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Impact of the Farm to Fork strategy and the EU's Common Agricultural Policy on the ability of the food system to cushion against multiple shocks

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Abstract

During the COVID-19 pandemic, many countries simultaneously faced challenges that went beyond economic crises, such as extreme weather events and the spread of diseases and pests that affected food supplies. To improve the sustainability and resilience of the food system, the European Commission launched the Farm to Fork (F2F) strategy and reformed the Common Agricultural Policy (CAP). This article aims to assess how the implementation of elements of the F2F strategy, and the CAP might affect the shock-absorbing capacity of the food system. Therefore, it uses a global computable general equilibrium model to simulate different what-if policy scenarios to analyse the resilience of the food system in the presence of multiple simultaneous economic and supply shocks.

Introduction

From 2020, global responses to the COVID-19 pandemic, such as border closures and lockdowns, led to economic challenges - a decline in gross domestic product (GDP) and an increase in unemployment. Although global staple food markets remained stable (OECD, 2021), some countries faced food price inflation due to supply disruptions and currency devaluations. The Russian invasion of Ukraine from February 2022, together with the pandemic, increased global energy, agricultural and food prices, affecting global food supplies.

The disruption of trade due to sanctions and trade restrictions and the decline in Ukrainian exports exacerbated the impact by increasing demand for food in countries dependent on Ukrainian imports, further pushing up global food prices. Organisations such as the FAO and the World Bank point to the continued vulnerability of the global food supply (e.g. WORLD BANK, 2021). Economic crises, including pandemics and international conflicts, as well as political responses and emerging global recessions, have the potential to disrupt global food systems and significantly increase the number of people affected by food insecurity.

During the COVID-19 pandemic, many countries simultaneously faced challenges that went beyond economic crises, such as extreme weather events and the spread of diseases and pests that affected food supplies. One example is Ethiopia, which faced a triple threat: the COVID pandemic, desert locusts and severe flooding, leading to increased dependence on food aid (KASSEGN and EBRAHIM, 2021). The UN Climate Change Conference in 2021 indicates that the world could miss the 1.5 degree target, and climate-related events are expected to increase as a result of global warming (IPCC, 2021). In addition, increasing global population density increases the potential for more frequent pandemics such as COVID-19, as new dangerous viruses may emerge (WONG and LI, 2020).

The European Commission has launched the Farm to Fork (F2F) strategy and reformed the Common Agricultural Policy (CAP) to improve the sustainability and resilience of the EU's food system. The F2F strategy envisions a more sustainable food system that takes into account the entire supply chain to the consumer, for example by promoting sustainable diets and preventing food waste. The CAP supports this vision in agricultural production by providing funding that supports the F2F strategy. This includes financial support for farmers to adapt to market changes, to address challenges such as extreme weather events, and to promote reduced use of fertilisers and pesticides in the interests of sustainability, biodiversity, fair trade and stable supply chains. The new CAP will play a central role in implementing the F2F strategy from 2023, providing funding for income support, rural development and market measures.

Given these recent developments and the current strategic direction of the European Commission's agricultural and food policies, it is important to assess the potential of these strategies and policy instruments to strengthen food system resilience. TENDALL et al. (2015) define food system resilience as the ability of a food system at different scales to cope with unexpected perturbations over time. Food systems include, for example, the environment, people, inputs, processes, infrastructure, institutions and activities involved in the production, processing, distribution, preparation and consumption of food, as well as the outcomes of these activities, including socio-economic and environmental impacts (HLPE, 2017). In this context, resilience is understood as the ability of food system actors to respond to shocks and stresses. Resilience in agricultural and food systems refers to their ability to adapt, recover from disruptions and maintain core functions such as production, distribution and access to food in the face of stresses such as extreme weather events, pandemics and economic shocks. Two key concepts are distinguished: "Resilience" refers to the ability of a system to withstand and recover from perturbations, stresses or shocks. "Shock absorption" refers to the ability of the system to mitigate the effects of perturbations by reducing their severity and duration. Both aspects are critical to the stability and sustainability of the food system, as a system that combines resilience and shock absorption is better able to cope with challenges and adapt to change.

Against this background, the first objective is to examine the ability of the global food system to absorb shocks. In particular, the impact of multiple shocks occurring simultaneously will be analysed. For example, this could be a combination of economic events such as the COVID-19 pandemic and the Russian invasion of Ukraine, occurring simultaneously with yield shocks as observed in the past. Another aim is to examine how the ability of our current food system to cushion against shocks could be affected by the implementation of different elements of the F2F strategy and the CAP.

For the quantitative analysis, a global computable general equilibrium (GGE) model is used and extended by the elements of the CAP and the F2F strategy to simulate different what-if policy scenarios. The question of the ability of food systems to mitigate shocks can only be answered in the context of volatile markets. Therefore, different economic shocks are simulated in combination with stochastic supply shocks. The analysis of the effects on different indicators allows us to compare the resilience of the food system under different policy scenarios.

The remainder of this article is organised as follows. Section 2 presents the model and its extensions for to implement different elements of the F2F strategy and the CAP, while section 3 introduces the scenario development and analyses the results. Section 4 discusses the results and derives conclusions.

Overview F2F and CAP and their link to resilience

The F2F strategy at the heart of the European Green Deal aims to make food systems fairer, healthier and greener. Sustainable food systems are characterised by neutral or positive environmental impacts, contribute to climate change mitigation and adaptation, increase biodiversity, ensure food and nutrition security and public health as well as access for all to sufficient, safe, nutritious, and sustainable food, ensure food affordability while achieving fairer economic returns, strengthen the competitiveness of the EU food industry and promote fair trade.

The F2F strategy can contribute to the resilience of the food system, for example by promoting sustainable agricultural production that respects the environment. This helps to minimise environmental impacts and conserve biodiversity, thereby increasing resilience to environmental change. The strategy looks at the entire food supply chain, from production to the consumer. This holistic approach identifies weaknesses in the supply chain and takes action to strengthen it and make it more resilient. The F2F strategy promotes changes in dietary habits towards more sustainable food consumption, such as reducing meat consumption.

This can increase dietary diversity and make the food system more resilient to changes in the availability of certain foods. By taking action to prevent food waste, the F2F strategy helps to ensure that resources are used more efficiently. This minimises the impact of shortages and supports the sustainability of food production. The F2F strategy emphasises the importance of a more direct link between producers and consumers and strengthens the local focus to make the food system more resilient to global crises and disruptions. It also promotes innovation and research to respond more effectively to challenges.

The CAP consists of the so-called "first pillar", which includes in particular direct payments to farmers, and the "second pillar", which specifically promotes sustainable and environmentally friendly agriculture. The CAP is constantly being reformed to reduce its distortionary effects on competition and trade and to focus its policies on sustainable, efficient and resilient agriculture. The CAP therefore plays an important role in strengthening the resilience of the food system, in particular its resistance to disturbances and shocks. Farm subsidies contribute to income security and risk management for farms, helping them to adapt to changing market conditions/demands and to cope with challenges such as extreme weather events. The CAP also supports the development of regional value chains.

Funding is linked to compliance with good farming practice and cross-compliance, which means that certain EU agricultural payments are conditional on compliance with requirements relating to the environment, human, animal and plant health and animal welfare. Failure to meet these standards can lead to a reduction in payments. In addition, the CAP promotes sustainable farming practices to reduce environmental impacts and preserve biodiversity. For example, the CAP encourages reduced use of fertilisers and pesticides. The post-2023 CAP will strengthen existing rules and introduce new ones that reward farmers for climate- and environment-friendly farming practices. In this way, the CAP will help to mitigate climate change, increase biodiversity and reduce environmental damage, contributing to a more sustainable agriculture in the long term.

Methodology

CGE models are used to analyse economic responses to changes such as policy changes or resource availability, considering interactions between economic sectors, interdependencies between sectors/markets and possible rebound effects. These models are therefore well suited to analysing, for example, the impact of crop failures due to extreme weather events in different regions of the world, together with economic shocks due to global/regional crises, including market disruptions or policy barriers.

To assess the capacity of the agri-food system to buffer multiple shocks, and to analyse how different elements of the F2F strategy and the CAP affect capacity to cushion against shocks, we use the Global Trade Analysis Project (GTAP) model, documented in HERTEL (1997) and CORONG et al. (2017), and the underlying GTAP version 10 database (AGUIAR et al. 2019). The GTAP model is a comparative static, global, multi-regional and multi-sectoral CGE model that captures global economic activities, including a detailed representation of agricultural and food sectors and their upstream and downstream sectors, industry and services, as well as factor markets in different economies. In addition, the model accounts for bilateral international trade flows, so that the interdependencies of the different markets within and outside the economies can be represented with GTAP.

Following the approach of URBAN, JENSEN and BROCKMEIER (2014) and BOULANGER, BOYSEN-URBAN and PHILIPPIDIS (2021), the depiction of domestic support in the model and the underlying database is modified to account for the detailed CAP. Furthermore, we use additional nutrition data complementing the GTAP version 10 database based on FAO food balance sheets (CHEPELIEV, 2021) to track calorie production through the supply chain from producer to final consumer. This allows to account for the impact of dietary changes under the F2F strategy and the associated effects on food security indicators.

Modeling of F2F on the consumer side

To implement the F2F strategy on the consumer side, we assume a reduction of food waste by 50% at both the consumer and retail levels of the supply chain, in line with the United Nations Sustainable Development Goal 12.3 and the ambitious target based on the European Commission's Policy Impact Assessment (DE JONG et al. 2023). Furthermore, we assume a change in consumer behaviour to bring meat, milk, fruit and vegetable consumption in line with the dietary recommendations of the EAT Lancet Commission (WILLET et al. 2020).

To derive the shocks of moving to the EAT Lancet diet, we calculate the difference between the actual diet of the average consumer in the GTAP model in 2014 and the EAT Lancet recommendations for a diet of 2500 kcal per capita per day. The composition of the EAT Lancet diet is shown in Figure 1. It is important to note that we do not consider the full implementation of the EAT Lancet diet, but only the changes in demand for key commodities such as meat, milk, vegetables and fruits.

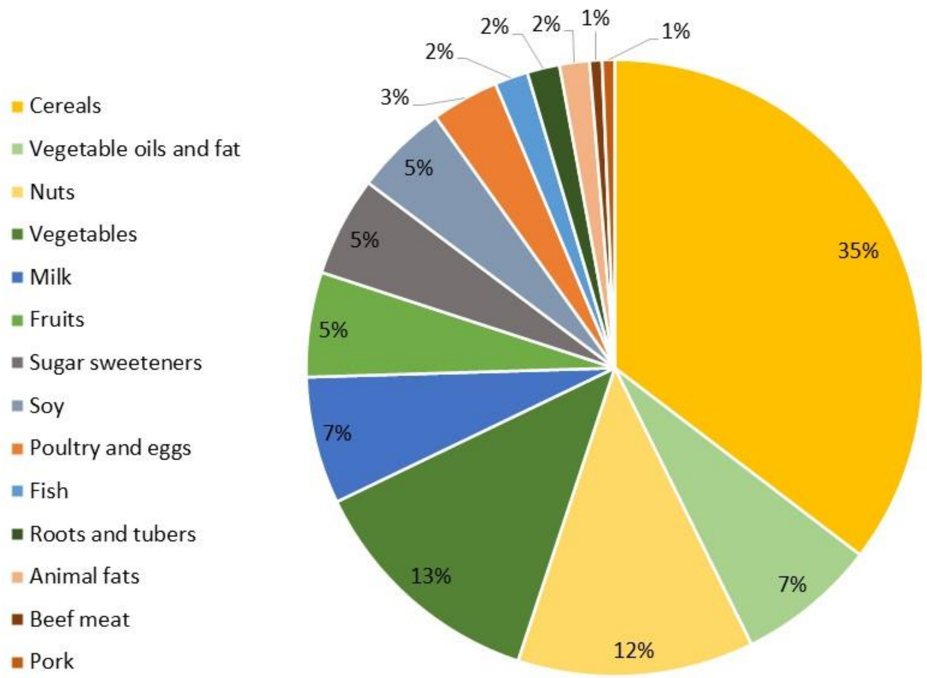

Figure 1: Composition of the EAT Lancet diet, 2500 kcal per capita per day
Source: Own figure, data from WILLET et al. 2019

Furthermore, the focus is not on how to achieve the EAT-Lancet diet, but on the effects of implementing such a diet ('what-if' scenarios). Therefore, we introduce dietary changes as exogenous changes in consumer preferences. In the GTAP model, household demand is specified by an aggregate implicit expenditure function with constant difference elasticity (CDE) and is complemented by a preference shift variable that allows household consumption to change to follow a given diet within the budget constraint (see BOYSEN-URBAN et al. 2022, PHILIPPIDIS et al. 2021, GEIBEL and FREUND, 2023).

The calculation of food waste reduction shocks is based on the shares of food waste in total food consumption or total retail sales for seven product groups and seven aggregated regions, as reported by FAO (FAO 2011). Food waste rates vary widely across regions, product groups and supply chain stages. Figure 2 shows the rates for different product groups at the consumer and retail levels. The highest levels of food waste are observed in high-income countries at the consumer level, while low-income countries tend to have the highest levels of food loss due to losses in agriculture, during production and post-harvest. Food waste is highest for horticultural products, including fruits, vegetables, roots and tubers, and for cereals. To account for these differences, the respective rates have been weighted with 2014 domestic supply data (FAOSTAT, 2023) according to the country and product aggregation in the GTAP model.

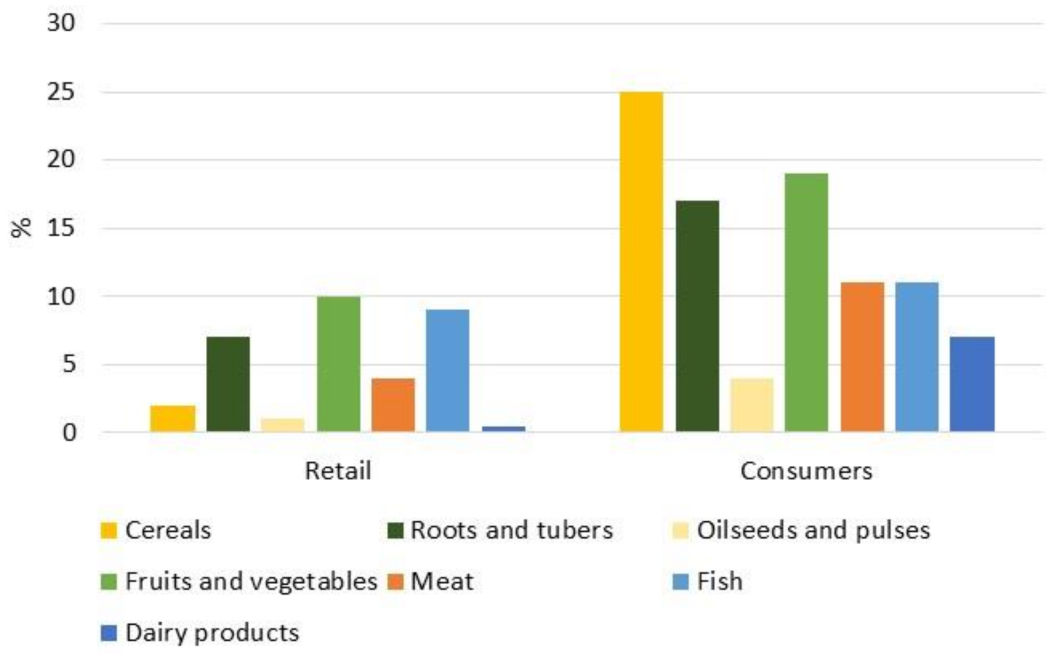

Figure A2: Share of EU consumer and retail food waste by product group
Source: Own figure, data from FAO 2011

The simulation of food waste reduction by product category is conducted using endogenously adjusted shifts in household budget allocation to achieve the targeted reduction in household consumption (PHILIPPIDIS et al. 2019, BOYSEN-URBAN et al. 2022). In this context, food waste is considered to be a reduction in the quantity or quality of food due to decisions and actions by retailers and consumers. A reduction in food waste is therefore equivalent to a reduction in food expenditure and a reduction in the demand for inputs from the food sector, leading to an increase in the efficiency of the use of inputs from the food sector.

Modeling of F2F an CAP on the producer side

The F2F strategy aims at increasing organic production to 25% of total cultivated land. As organic farming is mainly associated with lower yields compared to conventional farming, econometric estimates by KREMMYDAS, CIAIAN and BALDONI (2023) are used to measure the yield reduction in arable farming and to integrate it into the GTAP model. The estimates are based on a data panel of the Farm Accountancy Data Network (FADN) and are provided for five regions covering the EU and nine crop groups, see KREMMYDAS, CIAIAN and BALDONI (2023, Table A6). To calculate appropriate yield shocks for each product and region in the model, the current share of organic farming has to be taken into account. For this purpose, Eurostat data (EUROSTAT, 2024) on total and organic land for EU Member States and crops are used and mapped to the regions and product groups of the yield reduction data, which are used to construct a complete dataset of yield shocks for the model.

Furthermore, the use and risk of pesticides and the use of more hazardous pesticides will be reduced by 50% by 2030. This measure is also associated with a reduction in yields. Data on this is taken from BREMMER et al. (2021, Table 3.2). The authors conducted expert interviews on 10 different crops in seven EU Member States and derived yield reductions. These data were converted into the model by replacing missing values with existing values from the most similar country and then assigning these countries and products to those in the model.

The aim is to reduce nutrient losses by at least 50%, while avoiding deterioration of soil fertility, and to reduce fertiliser use by at least 20%. However, the measure is associated with reduced yields. Estimates for the yield reductions were taken from BREMMER et al. (2021, Table 3.7). The data were entered into the model in the same way as for pesticide use.

The total shock to yield from the three yield-reducing F2F policies is calculated by multiplying the individual shocks and is shown in Figure 3.

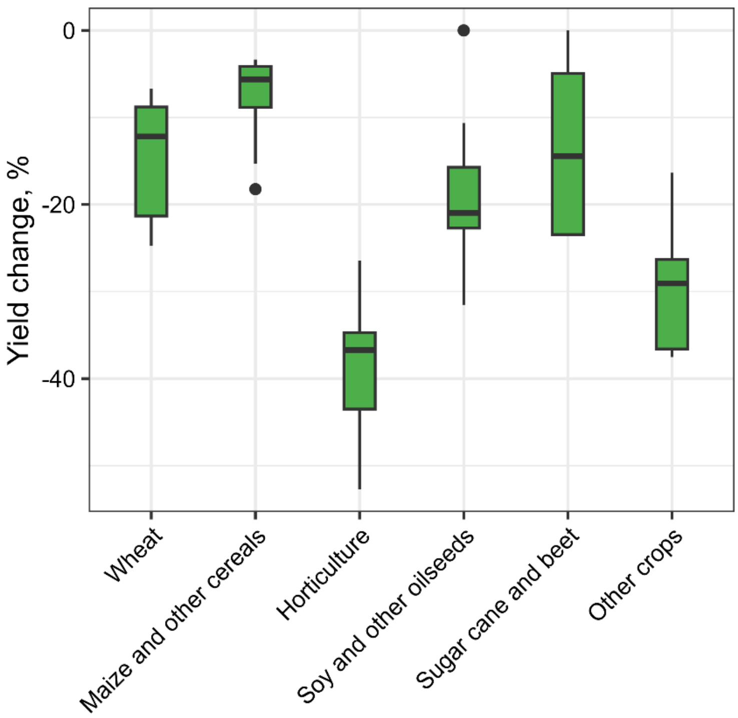

Figure A3: Box plots of yield changes due to F2F policies, shown by product group across all EU Member States.

Source: Authors estimations

Experiment design

For the quantitative analysis, we use the 2014 GTAP database, which covers 141 countries and 65 sectors. Our aggregation represents 24 EU Member States and regional aggregates, as well as 11 major regions based on continental affiliation. We take into account the granularity of the agricultural and food sectors, while other primary, industrial and service sectors are broadly aggregated.

Global economic activity in the base year of the database is first modified by adjusting the structure and budget of the previous CAP to represent the status quo of European agricultural policy and to serve as our reference scenario. Against this reference scenario, different policy scenarios are simulated, modeling selected elements of the Farm to Fork strategy such as dietary changes, food waste, fertilizer and pesticide reductions and the new CAP from 2023 onwards.

The question of the ability of food systems to mitigate shocks can only be answered in the context of volatile markets. For this purpose, a second set scenarios simulates different economic shocks in combination with stochastic supply shocks in the short-run. The economic shocks are, for example, based on the available data from the COVID-19 pandemic and the Ukraine-Russia conflict (e.g. GDP development, labor market effects, energy prices, trade disruptions, changes in consumer preferences). In contrast, the supply shocks include yield shocks estimated based on historical yield patterns. These historical yield shocks are estimated for our country and food commodity aggregation using FAO data for the period 1961 to 2022. We use regressions to isolate productivity trends related to weather events, plant and animal diseases, including locust infestations and the like. This results in a dataset of yield deviations from trend, from which we select the years with the most extreme deviations and arbitrarily combine them with the observed economic shocks.

Results

The resilience of the food system can be measured using various indicators and metrics. The focus in this study is on farm income, food prices, various food security indicators and dietary composition. In order to analyze the coherence of policies with the EU's development objectives, both the European Union and the regions of the Global South are considered in more detail.

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