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Bachelor Thesis [programme Topics in International Trade]

The impact of food dependency on food security in MENA countries

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Abstract

The Middle East and North African (MENA) region is a huge net importer of food, with grains making up a large share of those imports. The region depends on other countries to supply its food consumption. Meanwhile, it is also a region that is heavily confronted with food security issues. Using a fixed effects regression on data of MENA countries from 2001 until 2021, this paper tries to answer the hypothesis that food dependency lowers food security in MENA countries. The null hypothesis is rejected, which infers that there is indeed a negative impact of food dependency on food security, while it is also found that earlier levels of food security impact its current level.

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1. Introduction

Since the beginning of the Russian invasion of Ukraine food trade in the region has been heavily disrupted. According to the Food and Agriculture Organization of the United Nations (FAO) Russia and Ukraine are important producers and exporters of agricultural products, such as grain. A large part of their exports are imported by developing countries of whom many are situated in the Middle Eastern and Northern Africa (MENA) region. These countries are often net importers of food and depend on these imports to feed their growing populations. Historically, these countries have improved their food supply by importing food from the global market, according to Porkka, Kummu, Siebert and Varis (2013). But as of today, headlines of many reports, from sources such as the World Bank and the World Economic Forum, point to a growing food security crisis in the region. With a population of well over 500 million, trade shocks like those caused by the Ukraine war can lead to serious food crises. It is suggested that food dependent nations are hit harder by these shocks in food imports. An example is given by Luo and Tanaka (2021), who noticed a poor wheat harvest in 2007 in Ukraine and Australia, which increased wheat prices and caused food dependent nations, like MENA, to be less food secure. Now the question remains in how far the food dependency in MENA countries impacts their food security. While there is a growing body of literature studying food security, it hasn't been done in relation to the level of food dependency itself. An empirical study like this can shed light on the matter to what extend food dependent nations can expect their food security levels to change. It may give additional arguments to certain policy decisions these countries have to make in relation to international food trade and domestic agricultural production.

The rest of the paper is arranged as follows: in part 2 the theoretical framework is discussed. A hypothesis will be formed based on the body of literature on the subject. Then, in part 3, the gathered data shall be specified. Part 4 discusses the methodology and the chosen variables. Following that, in part 5 the results will be displayed and the hypothesis answered. Last, part 6 concludes the paper.

2. Theoretical framework

While almost any country produces food, it isn't always sufficient enough to supply its whole population. Those countries with insufficient food production turn to food imports to support their population. The term 'food import dependent' has been widely used in the literature to describe countries who rely on these food imports.

Porkka, Kummu, Siebert and Varis (2013) show how, globally, dependencies on food imports have changed over the last half-century. They note a change in countries with insufficient food production from 1965 to 2005. During this period they found global food supply to have increased, but found food self-sufficiently to have remained roughly the same. They also note that in the same period, countries with insufficient food production began importing more and more food. They concludes that food imports have gained an even more prominent role to combat food supply deficiencies in import dependent countries. This also means that these countries have begun to increasingly depend on food imports.

The reason to study these food dependent countries is that food dependency could be linked to the food security of a nation. There is a growing body of research looking into developing countries, many of which are large net importers of food, and the food crises they face. A great focus is on the MENA region, where most countries fall into both categories of net importers of staple foods and developing countries. The following papers illustrate in a number of ways how the food security in the region and food imports are linked together. Wright and Cafiero (2011) looked at the way food prices, and in turn the food security of MENA countries, respond to reductions in grain reserves. They noted that a lack of reserves increased food insecurity in those countries. A second paper by Luo and Takana (2021) states that the global wheat price and domestic wheat prices in the MENA region are positively correlated. Then, when the dependency on food imports is lowered, that correlation becomes weaker. Mary (2019) estimates the impact of food trade openness on food security and found that an increase in openness reduced food security. A recent paper by Hellegers (2022) notes that the Ukraine war could affect the food security of the MENA region through reduced imports. These studies highlight the interest in the connection between food dependency and food security. They are

but a few of the extensive literature, but it shows that many link import dependency to food security.

Otero, Pechlaner and Gurcan (2013) describe levels of dependency on food imports. Countries that require relatively more food imports to feed their populations are more food dependent. Moreover, they make a distinction between developed countries who are often more dependent on luxury foods and developing countries who depend more on basic foods. These basic foods are defined as those that provide the largest percentage of caloric intake in a person's diet. An often used example of such a basic food to study effects related to food dependency and food security in developing nations are cereals or subsets of cereals, like wheat. (Araujo-Enciso & Fellman, 2020; Breisinger, et al, 2010; Hellegers, 2022; Luo & Tanaka, 2021; Marson, Saccone & Vallino, 2023; Sadler & Magnan, 2011; Smith & Glauber, 2019; Veninga & Ihle, 2018; Wright & Cafiero, 2011). More specifically, Ahmed, Hamrick, Guinn, Abdulsamad and Gereffi (2013) tell us that a large portion, 37%, of the caloric consumption in MENA countries is provided by wheat.

Reading through these papers, I find that authors define food security in very different ways. To better compare these studies a formalized definition would be rather helpful, though finding one isn't that easy. As per the 1996 World Food Summit food security is defined as follows: "Food security exists when all people, at all times, have physical and economic access to sufficient, safe, and nutritious food that meets their food preferences and dietary needs for an active and healthy life." It is a broad subject and therefore there exists not one clear definition for food security. In fact, a whole range of food security variables and identifiers have been developed to measure food security. Jones, Ngure, Pelto, and Young (2013) have examined a large number of these and assessed when and for what purpose these many variables can be best used. They identified the *prevalence of undernourishment* as the variable to use when the purpose is to compare nations' food security in an international setting. This is also one of the main food security measurements of the FAO. It defines the prevalence of undernourishment to measure "...the percentage of the population whose habitual food consumption is insufficient to provide the dietary energy levels that are required to maintain a normal and active healthy life." In this paper the prevalence of undernourishment will be

taken to measure food security. A low prevalence of undernourishment will make for a food secure country.

It is important to keep in mind the other factors involved in determining the food security of a country. One of those could be the economic development of a country. Soriano and Garrido (2016) tell us that higher levels of economic growth lead to higher improvements in food security. Another research was conducted by Breisinger et al (2010) about the relation of economic development and food security in that region. According to them, both of these topics are deeply interlinked. A different impacting factor was found by Abdelhedi and Zouari (2020). They found agriculture, while insufficient to provide food for the whole population, to positively impact food security in some MENA countries. A further factor could be population growth. A growing population means a higher demand on food. Prosekov and Ivanova (2018) call population growth one of the main causes of hunger.

With all this in mind it is time to come to the main subject of this paper. To describe how food dependency impacts food security in MENA countries we have to look at the following question: Does food dependency have a negative impact on the food security in MENA countries? Based on the discussed literature above, I hypothesize that for MENA countries food dependency does have a negative impact on food security.

3. Data

To give an answer to the stated hypothesis, panel data have been collected from a couple of statistical databases. The FAOSTAT database, the database of the FAO that provides data for over 245 countries from the year 1961 onward, was used to collect data from MENA countries (classified as Northern Africa and Western Asia in the database itself) from 2001 till 2021. Countries' food balance data on wheat imports, exports and production in quantities were obtained. Further data were collected on population growth and GDP. Lastly, also from FAOSTAT, the data on the prevalence of undernourishment was obtained.

As FAOSTAT only had data on wheat stock variation and not the total yearly amounts of wheat stocks, that data was taken from the United States Foreign Agricultural Service (which is part of the United States Department of Agriculture) database.

4. Methodology

To test the hypothesis a fixed effects regression model was constructed. The model has the following form:

$$PoU_{it} = \alpha_i + \rho*importByTotal_{it} + \gamma_t + \beta_1*L1.PoU_{it} + \beta_2*L2.PoU_{it} + \beta_3*L1.importByTotal_{it} + \beta_4*GDP_{it} + \beta_5*populationGrowth_{it} + \varepsilon_{it}$$

Here, the variable *i* are the different MENA countries. The time variable *t* is expressed in years. γ_t is the time-dummy variable. The dependent variable *PoU* is the prevalence of undernourishment expressed in percentages. The independent variable *importByTotal* is the ratio of net wheat imports of a country divided by the total wheat available in that country, then multiplied by 100 to express it in a percentage. The total is calculated by adding net imports to the wheat reserves and production. It became clear from testing the model in multiple setups that former values of the prevalence of undernourishment had a great impact on the goodness of fit of the model. This is why two lagged instances of *PoU*, *L1.PoU* and *L2.PoU* were added to the model. In much the same way the lagged variable of *L1.importByTotal* was added. Last, control variables were added to the model: *GDP*, which is a country's Gross Domestic Product expressed in 1000 US dollars and *populationGrowth*, which is the percentage growth of the population that in year t. Table 4.1 shows some descriptive statistics of the variables and Table 4.2 gives correlations between those variables.

Table 4.1: Descriptive statistics of variables used in the regression

Variable	Observations	Mean	Std. Dev.	Min.	Max
PoU	399	6.83	7.40	2.50	42.90
ImportByTotal	399	21.19	32.06	-14.80	100
GDP	399	145094	197757.70	2038.535	957799.00
Pop. growth	399	1.96	2.62	-6.62	19.88

Table 4.2: Correlations of variables used in the regression

	Variable	1	2	3	4
1	PoU	1			
2	ImportByTotal	-0.091*	1		
3	GDP	-0.19**	0.063	1	
4	Pop. growth	0.072	0.24**	0.073	1

*p < 0.1, **p < 0.5

To evaluate the hypothesis, a fixed effects regression was chosen. In standard Ordinary Least Squares (OSL) regression models omitted variables could cause bias in the outcome of the model. Fixed effects captures the omitted characteristics of countries that don't change over time. These time-invariant omitted variables won't cause bias in a fixed effects model, as opposed to OSL regression models. In this way, I don't have to control for time-invariant omitted variables to the model. What I do have to control for in this model are variables that change over time. This is why the countries' GDP and population growth were added. Without those control variables, the model could have been biased.

The general fixed effects model is susceptible to time-variable unobserved variables. In this model I try to remedy that by adding GDP and population growth. Both variables have appeared in earlier literature to impact food security. To check for reversed causality between the independent and the dependent variable the Dumitrescu–Hurlin test for panel data was run. This can be seen in table 8.1 in the appendix. The test indicated no reverse causality. A number of regression models were run, adding relevant variables to build towards a better fitting model. First, a regression with only the dependent and independent variable, omitting all other variables. Following this, a regression adding the control variables *GDP* and *populationGrowth* and the first lags of the dependent and independent variables. Finally, the full model, adding the second lag of the dependent variable.

5. Results

This paper tests the hypothesis that food dependency impacts food security negatively in MENA countries. The regression results of the three models are shown in table 5.1.

Table 5.1: Fixed effects regression results on the relation between the import to total food ratio and the prevalence of undernourishment in MENA countries

Variable	Regression 3	Regression 2	Regression 1
ImportByTotal	0.0032*	0.0097**	-0.021
	(0.0015)	(0.0031)	(0.016)
1st lag ImportByTotal	-0.0040	-0.0014	
	(0.0030)	(0.0050)	
1st lag PoU	1.64**	0.95**	
	(0.087)	(0.057)	
2nd lag PoU	-0.71**		
	(0.057)		
GDP	$-9.07*10^{-7}$	$-3.27*10^{-6}$*	
	$(5.82*10^{-7})$	$(1.38*10^{-6})$	
Pop. growth	0.019	0.026	
	(0.014)	(0.016)	
Constant	0.49	-0.13	9.42
	(0.29)	(0.64)	(1.52)
Observations	361	380	399
R^2	0.9940	0.9788	0.0224

Standard errors are in brackets; *p < 0.05, **p < 0.01

Regression 1 is the model consisting of only the dependent and independent variables. *Regression 2* adds the control variables and the first lags of the dependent and independent variables. *Regression 3* is the full model, which I will now focus on. From the table can be seen that the independent variable *importByTotal* has a five percent significant positive coefficient. I stated before that a higher prevalence of undernourishment means that a country becomes less food secure. This means that the null hypothesis can be rejected. A coefficient of 0.0032 is found. This means that a one percentage point increase of the import by total food ratio makes for a 0.0032 percentage point increase in the prevalence of undernourishment. Relating this to food security means that it will decline with 0.0032 percentage point. It seems like a small change, but if you recount that the prevalence of undernourishment is expressed in a percentage of the population of the MENA region, that is well over 500 million, it is an impactful change. Larger changes give a better picture to interpret the findings: if the import by total food ratio experiences a 10 percentage point change, then the related change in prevalence of undernourishment will be 0.032 percentage point. A quick look at the FAOSTAT database gives us a population of almost 550 million for the MENA region. The 0.032 percentage point change means that almost 17.5 million more people will go undernourished because of the change in imports by total food ratio.

A second outcome is that the lags of the prevalence of undernourishment both have one percent significant coefficients. The height of the variable is thus heavily related to its earlier years. This could mean that food security is in some way sticky. Changes occur gradually over the years in response to its impacting variables instead of at a moment's notice.

6. Conclusion

The study carried out here on MENA countries over the years 2001 to 2021 shows that increases in imports relative to the total amount of food a country has access to increases the percentage of people that are undernourished in that country. This answers the main question that food dependency indeed lowers food security across the region. The region is known for its dependency on food imports. While percentage wise the numbers seem small, the MENA region has a large population. Small changes in food security could mean millions of people go from food secure to undernourished. This result is in line with earlier studies that covered

the subject in theory. Therefore this empirical study supports the growing literature in food dependency and food security. It is also important to note that the study found food security levels to be very dependent on earlier levels. Changing food security for the better may well be a time-consuming challenge. For the MENA region it is important to domestically produce enough food to combat food insecurity. However, it will face many challenges. Many of its countries are developing nations, their domestic agricultural production levels are at the moment by far not enough to sustain themselves, the Ukraine war is still ongoing, and to make matters worse, there is the worsening environmental crisis.

7. Literature list

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8. Appendix

Table 8.1 displays results from the Dumitrescu-Hurlin test that was conducted to test for reverse causality. The Dumitrescu-Hurlin tests whether *PoU*, the prevalence of undernourishment, Granger-causes *importByTotal*, the import by total food supply ratio. The null hypothesis is that *PoU* does not Granger-cause *importByTotal*. The test uses a lag order of two, as the main regression found first and second lagged variables to be impacting the model. Z-bar and Z-bar tilde both test statistics that are used to test whether the null hypothesis should be rejected. Since both are not significant, the null hypothesis is not rejected and it cannot be said that the dependent variable Granger-causes the independent variable. Thus it is safe to say that there is no reverse causality within the model.

Table 8.1: Dumitrescu-Hurlin test for prevalence of undernourishment on imports by total food supply ratio

Test statisctic	coefficient	p-value
Z-bar	1.55	0.12
Z-bar tilde	0.83	0.41

Lag order: 2