}_{it} + \beta_4 \mathrm{lpopulation}_{it} + \beta_5 \mathrm{landarea}_{it} + \beta_6 \mathrm{precip}_{it} + \beta_7 \mathrm{polity}_{it} + \mathrm{u}_{it}$$

The model specification includes the dependent variable, food security (fs), regressed against a set of independent variables including globalisation index (kof), GDP growth (growth), GDP per capita (lgdp), population (lpopulation), land area (landarea), precipitation (precip), and political stability (polity). Graphical analysis and residual plots are used to assess model assumptions and diagnose potential issues such as multicollinearity or heteroskedasticity. The dataset is further disaggregated based on income and political stability levels to examine differential impacts across subgroups.

Analysis

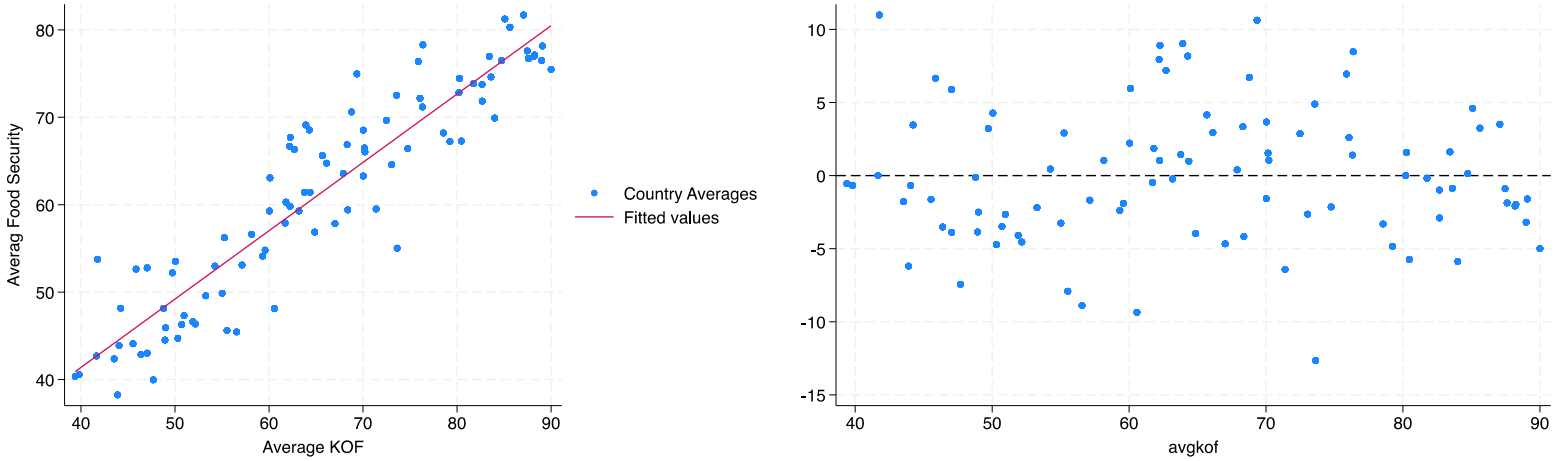

Figure 2

When looking at the data graphically (Figure 2) as a whole, we can see that plotting average food security and average KOF gives us an obvious positive trend, meaning countries associated with lower levels of globalisation also experience lower levels of food security. In comparison, countries with higher levels of globalisation experience higher levels of food security. Plotting the residuals for the country averages shows us that the residuals are randomly dispersed around zero and there is no real clear pattern. This means OLS model assumptions are met, and the residuals exhibit no correlation with the independent variable.

The main regression

$$fs_{it} = 0.390\text{kof}_{it} - 3.17\text{growth}_{it} + 3.84\text{lgdp}_{it} + 22.3\text{lpopulation}_{it} - 0.0000252\text{landarea}_{it} - 0.320\text{precip}_{it} + 0.00522\text{polity}_{it} + u_{it}$$

The model for food security utilizes the Driscoll-Kraay robust standard errors which account for serial correlation, group-wise heteroskedasticity, and cross-sectional dependences, however, the Driscoll-Kraay robust standard errors do not account for endogeneity.

Running a fixed effect regression on the panel data using the Driscoll-Kraay standard errors gives us the expected positive sign for KOF and a coefficient of 0.390. Suggesting that for a one-unit increase in KOF, we can expect to see a 0.390 increase in food security, holding the other variables constant. The coefficient is statistically significant at the 0.05 level, implying that the relationship between KOF and food security is unlikely to have occurred by chance.

Growth, lgdp, and lpopulation, all have the expected signs and are statistically significant at the 0.05 level. The lgdp coefficient implies that for every 1% increase in GDP, expect food security to increase by 3.84 units. The growth coefficient implies that a 1% increase in GDP growth results in a 3.17 unit decrease in food security, and the coefficient for lpopulation suggests that a 1% increase in population leads to a 22.3 unit increase in food security.

However, landarea and precipitation both exhibit unexpected negative signs but remain statistically significant at the 0.05 level. The coefficient for landarea implies that a one-unit increase in landarea results in a 0.0000252 decrease in food security, which is a small but still significant effect. Precipitation coefficients suggest that a one-unit increase in rainfall leads to a 0.320 decrease in food security, implying that countries with more rainfall won't necessarily experience higher levels of food security.

Finally, the political stability variable polity is the only one to exhibit a statistically insignificant coefficient at the 0.05 level. The coefficient implies that a one-unit increase in political stability results in a 0.00522 increase in food security, although the sign is what we expected the insignificant coefficient indicates that the relationship between polity and food security may not be reliable.

Income

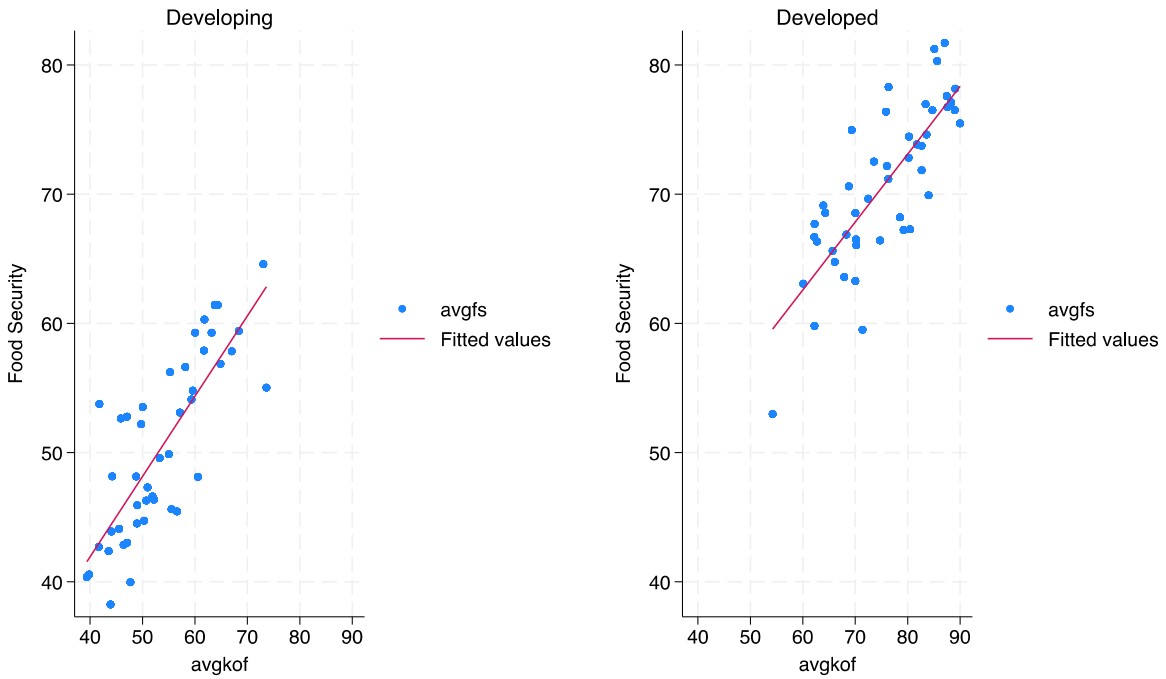

Figure 3

When taking a closer look at the countries we have in this dataset in terms of income, we find that the median income is $5906, the 25th percentile is $1490, and the 75th percentile is $22242. After finding the average GDP per country, we can then group them into developed and developing (above and below the median respectively), underdeveloped (under 25th percentile), and over-developed (over the 75th percentile).

When splitting the countries by median income (Figure 3) we find that globalisation has a greater effect on developed countries when compared to developing countries , with a coefficient of 0.720 compared to 0.223 for developing countries.

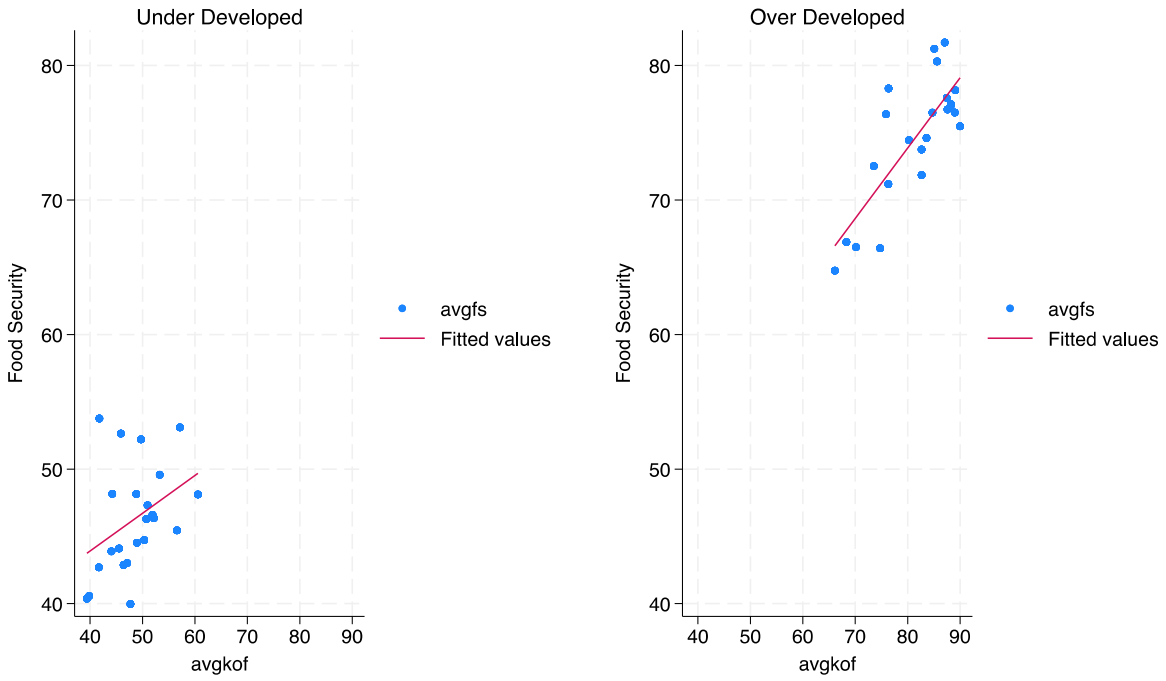

Figure 4

We find a similar result when we break this down even further and compare underdeveloped and over-developed countries (Figure 4). Globalisation seems to have a much greater influence on food security for countries with the highest incomes with a coefficient of 1.03 which is the highest so far. However, for under-developed countries, we get an unexpected result with a coefficient of 0.475 which is much lower than over-developed countries but still higher than if we were to include developing countries up to the median (why? A possible reason could be because it's a smaller sample size?).

Political Stability

Next, the data was broken down by political stability where the median score was 39.1, countries above this were classified as stable, while countries below were classified as unstable. Again, the data is broken down even further with countries below the score of 19.3 (25th percentile) as highly unstable, while countries above 61.3 (75th percentile) as highly stable.

When looking at the data split by the median (Figure 5), politically unstable countries are even

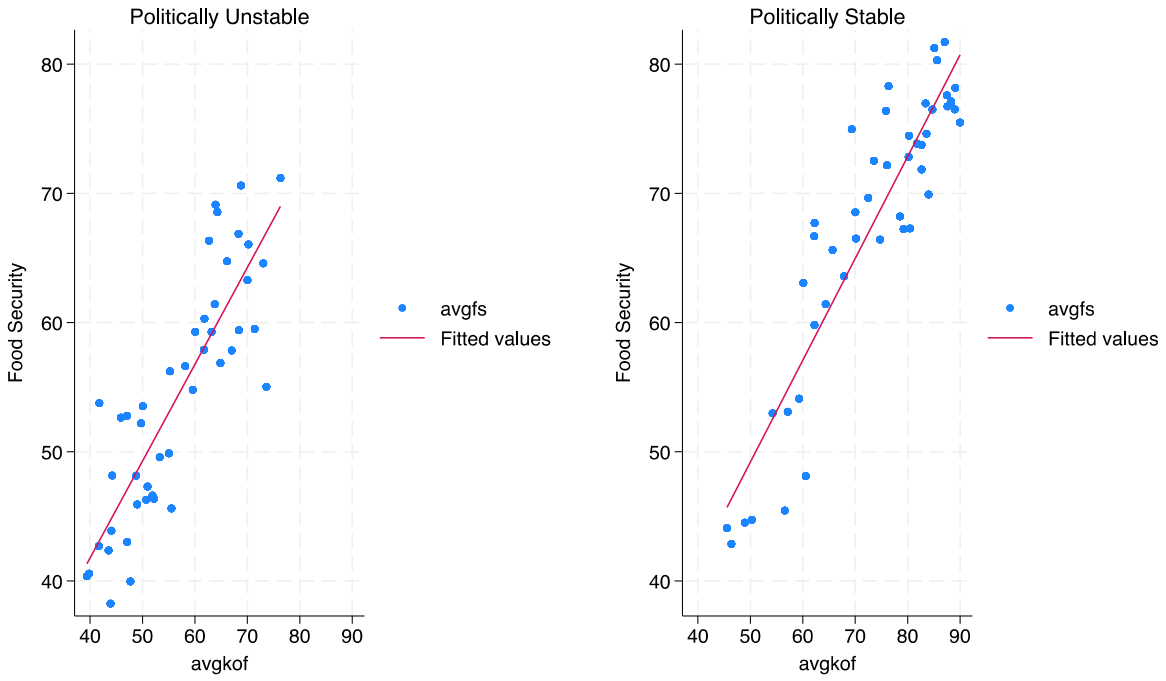

Figure 5

distributed along KOF and food security up until the 75th percentile for both variables. Past this point is populated more tightly by politically stable countries. Globalisation seems to have a stronger influence on food security for politically stable countries than unstable countries with coefficients of 0.578 and 0.273 respectively.

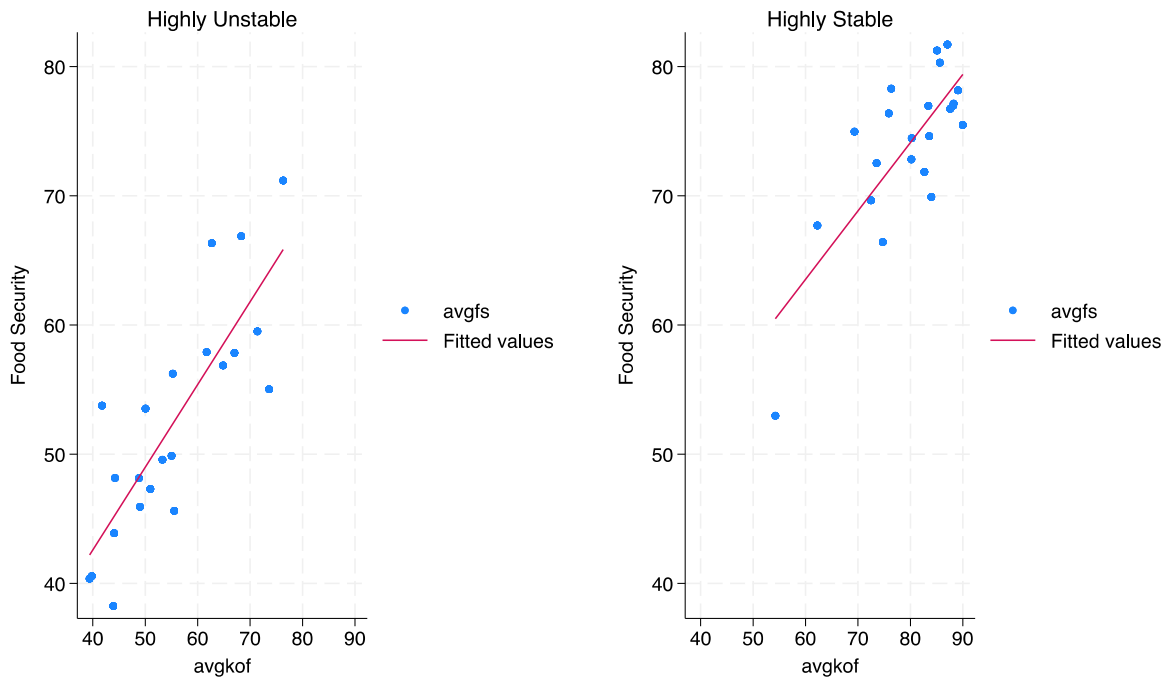

Figure 6

This trend continues when isolating for highly unstable and highly stable countries (Figure 6), with the KOF coefficient for highly stable countries increasing to 0.836 and for highly unstable countries to 0.315. like the previous comparison, we see the most politically stable countries are concentrated among the highest in KOF and food security scores. However, the most unstable countries are still evenly distributed and are more spaced out, so there exist far more variation in food security for both the countries under the median and under the 25th percentile political stability score.

Discussion

Policy Implications

The significant positive relationship between globalisation and food security suggests that policies aimed at promoting globalisation could potentially improve food security. However, policymakers should also consider the nuanced effects of economic growth, population dynamics, and environmental factors.

The regional disparities in the differential impact of globalisation on food security highlight the importance of targeted interventions. Developed and over-developed countries seem to benefit more from globalisation regarding food security than developing and underdeveloped countries. Reasons for this could include being less globally integrated or having lower political or conflict stability. There is an argument to be made (for developing countries) that the globalisation of agriculture can negatively impact ecological, livelihood, and food security on a regional level, and what regional farmers need is internal liberalization and not external liberalization (Vandana, 2002). However other

research argues that systems dedicated to regional food security are inferior to a globalized system in terms of production levels (Brown *et al.*, 2014).

The weaker relationship between globalisation and food security in politically unstable countries underscores the vulnerability of these nations to external economic factors. Evidence suggests that political stability can affect food security, and a lack of food security from external shocks (international embargo, poor climate) can lead to increased political stability (Akongdit, 2014). Policymakers should focus on enhancing resilience and addressing structural issues in these regions.

Research Implications

The findings raise questions about the underlying mechanisms driving the relationship between globalisation, economic factors, and food security. Further research could explore the mediating factors and potential interactions between different variables.

Limitations

The unexpected negative coefficients for land area and precipitation suggest that larger land areas and higher precipitation might be associated with lower food security, therefore further investigation is needed to understand these relationships better. While the coefficient for political stability (polity) is in line with expectations, indicating a positive relationship with food security, it is statistically insignificant. This suggests that the relationship between political stability and food security might not be robust. Although we observe that countries which have a higher globalisation index also exhibit higher food security (and vice versa), we cannot interpret this as a causal effect, because there could be a potential endogeneity problem which I intend to address in future studies.

Conclusion

In conclusion, our analysis reveals important insights into the relationship between globalisation, economic factors, political stability, and food security. Utilizing fixed-effects regression with Driscoll-Kraay standard errors, we found significant positive associations between various factors and food security, highlighting the multifaceted nature of this relationship.

Globalisation emerges as a key determinant of food security, with higher levels of globalisation generally associated with improved food security. However, the impact of globalisation varies across income levels and political stability, suggesting the need for targeted policy interventions. Developed and politically stable countries tend to benefit more from globalisation in terms of food security compared to their developing and politically unstable counterparts.

It's important to acknowledge certain limitations of our analysis, particularly the need for further investigation into unexpected coefficients for land area and precipitation, as well as the statistically insignificant coefficient for political stability.

Further research is needed to understand the underlying mechanisms driving the observed relationships while addressing potential endogeneity issues. Investigating mediating factors and potential interactions between different variables could provide a more comprehensive understanding of the dynamics at play. Additionally, exploring regional disparities and refining our methodology in future studies will contribute to a more nuanced understanding of food security dynamics. More specifically I aim to focus more on under-developed and developing economies and investigate how conflict and land-use influence food security.

By pursuing these avenues for future study, we can refine our understanding of the complex dynamics between globalisation, economic development, political stability, and food security, informing more targeted and effective policy interventions.

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Appendix I

Main regression with Driscoll-Kraay standard errors

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Regression with Driscoll-Kraay standard errors   Number of obs     =       837
Method: Fixed-effects regression                 Number of groups  =        93
Group variable (i): c_id                         F(  6,     8)     =3804395.49
maximum lag: 2                                   Prob > F          =    0.0000
                                                 within R-squared  =    0.2843
```

fs	Coefficient	Drisc/Kraay std. err.	t	P>|t|	[95% conf.	interval]
kof	.389968	.0931916	4.18	0.003	.1750677	.6048682
growth	-3.169557	.4049504	-7.83	0.000	-4.103374	-2.23574
lgdp	3.842908	.7476854	5.14	0.001	2.118743	5.567074
lpopulation	22.26793	2.511456	8.87	0.000	16.4765	28.05936
landarea	-.0000252	4.92e-06	-5.13	0.001	-.0000366	-.0000139
percip	-.3202327	.0466548	-6.86	0.000	-.4278189	-.2126465
polity	.0052205	.0090619	0.58	0.580	-.0156762	.0261173
_cons	0	(omitted)				

Appendix II

Stata Do File

```
xtset c_id year
egen avgfs=mean(fs), by(c_id)
egen avgkof =mean( kof ), by(c_id)
twoway (scatter  avgfs avgkof)  (lfit avgfs avgkof)
reg avgfs avgkof
predict residuals, residuals
scatter residuals avgkof, yline(0)
by c_id: gen lpopulation=log(population)
by c_id: gen lgdp=log(gdp)
by c_id: gen growth=s.lgdp
xtreg fs kof growth lgdp lpopulation landarea percip polity i.c_id
ssc install xtscc
xtscc fs kof growth lgdp lpopulation landarea percip polity, fe
sum gdp, detail
egen avggdp=mean(gdp), by(c_id)
gen developed=0
replace developed=1 if avggdp>=5905.666
gen udeveloped=0
replace udeveloped=1 if avggdp<=1489.578
gen hdeveloped=0
replace hdeveloped=1 if avggdp>=22242.41
xtreg fs kof growth lgdp lpopulation landarea percip polity i.c_id if developed==1
xtreg fs kof growth lgdp lpopulation landarea percip polity i.c_id if developed==0
twoway (scatter  avgfs avgkof)  (lfit avgfs avgkof) if developed==0, saving(graph1)
twoway (scatter  avgfs avgkof)  (lfit avgfs avgkof) if developed==1, saving(graph2)
gr combine graph1.gph graph2.gph, ycommon xcommon
xtreg fs kof growth lgdp lpopulation landarea percip polity i.c_id if udeveloped==1
xtreg fs kof growth lgdp lpopulation landarea percip polity i.c_id if hdeveloped==1
```

```
twoway (scatter  avgfs avgkof)  (lfit avgfs avgkof) if udeveloped==1, saving(graph3)
twoway (scatter  avgfs avgkof)  (lfit avgfs avgkof) if hdeveloped==1, saving(graph4)
gr combine graph3.gph graph4.gph, ycommon xcommon
sum polity, detail
egen avgpolity =mean(polity), by(c_id)
gen stable=0
replace stable=1 if avgpolity>=39.09928
xtreg fs kof growth lgdp lpopulation landarea percip  polity i.c_id if stable==1
xtreg fs kof growth lgdp lpopulation landarea percip  polity i.c_id if stable==0
gen hunstable=0
replace hunstable=1 if avgpolity<=19.33962
xtreg fs kof growth lgdp lpopulation landarea percip  polity i.c_id if hunstable==1
gen hstable=0
replace hstable=1 if avgpolity>=61.32076
xtreg fs kof growth lgdp lpopulation landarea percip  polity i.c_id if hstable==1
twoway (scatter  avgfs avgkof)  (lfit avgfs avgkof) if stable==0, saving(graph5)
twoway (scatter  avgfs avgkof)  (lfit avgfs avgkof) if stable==1, saving(graph6)
gr combine graph6.gph graph6.gph, ycommon xcommon
twoway (scatter  avgfs avgkof)  (lfit avgfs avgkof) if hunstable==1, saving(graph7)
twoway (scatter  avgfs avgkof)  (lfit avgfs avgkof) if hstable==1, saving(graph8)
gr combine graph7.gph graph8.gph, ycommon xcommon
```