THE IMPACT OF COVID-19 PANDEMIC ON AGRICULTURAL TRADE

Radovan Kastratović
University of Belgrade, Faculty of Economics
Kamenička 6, 11000 Belgrade
Phone: +381648212064
E-mail: radovan.kastratovic@ekof.bg.ac.rs

Predrag Bjelić
University of Belgrade, Faculty of Economics
Kamenička 6, 11000 Belgrade
Phone: +381653835943
E-mail: predrag.bjelic@ekof.bg.ac.rs

Abstract
In this study, we analyse the effects of Covid-19 pandemics on agricultural trade. We conduct a descriptive analysis in order to identify the key trends and changes in agricultural trade, production, demand, and food security caused by the pandemic and the related policy measures. Additionally, we compare the effects across regions and subsectors, finding considerable heterogeneity in the trade effects of the pandemic. Finally, an overview of the trade-policy response to the pandemic concerning agriculture is provided. The results of our analysis show that agriculture was highly resilient during the Covid-19 pandemic. Thereby, we identified some of the major reasons for this resilience. We also described some adapting strategies of agricultural firms with the potential to further increase the resilience of agriculture. However, the increased food insecurity and the persistent reactive trade policies raise questions regarding the future of agricultural trade liberalisation.

Keywords: international trade, exports, agriculture, trade policy, covid-19, pandemic

JEL classification: F13, Q17, Q54

1. Introduction

The onset of the Covid-19 pandemic had an immediate effect on the world economy. Policymakers responded with measures aimed at curtailing the spread of the virus. The more restrictive measures, such as movement limitations and lockdowns led to considerable disruptions of numerous economic activities, resulting in increased unemployment, loss of production and income, and disequilibria in many markers. The movement restrictions also caused increased frictions in logistics, putting additional pressure on supply chains (Kerr, 2020). It is estimated that the global output fell by 3.3% in 2020 (International Monetary Fund, 2021). The initial forecasts predicted severe drops in international trade (World Trade Organisation, 2020). These fears did not actualise in the case of agriculture. On the contrary, after the initial shock agricultural trade increased during the pandemic.

In this paper, we explore the effects of the Covid-19 pandemic on agriculture. Thereby we focus on agricultural trade and trade-related policies, while also considering the issues of food security, agricultural production, and demand. The main aim of the research was to identify the changes in the sector occurring due to the pandemic, the reasons behind robust performances of agricultural

trade, and the dynamics of the introduction of related policy measures in order to consider the future of agricultural trade.

We conduct a descriptive statistical analysis, using the most recent data available from various sources (including the Food and Agriculture Organisation, International Labour Organisation, World Trade Organisation, and Global Trade Alert). In addition, we carry out a comparative analysis, accentuating the regional and sectorial heterogeneity of the negative effects of pandemics. Finally, we provide an overview of the key empirical studies which investigated the effects of the Covid-19 pandemic on agriculture. We identified high levels of resilience in agricultural trade and the value chains. These strong performances of agricultural trade could be attributed to various factors, including the low income elasticity of food demand (Arita, Grant, Sydow, & Beckman, 2022), specific transport modes used for the majority of agricultural products, adaptability of agricultural firms, and appropriate policy response. However, our analysis also reveals certain issues which could require a change in the multilateral trade system to avert future crises and further increase the resilience of the sector.

The remainder of this paper is organised as follows. In Section 2, we analyse the effects of the Covid-19 pandemic on the supply of agricultural products. Section 3 deals with the effects of the pandemic on food demand. The implications for food security are elaborated in Section 4. In Section 5, we present the results of the descriptive analysis dealing with the effects of the pandemic on agricultural trade. We provide an overview of the key issues agricultural firms faced during the pandemic and their response strategies in Section 6. In Section 7, we investigate the trade-policy response to pandemics and consider the persistence and dangers of the newly introduced measures. The final section concludes.

2. The Effects of the Pandemic on Food Supply

The Covid-19 pandemic affected nearly all facets of the agriculture sector. There were disruptions on both supply and demand sides, which, ultimately, contributed to the increased food insecurity, particularly in certain regions. In this section, we provide an overview of the key supply-side factors influencing agricultural production and trade which were affected by the pandemic.

On the supply side, the pandemic led to the disruption of economic activities both within the agricultural sector and in the other sectors associated with agriculture. In an attempt to curb the spread of the virus, governments across the world introduced measures containing limitations on the movement of people and goods. The limitations referred to the internal and international movements, alike. The disruptions in food supply due to the pandemic could be categorised into two main groups: the input market disruptions and the output market disruptions.

Agricultural production in many countries relies heavily on imported inputs. Pandemic-related measures led to supply chain problems in numerous industries, including agriculture. Securing stable supplies of the needed input became increasingly difficult. For instance, in the European Union, supply chain disruptions led to short-term shortages of agricultural machinery and pesticides (Garnett, Doherty, & Heron, 2020).

Labour shortages are another important supply-side disruption the agricultural sector faced during the pandemic. The labour shortages could be due to either direct or indirect effects of Covid-19. The direct effects entail Covid-19 infections making the workers in the sector absent and unable to work. It is estimated that 54,036 agricultural workers were affected and unable to conduct their

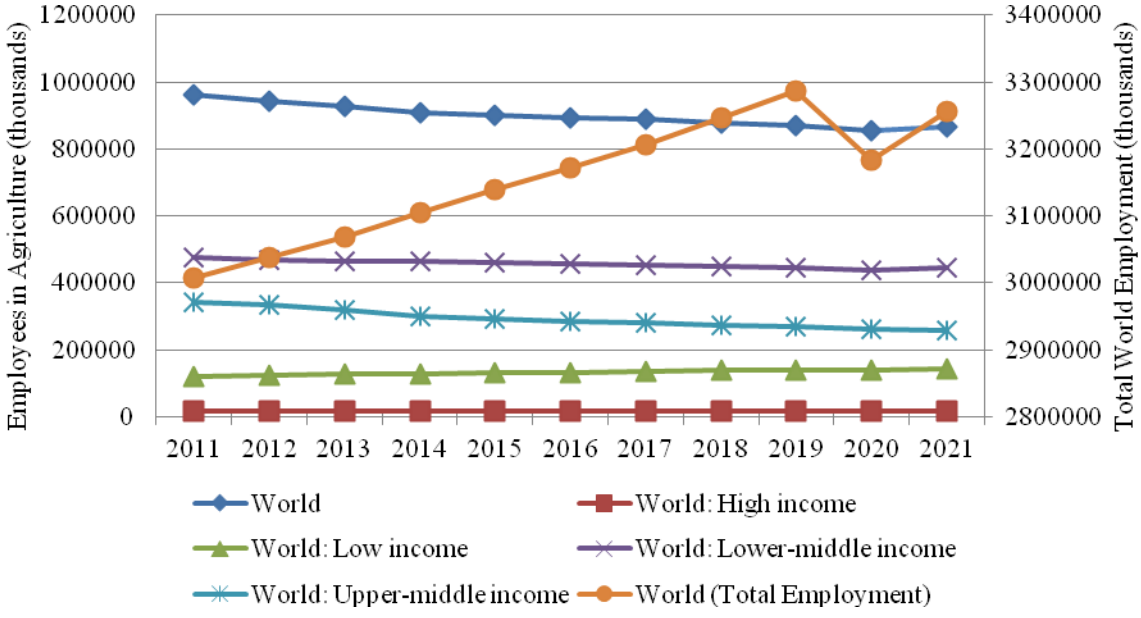
work-related activities since the onset of the pandemic (Aday & Aday, 2020). Similar non-negligible instances of labour shortages directly caused by Covid-19 infections are reported in the meat-processing industries of Germany and abattoirs in France (Abid & Jie, 2021).

There is also an international dimension to the temporary employment shortages in agriculture. Agricultural producers, particularly in the bordering regions of countries, employ foreign seasonal workers, especially during the sowing and harvesting seasons. Tighter border controls aimed at limiting the international movement of people for the purpose of curbing the pandemic suddenly took away the option for agricultural producers to rely on foreign seasonal workers. These measures temporarily restricted labour migrations, limiting the production capacity of the agricultural sector.

In Figure 1, we present the dynamics of employment in agriculture. There is an apparent global decreasing trend of labour input in the sector. The average annual growth rate of total world employment in agriculture in the period between 2011 and 2021 is -1.27%. This long-term trend is, for the most part, caused by the general transformation of the food system and the increased reliance on more capital-intensive production methods.

After the onset of Covid-19 pandemic the employment in agriculture fell by approximately 1.66% in the world. This decrease in employment, despite being above average, is not higher than the decreases in the period 2011-2014, where employment in agriculture was reduced by between 1.77% and 1.85% annually. However, the decrease was heterogeneous in terms of economic activities and regions, which caused increased operational uncertainties.

Figure 1. Employment in Agriculture (2011-2021)



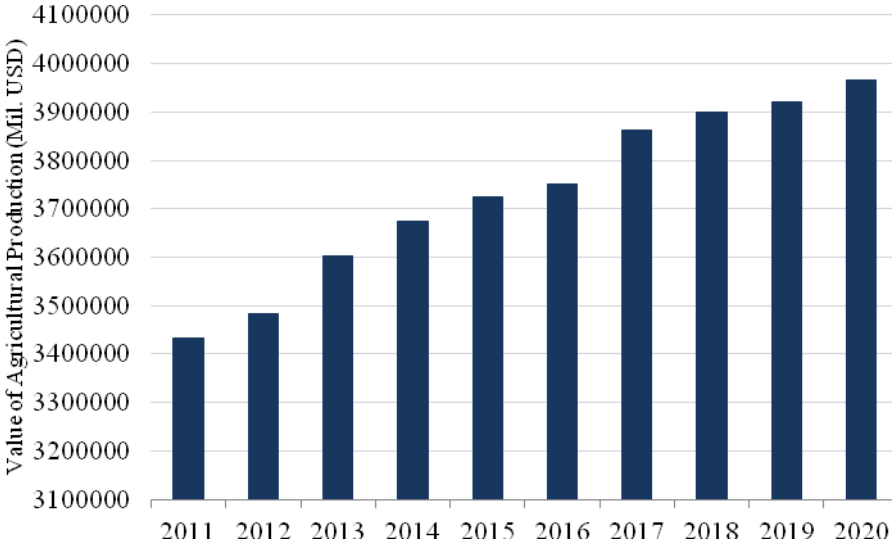
Source: Authors' calculations based on the International Labour Organisation data (accessed on 27 September 2022)

In 2021 there was a noticeable recovery of employment in the sector, as the number of employees increased by 1.15%. Compared to the other sectors, we can conclude that employment in agriculture was relatively less affected by the pandemic. For example, in 2020, total world employment fell by 3.16% after a decade of consistent annual growth of between 0.99% and

1.28%. In contrast, there is the opposite trend in agriculture and a much less severe decrease in employment in 2020. Similarly to the employment in agriculture, total world employment relatively quickly recovered as evidenced by the growth rate of 2.32% in 2021.

There is some heterogeneity in employment dynamics in agriculture in terms of both the long-term trend and the change during the pandemic depending on the income-level group. For instance, unlike in all the other groups of countries, in low-income countries, there is a positive trend in employment in agriculture which could reflect the agricultural development strategy of these countries. With relatively low labour costs, these countries predominantly expand agricultural production through extending land use, whilst maintaining labour-intensive production techniques. Incidentally, in this group of countries, the decrease in agricultural employment was the least pronounced during the pandemic. With the increase in income level, the negative effects of the pandemic on agricultural employment are increasingly severe.

Figure 2. Gross Agricultural Production (2011-2020)



Source: Authors' calculations based on the Food and Agriculture Organisation data (accessed on 28 September 2022)
Note: The values are expressed in millions of constant USD for 2014-2016.

Another important supply-side factor exacerbated by the pandemic is logistics and, particularly, transport. Certain border measures led to logistics problems and delayed shipments, which is highly problematic for perishable agricultural products. In addition, labour shortages, previously discussed in the context of agriculture, were not averted in other sectors, including logistics. The lack of workers in the sector led to the lack of transport options available to agricultural producers. This resulted in some agricultural producers dumping the products, unable to reach the markets, resulting in the loss of agricultural production. Access to markets was limited in the case of both domestic and foreign markets. The livestock sector was markedly affected by these developments. This, coupled with the disruption of input supply in the sector, meant that the farmers in countries such as China were effectively unable to sell their livestock during the onset of the pandemic (Zhuo, Ji, & Ding, 2020).

However, viewed aggregately, there is little evidence of the significant effects of the Covid-19 pandemic on agricultural production. This is evidenced by Figure 2. Here we can notice a

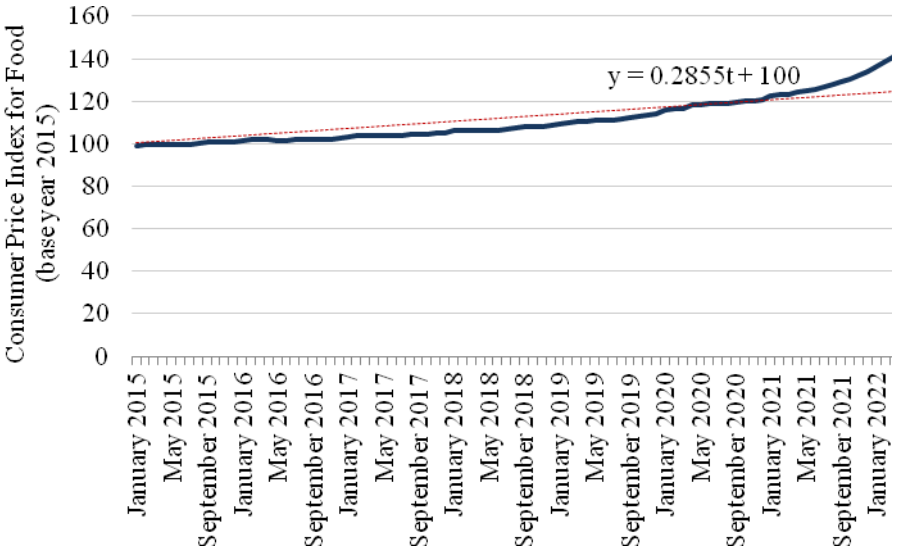
dynamic increase in the value of gross agricultural production over the past decade. There was a positive growth rate in every observed year, averaging 1.62%. In spite of the pandemic and the related disruptions, the production continued growing throughout 2020, increasing by 1.18% compared to 2019 and continuing the long-term upwards trend. At the end of 2020, the production value was 15.48% higher than at the beginning of the observed period.

Finally, the supply of agricultural products was also affected by trade policy measures that were part of the pandemic-related response. The main goal of these temporary measures was to stabilise the supply of agricultural products and achieve food security. The measures primarily consisted of various export restrictions. The main idea of these restrictions was to limit the ability of farmers to sell their products overseas in order to increase domestic supplies, thereby controlling the prices and maintaining the affordability of food. These measures are considered in greater detail in Section 7 of this paper.

3. The Effects of the Pandemic on Food Demand and Prices

The Covid-19 pandemic increased the concerns over the availability and affordability of food. One of the ways to consider the effects of the pandemic on food demand and food supply simultaneously is to examine food prices. We do this in Figure 3, where we present the monthly dynamics of the food consumer prices index.

Figure 3. Monthly Dynamics of Consumer Prices of Food (Base Index, 2015=100)



Source: Authors' calculations based on the Food and Agriculture Organisation data (accessed on 28 September 2022)

We can determine a clear upwards trend in food prices in the period between 2015 and 2022. A simple regression analysis we conducted in order to identify the trend shows that the price index for food increases by 0.28 per month on average, in comparison to the base year of 2015. Around the beginning of 2020 price movement diverged from the long-term trend, indicating the accelerated food prices growth which could be attributed to the changes caused by the Covid-19 pandemics. Namely, in the first quarter of 2020, food prices grew by over 1% monthly on average. The price growth was somewhat subdued over the remainder of the year. However, continuous instability in the economic and political environment and general inflation led to a new period of intensive food price increases. The increases were particularly pronounced in the

period after October 2021, continuing throughout 2022, and averaging over 2.03 percent points per month.

Consumers' income is another important factor determining demand. As discussed previously, the pandemic itself, as well as the following measures, disrupted economic activity leading to the rise in unemployment. Agricultural producers were particularly vulnerable to this, losing both their produce and their primary income. More generally, the loss of jobs and income reduced the purchasing power worldwide. This, paired with growing food prices, indicates that food affordability is diminishing, imperilling global food security.

It is worth mentioning that for many individual agricultural products, demand remained unscathed despite the negative effects of the aforementioned demand-side factors. This can be explained by the relatively low price elasticity of food. Namely, food is a necessary product. In spite of the income levels decreasing, job losses, and price increases, the demand for it remains stable, as the consumers substitute the consumption of more luxurious products with food (Kerr, 2020).

This consistent inelastic demand paired with the previously described disruptions, particularly the logistics-related ones, led to some food shortages in many urban centres. In addition to the reduced production of some products and the logistics problems, panic purchases at the beginning of the pandemic contributed to the problem. Pessimistic expectations of the consumers regarding the supply of food and movement restrictions during the pandemic encouraged them to stock up the essential food products. The disequilibrium was short-term in nature, and the agricultural supply chains managed to adequately react and come up with increased quantities of food, averting a more severe shortage and food crisis (Abid & Jie, 2021).

A significant part of the demand for agricultural products comes from linked economic activities. The evidence from computed general equilibrium simulations based on the data from the World Agricultural Supply and Demand Estimates for 2020 shows that negative effects on agriculture are the strongest in economies with the largest hospitality sectors (Beckman & Countryman, 2021). Indeed, the hospitality sector was among the most affected by Covid-19 response measures, reducing the demand for agricultural products in the short term. The negative effects were especially strong in the United States, where it was estimated that disruptions in the hospitality sector resulted in a drop in agricultural products' prices by approximately 20% in the short term. Additional negative effects could be attributed to the limitations imposed on the retail sectors that further drove down the demand for agricultural products. However, the producers and consumers reoriented themselves toward the alternative channels, and in the case of most products, successfully overcame the disruptions. Still, frequent short-term demand-side changes make it difficult to predict the demand. This leads to increased uncertainty and risks the agricultural producers face when making business decisions.

4. Implications of the Supply and Demand Changes for Food Security

The previously discussed disruptions on both the supply and the demand side have important ramifications for food security and all of its four pillars. Problems with food supply directly affect the availability of food, while the combined interaction between a more limited supply, disrupted logistics, and falling incomes increase the unaffordability of food limiting access to food, particularly in the lower-income regions of the world. Logistical problems could also negatively affect the utilisation of food, as difficulties and delays in distribution compromise the sanitary and phytosanitary conditions of agricultural products. Finally, high levels of uncertainty affecting the

supply and the demand for agricultural products negatively reflect on the stability pillar of food security, as people face difficulty to access food consistently over time.

We consider some preliminary data on food security in Table 1. We aggregate the total number of people facing moderate or severe food insecurity, focusing on the period preceding the Covid-19 pandemics, as well as the period of pandemics.

Table 1. Moderately and Severely Food Insecure People (2018-2021)

Region	**2018**	**2019**	**2020**	**2021**
World	3359.3	3482.2	4038.6	4060.4
Africa	1065.4	1112.4	1213.8	1294.7
Asia	1748.4	1810.3	2159.5	2081.4
Latin America and the Caribbean	353.6	364.6	452.4	467.8
Northern America and Europe	183	185.5	204.4	207.4
Oceania	9.0	9.3	8.6	9.0

Source: Authors' calculations based on the Food and Agriculture Organisation data (accessed on 28 August 2022)

Note: The values are expressed in millions of people.

The results show a remarkable increase in the number of food insecure people since the beginning of the pandemic. In 2020 over 556 million more people in the world became moderately or severely food insecure. After this initial increase in food security by 16%, the situation stabilised in 2021, and food insecurity grew by around 1% compared to the previous year. The latest developments in 2022 are likely to deepen the food crisis which could further increase food insecurity, or, at the very least, prevent the quick recovery following the situation caused by the pandemic.

The changes in food security during the pandemic were heterogeneous across regions. Latin America and the Caribbean and Asia were particularly severely affected, with food insecurity growth in 2020 surpassing the world average, totalling 24.1% and 19.3%, respectively. Asia had a more robust recovery, with food insecurity decreasing the following year at a rate of 3.6%. In contrast, the problem was deepened in the Latin America region, where additional 15.4 million people became food insecure in 2021.

In Africa, the problem of food insecurity also worsened during 2020, but the growth rate of food insecure people was relatively less compared to Asia and Latin America. However, in Africa, the problem was already the most pronounced compared to the other regions. Additionally, the recovery trajectory is more unfavourable, with the number of food insecure people further increasing by 6.7% in 2021. This is the highest rate for 2021 of all the considered regions.

Traditionally regions of Europe and North America, characterised by a high level of food security, also faced an increase in food insecurity, albeit at a lower rate than the global average. In this region, 18.9 million people became moderately or severely food insecure during the pandemic. This negative development decelerated in 2021, although the number of food insecure people continued to grow, surpassing a total of 207 million people by the end of 2021. The region of

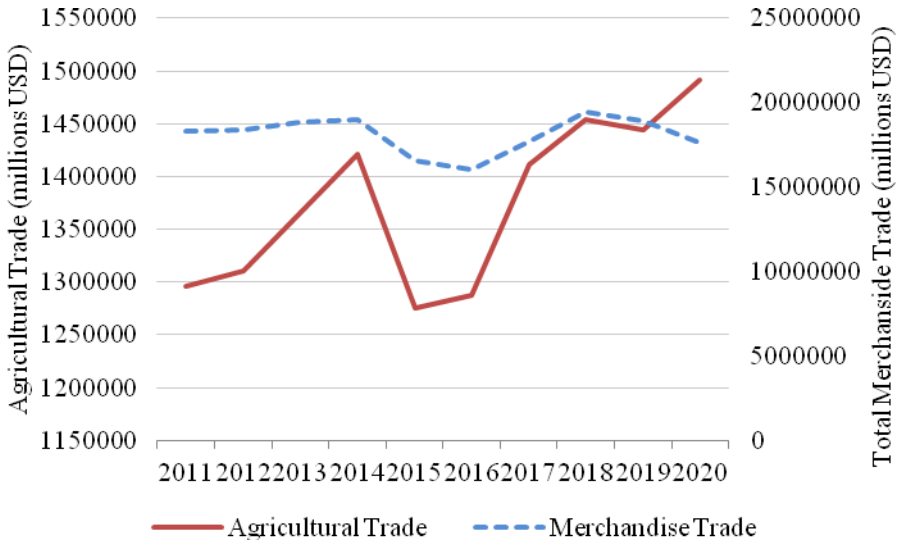
Oceania strongly contrasts these trends. In 2020, food insecurity decreased in the region by 7.5%. However, in 2021, the situation turned with 4.7% more people becoming food insecure. The growth rate was amongst the highest of all the considered regions, comparable only to the one in Africa.

5. The Covid-19 Pandemic and Agricultural Trade

Agricultural trade fell during the initial wave of the Covid-19 pandemic and the consequential lockdowns, in the first quarter of 2020. There are multiple confounding factors contributing to this decrease. Some empirical studies attempting to isolate the effects of Covid-19 from the other factors report that the pandemic directly contributed to a 5-10% decrease on aggregate (Arita et al., 2022). The negative effects were, however, up to three times lesser compared to the non-agricultural trade, according to the results of the same study.

In Figure 4 we present the dynamics of agricultural trade in the period between 2011 and 2020. Thereby, we make a comparison of agricultural trade to the global aggregate merchandise trade.

Figure 4. Agricultural and Total Merchandise Trade (2011-2020)



Source: Authors' calculations based on the Food and Agriculture Organisation data (accessed on 29 September 2022)

It is evident from the figure that agricultural trade was more volatile than the total merchandise trade in the observed period. However, the two series differ in the long-term trend. While the total merchandise trade was somewhat stagnant, agricultural trade was characterised by a strong upward trend, particularly following 2015.

There is also a distinction between how aggregate merchandise and agricultural trade reacted during the pandemic. The data for 2020 suggests that global merchandise trade fell by nearly 7% since the outbreak of the Covid-19 pandemic. Contrastingly, at the same time, agricultural trade grew by 3.31% annually.

In spite of the initial drop in agricultural trade in the first quarter of 2020, the trade recovered fairly quickly and steadily after the initial shock, returning to the long-term trend. This implies

that agricultural trade was relatively resilient during the pandemic. There are several possible reasons for such strong performances in agricultural trade.

One of the fundamental reasons is the high level of necessity of food. Despite all the negative effects the pandemic had on the global economy and consumers' income levels, the fundamental need for food remained. For this reason, consumption was, for the most part, restructured and the share of food remained intact. Even in the instances where the demand for agricultural products was reduced, as was the case with the hospitality industry, the demand, on aggregate, did not change but was, rather, covered through alternative channels.

In addition, agricultural products are mostly bulky, having a low value-to-weight ratio. For this reason, they require different modes of transport compared to the majority of consumer goods. Bulk shipments were less susceptible to logistical disruptions during the pandemic. Therefore, agricultural trade was impeded less by logistics than the other categories of trade.

Moreover, agriculture has simpler value chains. Compared to the more complex economic sectors, agricultural value chains stretch across fewer countries and include fewer agents to coordinate. They are also less fragmented than other value chains. The agricultural products themselves are less complex compared to the industrial products, requiring less foreign inputs and fewer input sources. All this contributes to the smaller change of value chain disintegration under stress. This proved to be beneficial during the Covid-19 pandemic, as agricultural value chains maintained their functionality throughout the crisis.

Finally, the pandemic coincided with the large increase in agricultural import demand in China. In addition to strict measures aimed at limiting the spread of the disease, China's agriculture faced additional problems, including the outbreak of African swine fever. Domestic agricultural production, particularly in the livestock segment, became insufficient to cover domestic needs. Overseas producers stepped in to cover this unsatisfied demand, which further contributed to the performance of agricultural trade.

In addition to trade, agricultural production also stabilised after the initial shock (Kerr, 2021). The producers quickly adapted to the uncertainties in the economic environment. The demand stabilisation followed.

There is considerable sectoral heterogeneity of the Covid-19 pandemic effects on agricultural trade. Some sectors within agriculture proved to be less resilient and more sensitive to the increased uncertainties, logistical problems, and labour shortages than others. Using a reduced-form gravity model to isolate the effects of the pandemic on sector-level trade, Arita *et al.* (2022) estimated the direct contribution of Covid-19, as well as the contribution of the related policy measures on sectorial-level trade. Some key results of this analysis are presented in Table 2.

Table 2. Sectorial Effects of Covid-19 Pandemic on Agricultural Trade

Product Group	Direct Covid-19 effects	Policy Response effects	Total Average Effects
Animal fats	0%	0%	0%
Beef	-3%	-3%	-4%
Biodiesel blends	0%	0%	-2%
Chocolate cocoa products	0%	-3%	-2%
Cocoa beans	0%	-11%	-4%
Coffee (unroasted)	2%	0%	-3%
Coffee roasted extracts	1%	3%	1%

Condiment sauces	1%	-2%	0%
Corn	0%	0%	-7%
Cotton	0%	-11%	-7%
Dairy products	0%	3%	1%
Distilled spirits	-5%	5%	-6%
Distillers grains	0%	0%	0%
Eggs	-1%	-4%	-1%
Essential oils	-6%	-4%	-5%
Ethanol	-7%	-7%	-10%
Feed and fodders	-5%	-4%	-1%
Fish	-2%	-7%	-5%
Food prep.	0%	-2%	-1%
Forest products	0%	-3%	-4%
Fresh fruit	0%	0%	0%
Fresh vegetables	0%	0%	0%
Fruit and vegetable juices	0%	0%	0%
Hay	-6%	0%	-2%
Hides and skins	0%	-22%	-15%
Live animals	2%	0%	1%
Meat	-3%	-8%	-5%
Non-alcoholic beverages	0%	0%	0%
Nursery flowers	-5%	-9%	-6%
Oilseed meal	3%	0%	1%
Other bulk commodities	0%	5%	2%
Other products	0%	-2%	-1%
Palm oil	0%	0%	0%
Peanuts	0%	-8%	-3%
Pet food	0%	-3%	-1%
Planting seeds	2%	5%	3%
Pork	2%	-2%	-2%
Poultry	-3%	-3%	-3%
Processed fruit	1%	0%	0%
Processed vegetables	0%	-3%	-1%
Pulses	0%	0%	0%
Rapeseed	0%	0%	0%
Rice	4%	0%	3%
Rubber	0%	-4%	-5%
Snack foods	-1%	-3%	-3%
Soybean meals	0%	0%	0%
Soybean oil	9%	0%	3%
Soybeans	0%	34%	11%
Spices	2%	-5%	-1%
Sugars	0%	-6%	-5%
Tea	0%	-6%	-5%
Tobacco	-3%	-7%	-3%
Tree nuts	0%	-8%	1%
Vegetable oils	0%	0%	0%
Wheat	-2%	0%	-2%

Source: Arita *et al.* (2022)

Note: Refers to the isolated effects determined by the econometric analysis. The numbers represent the change in trade due to a change of one standard deviation of the considered factors.

The results show how the increase in death rates within a country (by 50 per million people) decreases (or in some instances even increases) agricultural trade. The determined effect size could be considered an approximation of the effects that the infections of workers had on production and, consequentially, agricultural trade. The other determined effect is related to policy measures, and it shows how agricultural trade changes with the change in the Oxford

stringency index by 15 percentage points. These estimates encapsulate the indirect effects Covid-19 had on agricultural trade, through the related measures limiting the movement of people and goods.

The key pattern which is releveled by these results is that higher value-added and non-essential products sustained more severe negative trade effects. This could be explained by the higher income elasticity of those products. Consumers are sensitive in times of crisis and decreasing income, substituting more expensive products with cheaper alternatives, redirecting their consumption toward staples. In addition, supply-side disruptions reduced the availability of products for exports. In other instances, demand-side factors limited trade. For example, temporary shutdowns of retailers during the lockdowns, affected, to a certain extent, the agricultural producers exporting overseas. It is noteworthy, however, that the majority of sectors within agriculture were not affected by the pandemics.

In some cases, there are additional specific factors at play, discouraging international trade during the pandemic. In the case of meat, China as the major producer suffered additional negative effects of African swine fever, leading to a significant supply shortage which required redirection of meat sales from overseas to the domestic market. At the same time, there were temporary halts in other major meat-producing facilities, particularly in the Brazil and United States (Lusk, Tonsor, & Schulz, 2021). The spread of the Covid-19 virus among the workers caused halts which further reduced the meat supply and affected the exports of the sector.

Another example where Covid-19 negatively affected the trade is seafood products. These products generally have higher price elasticity. In addition, the sector relies heavily on air traffic as a means to distribute products across borders. The air traffic was much more disrupted than the other transportation modes for bulkier products, reflecting on the seafood global exports (Kerr, 2020). Similar effects can be observed in the case of trade in fungus and other more luxurious horticultural products (Lin & Zhang, 2020).

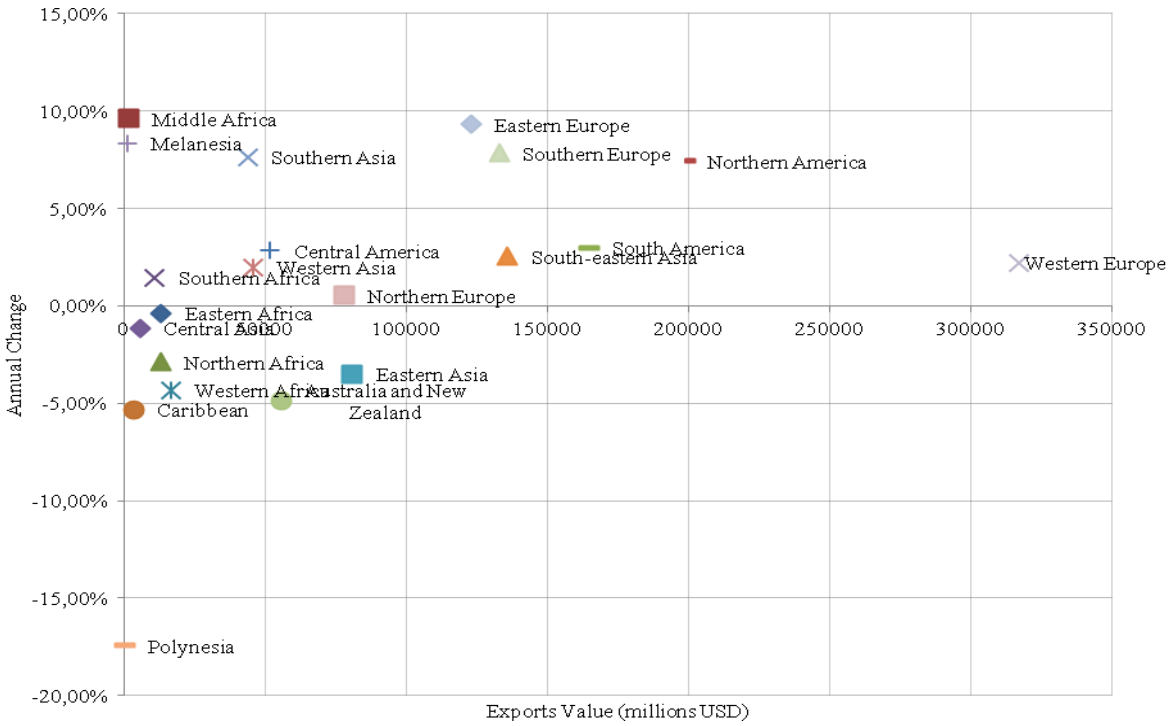
Another interesting pattern is related to the pronounced negative effects of Covid-19 on trade in agricultural products which serve as an input for the textile industry. These segments of agricultural trade were more severely hit by the pandemic, as clothing sales dropped due to a lower income and increased unemployment, reduced accessibility of clothing due to lockdowns, and the related limited functionality of the traditional brick-and-mortar clothing retail.

There are also some notable examples of sectors where the Covid-19 pandemic contributed to the increase in trade. These include soybean (and related products), livestock, rice, dairy products, bulk commodities, coffee, spices, and others. The common characteristic of the aforementioned sectors is that they produce staple food and (or) have lower value-added production. These products have a relatively inelastic demand. For this reason, most of the positive effects could be attributed to demand shifting from more expensive products to essential food. Partially, stockpiling of food also had a positive effect on trade, particularly in the short term.

The effects of the Covid-19 pandemic on agricultural trade also exhibit remarkable regional heterogeneity. This heterogeneity was explored in greater detail for agricultural exports in Figure 5, where we simultaneously consider the annual change in exports of the regions during 2020 and the absolute importance of the region for global agricultural trade. We can see the greatest decrease in agricultural exports in the regions with particularly severe Covid-19-related measures (such as Australia, New Zealand, and Eastern Asia), as well as the regions with relatively low

agricultural productivity and higher vulnerability of the sector. At the same time, the regions with traditionally highly productive and robust agricultural sectors reported significant increases in agricultural exports during the pandemic.

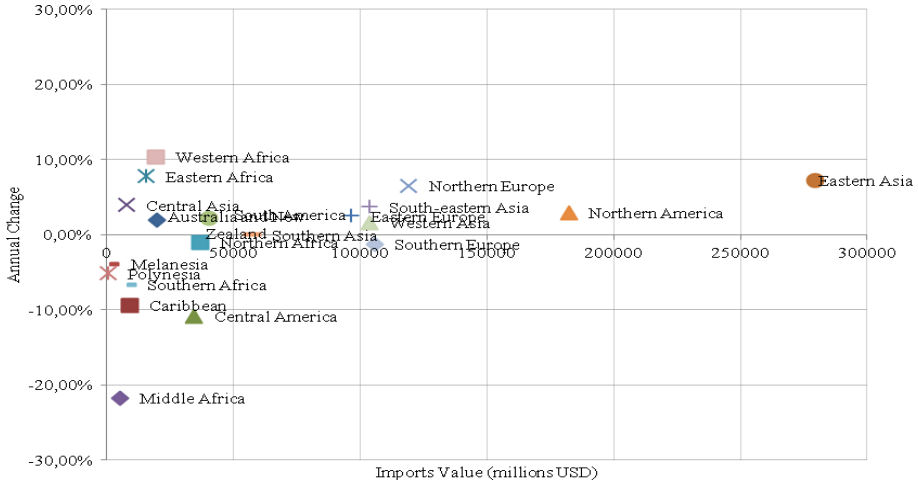
Figure 5. Annual Change in Agricultural Exports by Regions (2020)



Source: Authors' calculations based on the Food and Agriculture Organisation data (accessed on 30 September 2022)

A similar comparative analysis was conducted for agricultural imports. The results are presented in Figure 6.

Figure 6. Annual Change in Agricultural Imports by Regions (2020)



Source: Authors' calculations based on the Food and Agriculture Organisation data (accessed on 30 August 2022)

European and North American regions report significant increases in imports, albeit at a lower rate compared to their respective export growth. Eastern Asia, Western and Eastern Africa, and Australia and New Zealand had a considerable increase in imports. Paired with the decline in exports, this could suggest that these regions increased their reliance on foreign sources of agricultural products. For some of these regions, this could prove to be problematic, due to rapid increases in food prices and their stagnant income levels, which increases food insecurity due to decreased affordability and accessibility of food. Particularly worrisome is the situation in the regions of Polynesia and the Caribbean which faced the most drastic decreases in both imports and exports of agricultural products, potentially causing problems with food availability. In the related studies, the Covid-19 pandemic was found to significantly exacerbate the problem of food security (Baquedano, Zereyesus, Christensen, & Valdes, 2021).

Taken as a whole, this descriptive analysis shows that there were significant changes in both the imports and exports of agricultural products across regions, with some regions benefiting from the agricultural production disruptions in other regions. However, the analysis does not indicate significant differences in changes in agricultural trade performances for developing and developed countries. This corroborates the findings of Arita *et al.* (2022).

6. Firm-level Responses to the Crisis

Agricultural producers faced a variety of challenges during the Covid-19 pandemic. They followed various strategies in addressing these challenges. Firm-level surveys offer some insights into the micro-level problems agricultural firms faced with their participation in international trade during the pandemic. One of the most notable studies reporting the results of such surveys was conducted by Lin and Zhang (2020).

Among the most frequent hurdles to exporting cited by the agricultural firms are the rising costs and difficulties the firms face with financing their foreign trade operations. Many firms also considered the most commonly discussed general problems caused by the pandemic and the related measures as an important challenge in conducting exports. These include problems with logistics, labour shortages, and unstable and uncertain changes in demand. Small and medium enterprises are reported to suffer more severe effects on exports from these problems than large enterprises (Haqiqi & Bahalou Horeh, 2021).

Some of the reasons why agricultural trade was resilient during the pandemic, such as the demand elasticity of the products, were previously discussed. However, a non-negligible factor was also the adaptability of agricultural firms. These firms devised various strategies to help them adapt to the changes in the environment and address the problems caused by the pandemic.

One of the most common responses was the increased use of information and communication technology. The pandemic provided a strong impulse to agricultural firms to adopt these technologies and integrate them with their business processes in order to successfully adapt to the unstable environment during the pandemic (De', Pandey, & Pal, 2020). The technology allowed for a better connection between the buyers and sellers in agricultural markets. The use of smartphones and their related applications proved to be particularly important for the sector, especially in developing countries (Amjath-Babu, Krupnik, Thilsted, & McDonald, 2020). The needed infrastructure was already prepared, allowing for the quick and efficient deployment of technology applications aimed at facilitating agricultural trade. The technology enabled agricultural producers to establish direct contact with their customers with little complexity in its

application and usage. The use of technology was well-suited and complementary to the risk-mitigation measures intending to prevent Covid-19-related risks, as they enabled limiting physical contact during payment and contactless shopping and delivery.

In addition to agricultural producers adapting by using the existing technological solutions, such as e-commerce platforms and social networks, the pandemic also stimulated technology companies to develop new services aiming to satisfy the needs of traders of agricultural products. One such example is the foundation of a special Green Channel within the Alibaba e-wholesale system (Abid & Jie, 2021). This innovation facilitated the cooperation and coordination between all the participants in agricultural value chains.

The pandemic revealed the high potential of greater e-commerce use in agriculture. Before the pandemic, the effects of e-commerce use on agricultural trade were limited (Kastratović & Bjelić, 2022). The pandemic provided an opportunity to overturn this trend in agriculture and increase the use of e-commerce and information and communication technologies in general. The benefits this change offers are numerous. The technology could facilitate market access for agricultural producers and improve information flows. It opens up new market opportunities, particularly in a highly uncertain environment. In addition, the e-commerce systems typically provide the corresponding payment systems which mitigate the majority of subjective risks in agricultural trade for all the parties in transactions (Lu, 2018). The technologies also indirectly contribute to the efficiency of agricultural trade through their application in transport and logistics. The continuation of the use of technology in agricultural trade propagated by the pandemic would likely be beneficial in the future, as it would improve the resilience of agricultural value chains in the event of future crises, benefiting all the participants (Zhu, Chou, & Tsai, 2020). However, this would require further development of the needed infrastructure, as well as education in the use of technologies, particularly in agriculture, where the full potential of the application of information and communication technologies is yet to be utilised.

Some agricultural firms reacted to the uncertainty the pandemic caused in international trade by redirecting their sales toward domestic markets. Some estimates show that nearly half of agricultural firms in China adopted a variant of this strategy (Lin & Zhang, 2020).

Considering that one of the most commonly cited problems during the pandemic in regards to foreign trade was the problems with financing it comes as little surprise that many agricultural firms put a significant effort into diversification of financing sources. An important channel for reducing financing costs was government support. It mostly came in the form of tax breaks and subsidies. This support was regionally unequally distributed to agricultural producers. Financial support was the most difficult to implement in the lower-income regions due to financial constraints. At the same time, the agricultural producers in these regions required the most support to maintain their participation in international trade.

Foreign direct investment was another method of addressing the challenges during the pandemic. Preliminary survey data suggest that agricultural firms seldom followed this strategy (Lin & Zhang, 2020). This could reflect the expectation of typical agricultural firms that the crisis will be resolved in the short to medium term, thus not requiring relocation of business activities overseas. However, sovereign wealth funds and state-owned enterprises might consider foreign land acquisitions a way to strategically secure a stable supply of agricultural products (Kastratović & Vasiljević, 2018). A more detailed analysis of this is not possible at this moment due to data

considerations but could prove an interesting avenue for future research on the effects of the Covid-19 pandemic in agriculture.

Some agricultural firms considered the change in the economic environment due to the Covid-19 pandemic as an opportunity to increase exports and supply new markers in which the domestic supply decreased because of disruptions. However, these increases in overseas sales were generally only short-term responses to the initial shock and disequilibrium. It is expected that this channel of sales growth for agricultural firms is unsustainable in the long run as the global economy returns to its equilibrium (Kerr, 2021).

Finally, some firms were forced to undertake radical responses to the crisis. In the circumstances where the good could not be transported to their buyers, some agricultural producers opted for dumping the stocks. This meant either a complete loss of their production or sale at discounted prices. The result was an increase in food waste, particularly at the beginning of the pandemic (Roe, Bender, & Qi, 2021). Others opted for restructurings and layoffs. The ones which were insufficiently productive and adaptable were forced to file for bankruptcy.

To sum up, the micro-level evidence supports the general macro-level conclusions outlined previously. The effects on the micro-level are mixed and oftentimes heterogeneous across subsectors and regions. Staple food producers maintained markedly strong and stable performances throughout the pandemic. Agricultural production linked to medical and pharmaceutical use also witnessed a surge in performance. In other sectors, the negative effects of pandemics were more or less offset but the adaptation strategies, which could permanently increase the resilience of the agricultural sector in the case of any similar crises in the future.

7. Trade Policy Response

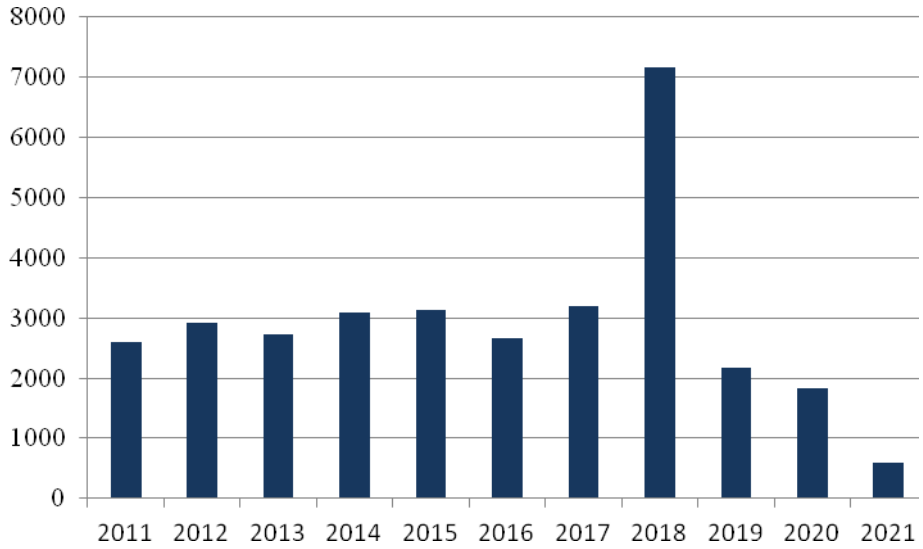
Governments throughout the world reacted to the pandemic by introducing various policy measures. Some of these measures were aimed at preventing the spread of the virus. The others had a goal of alleviating the problems caused by the virus. In general, policymakers properly understood the importance of agriculture and took the strategic importance of the sector into consideration when defining the policy measures. Therefore, the borders, for the most part, remained open for agricultural trade, contrasting the restrictions imposed on the movements of people.

A subset of the policy measures is directly related to trade. The dynamics of non-tariff measures introduction concerning agricultural trade is presented in Figure 7. The data suggests that the total number of problematic measures did not escalate during the pandemic. In fact, the number of newly introduced measures was lower compared to all the other observed years in the period of the analysis. The newly introduced measures covered approximately 4% of the total volume of agricultural trade (Evenett et al., 2022). Most of the initial measures were directed toward medicinal products. It appears that most governments decided against imposing additional trade barriers in order not to worsen the situation and uncertainty faced by agricultural producers.

The trade-related measures were mostly introduced in the form of export restrictions. The main motivation behind the restrictions was to limit exports and, thereby, increase the availability of agricultural products in domestic markets. Policymakers avoided the proliferation of these measures, limiting their geographic coverage. Due to this, the measures affected only a minor

portion of agricultural trade. Namely, Evenett *et al.* (2022) estimated that export restraints affected around 3% of total agricultural trade during the first three quarters of 2020.

Figure 7: Newly Introduced Non-Tariff Measures affecting Agriculture (2011-2021)



Source: Authors' calculations based on the Global Trade Alert data (accessed on 10 September 2022)
Note: The values are the count of newly introduced measures in a giver year globally. Only "red" and "amber" type measures covering agricultural products were considered.

The trade-related measures were mostly introduced in the form of export restrictions. The main motivation behind the restrictions was to limit exports and, thereby, increase the availability of agricultural products in domestic markets. Policymakers avoided the proliferation of these measures, limiting their geographic coverage. Due to this, the measures affected only a minor portion of agricultural trade. Namely, Evenett *et al.* (2022) estimated that export restraints affected around 3% of total agricultural trade during the first three quarters of 2020.

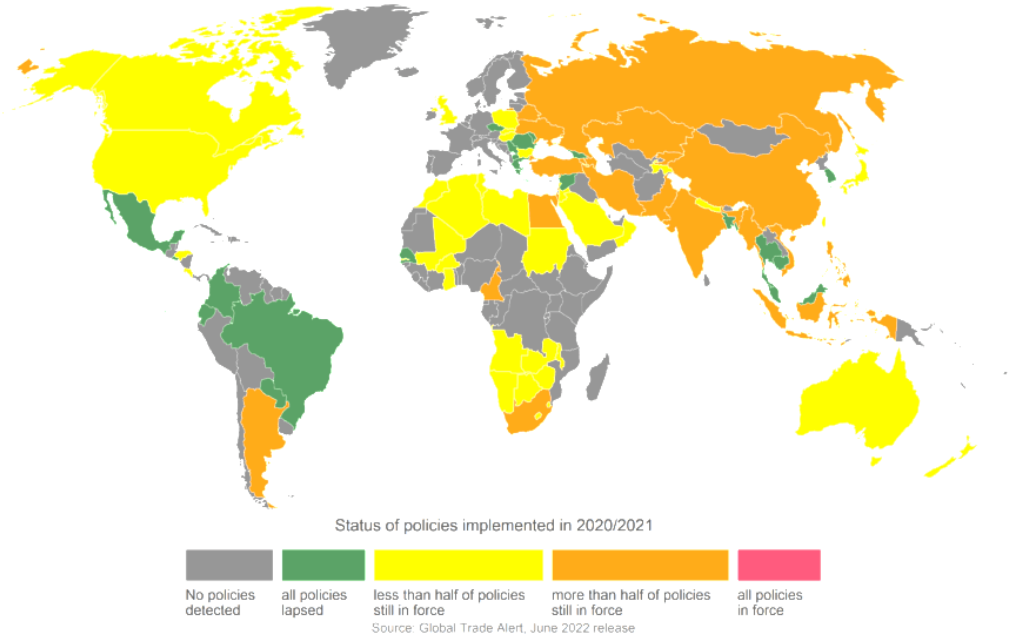
Despite the limited distortive effects of the introduced measures, their use during the pandemic revealed significant dangers and limitations of the multilateral trading system organised under the auspice of the World Trade Organisation. Namely, the General Agreement on Tariffs and Trade stipulates no restrictions on the use of export tariffs. This makes the control of the abuse of export tariffs problematic (Cardwell & Kerr, 2014). Although only the export tariffs are allowed under the current system, while the prohibitions of exports are forbidden, economies can set export tariffs prohibitively high, effectively banning exports while remaining within the framework defined by the World Trade Organisation (Scholefield & Gaisford, 2007). Because of the idiosyncratic nature of agriculture and agricultural trade, the current multilateral system additionally allows the economies to temporally introduce export restrictions for agricultural products in order to address critical shortage problems.

There were attempts to resolve aforesaid issues through the use of soft law (Kerr, 2020). Namely, the economies are obliged to take into consideration the food security issues of their trade partners when introducing export restrictions for agricultural products. If such restrictions potentially cause problems for their trade partners, there is a requirement to consult with the said partners before introducing the measure. However, history shows that in times of crises, economies do not

follow these soft law provisions, but rather opt to solve their acute food security issues with little regard for the interests of their trade partners (Mitra & Joslin, 2009).

Most of the trade-related measures were introduced as a temporary solution during the pandemic. The data shows that the duration of these measures often goes beyond the initial projections. This is illustrated in Figure 8.

Figure 8: Status of Covid-19 Trade-Related Export Restrictions in Agriculture (2022)



Source: Global Trade Alert (2022) (accessed on 10 September 2022)

The figure shows that in the majority of countries, the initially introduced export restrictions for agricultural products still persist in some form. There are few examples where the introduced measures were kept to this date in entirety. However, most of the Asian countries, as well as Egypt, Cameroon, South African Republic, and Argentina maintained more than half of the Covid-19-related export policies. In much of North America, Europe, Oceania, and Africa, less than half of export restrictions persist today. Countries of South America, South-eastern Europe, and South-eastern Asia abolished all the export restrictions introduced as a response to the Covid-19 pandemic. This suggests that there is a danger of persisting increased interventionism in agricultural trade in the future, particularly in the unstable environment and prospective crises.

8. Conclusions

In this paper, we examined to effects of the Covid-19 pandemic on agricultural trade and its implications for food security and trade policies. Using the most actual data available, we analysed the changes in agricultural production, demand, markets, trade, and trade policies, accentuating the major changes occurring during the pandemic. We showed that agricultural trade remained resilient throughout the period of the pandemic, surpassing the non-agricultural trade in terms of growth.

The negative effects of the pandemic were contained in particular regions and subsectors. Trade decreased most severely in the case of higher value-added and non-essential agricultural products,

due to higher demand elasticity, demand-side disruptions, labour shortages, and logistical problems. In contrast, the staple food trade increased, due to inelastic demand and the recomposition of consumption structure. Countries with more capital-intensive, productive, and robust agriculture experienced an expansion of the sector and agricultural exports, whereas the countries with more vulnerable agriculture endured the contraction of the sector, followed by increased agricultural imports or, in some specific instances, disengagement from agricultural trade.

We identified significant negative effects of the Covid-19 pandemic on global food security. Resilient agricultural trade somewhat alleviated the problem, although there was a notable increase in the number of food insecure people in nearly all observed regions. The pandemic and the related restrictive measures disrupted certain demand channels and caused panic stocking up of agricultural products. At the same time, there were considerable input supply disruptions and logistical problems with the distribution of agricultural products, particularly in some subsectors. This instigated an intensive growth of food prices, further worsened by the current instabilities in the economic environment and the energy crisis. This negatively affects food availability, affordability, utilisation, and stability.

The pressure placed upon the agricultural producers by the pandemic forced them to react and adapt to a growingly uncertain environment. The use of information and communication technology had a particularly important role in this. The pandemic revealed the potential of technologies' application in the sector and the need to further support digitalisation within food value chains in order to improve their functionality and resilience. This requires investment in the development of the necessary infrastructure and education as well as the promotion of entrepreneurial activities, particularly in developing countries.

The pandemic also raised a question of the future of globalisation in agriculture. Before the pandemic, agriculture was amongst the most protected sectors. There was no truly global specialisation as the individual economies aimed to maintain the domestic production of agricultural products, particularly staple food. However, there were efforts to liberalise agricultural trade, especially within the Doha round of negotiations among the World Trade Organisation members. Dangers related to food security could prompt the economies of the world to revert their stance on the globalisation of agriculture and their integration in the world economy, seeking higher levels of self-sufficiency in this strategically important sector. This could be followed by introducing measures to reduce the dependence on foreign suppliers of agricultural products and promote domestic agricultural production. This path could be dangerous, as the lobbyists for these measures have additional motives, and the measures intended to stabilise the agricultural sector could easily spread to other sectors. This would, in turn, reduce cooperation in the world economy, defragmentation of global value chains, and ultimately result in the loss of global welfare previously achieved through free trade. Thereby, it is questionable to which extent this would mitigate the food security risk, as relying on only one (domestic source) of agricultural products still entails the risks of local crises and shocks. Therefore, deeper integration and cooperation and improved resilience of agricultural value chains appear to be a better option for averting similar food crises in the future.

The initial trade policy response concerning agricultural trade was mostly directed toward export restrictions. This revealed the necessity to regulate the use of these measures in the future, particularly in the event of food crises. Stronger discipline in their use needs to be imposed in order to avert a more grievous deglobalisation of the sector. Objectively, economies need to exert

some control over their food supply to avert food shortages, so some manoeuvring space needs to be left for their policymakers to react in such situations. Otherwise, developed countries could outbid developing countries on the world market and jeopardise their food security. However, this needs to be supervised by the World Trade Organisation with a similar system used for other trade-related measures in order to prevent balance the risks of the trade partners are enforce consideration of the interests of all parties. The first steps towards this direction have already been made by the Ottawa group of economies within the World Trade Organisation. The Ottawa group made the first formal proposal for the regulation of export controls. However, current perspectives of the major reform are bleak, considering the lack of support from the major economies, notably the United States and China. In addition, it is worrisome that the self-sufficiency and protectionist motivations conflict with the agenda of the Doha round, which stalled even before the latest food crises. Current developments increase the uncertainty of the round's eventual successful conclusion

Literature

Abid, A., & Jie, S. (2021). Impact of COVID-19 on agricultural food: A Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis. *Food Frontiers, 2*(4), 396-406. doi: 10.1002/fft2.93

Aday, S., & Aday, M. S. (2020). Impact of COVID-19 on the food supply chain. *Food Quality and Safety, 4*(4), 167-180. doi: 10.1093/fqsafe/fyaa024

Amjath-Babu, T. S., Krupnik, T. J., Thilsted, S. H., & McDonald, A. J. (2020). Key indicators for monitoring food system disruptions caused by the COVID-19 pandemic: Insights from Bangladesh towards effective response. *Food Security, 12*(4), 761-768. doi: 10.1007/s12571-020-01083-2

Arita, S., Grant, J., Sydow, S., & Beckman, J. (2022). Has global agricultural trade been resilient under coronavirus (COVID-19)? Findings from an econometric assessment of 2020. *Food Policy, 107*, 102204. doi: https://doi.org/10.1016/j.foodpol.2021.102204

Baquedano, F., Zereyesus, Y. A., Christensen, C., & Valdes, C. (2021). COVID-19 Working Paper: International Food Security Assessment, 2020-2030: COVID-19 Update and Impacts of Food Insecurity.

Beckman, J., & Countryman, A. M. (2021). The Importance of Agriculture in the Economy: Impacts from COVID-19. *American Journal of Agricultural Economics, 103*(5), 1595-1611. doi: 10.1111/ajae.12212

Cardwell, R., & Kerr, W. A. (2014). Can Export Restrictions be Disciplined Through the World Trade Organisation? *The World Economy, 37*(8), 1186-1196. doi: https://doi.org/10.1111/twec.12173

De', R., Pandey, N., & Pal, A. (2020). Impact of digital surge during Covid-19 pandemic: A viewpoint on research and practice. *International Journal of Information Management, 55*, 102171. doi: https://doi.org/10.1016/j.ijinfomgt.2020.102171

Evenett, S., Fiorini, M., Fritz, J., Hoekman, B., Lukaszuk, P., Rocha, N., . . . Shingal, A. (2022). Trade policy responses to the COVID-19 pandemic crisis: Evidence from a new data set. *The World Economy, 45*(2), 342-364. doi: https://doi.org/10.1111/twec.13119

Garnett, P., Doherty, B., & Heron, T. (2020). Vulnerability of the United Kingdom's food supply chains exposed by COVID-19. *Nature Food, 1*(6), 315-318. doi: 10.1038/s43016-020-0097-7

Global Trade Alert. (2022). Status of Policies 2020/2021. Retrieved 10.09.2022, from https://www.globaltradealert.org

Haqiqi, I., & Bahalou Horeh, M. (2021). Assessment of COVID-19 impacts on U.S. counties using the immediate impact model of local agricultural production (IMLAP). *Agricultural Systems, 190*, 103132. doi: https://doi.org/10.1016/j.agsy.2021.103132

International Monetary Fund. (2021). *World Economic Outlook: Managing Divergent Recoveries*. Washington, DC: International Monetary Fund.

Kastratović, R., & Bjelić, P. (2022). E-commerce and Exports in Europe: A Dynamic Panel Data Approach. *International Trade Journal*. doi: 10.1080/08853908.2022.2125460

Kastratović, R., & Vasiljević, Z. (2018). Determinants of Foreign Direct Investments in Agriculture of Danube Region. In J. Subić, B. Kuzman & A. J. Vasile (Eds.), *Thematic Proceedings "Sustainable Agriculture and Rural Development in Terms of the Republic of Serbia Strategic Goals Realization within the Danube Region – Support Programs for the Improvement of Agricultural and Rural Development"*. Belgrade: Institute of Agricultural Economics.

Kerr, W. A. (2020). The COVID-19 pandemic and agriculture: Short- and long-run implications for international trade relations. *Canadian Journal of Agricultural Economics, 68*(2), 225-229. doi: 10.1111/cjag.12230

Kerr, W. A. (2021). Agriculture after a year with COVID-19: Any long-term implications for international trade policy? *Canadian Journal of Agricultural Economics, 69*(2), 261-267. doi: 10.1111/cjag.12274

Lin, B.-x., & Zhang, Y. Y. (2020). Impact of the COVID-19 pandemic on agricultural exports. *Journal of Integrative Agriculture, 19*(12), 2937-2945. doi: https://doi.org/10.1016/S2095-3119(20)63430-X

Lu, L. (2018). How A Little Ant Challenges Giant Banks? The Rise of Ant Financial (Alipay)'s Fintech Empire and Relevant Regulatory Concerns. *International Company and Commercial Law Review, 28*(1), 12-30.

Lusk, J. L., Tonsor, G. T., & Schulz, L. L. (2021). Beef and Pork Marketing Margins and Price Spreads during COVID-19. *Applied Economic Perspectives and Policy, 43*(1), 4-23. doi: https://doi.org/10.1002/aepp.13101

Mitra, S., & Joslin, T. (2009). Agricultural export restrictions: Welfare implications and trade disciplines *IPC Position Paper: Agricultural and Rural Development Policy Series*. Washington, DC: International Food and Agricultural Trade Policy Council.

Roe, B. E., Bender, K., & Qi, D. (2021). The Impact of COVID-19 on Consumer Food Waste. *Applied Economic Perspectives and Policy, 43*(1), 401-411. doi: https://doi.org/10.1002/aepp.13079

Scholefield, R., & Gaisford, J. D. (2007). Export Taxes: How They Work and Why They Are Used. In W. A. Kerr & J. D. Gaisford (Eds.), *Handbook on International Trade Policy*. Cheltenham, UK: Edward Elgar Publishing.

World Trade Organisation. (2020). Methodology for the WTO Trade Forecast of April 8 2020. Retrieved 26.08.2022, from https://www.wto.org/english/news_e/pres20_e/methodpr855_e.pdf

Zhu, G., Chou, M. C., & Tsai, C. W. (2020). Lessons Learned from the COVID-19 Pandemic Exposing the Shortcomings of Current Supply Chain Operations: A Long-Term Prescriptive Offering. *Sustainability, 12*(14), 5858.

Zhuo, N., Ji, C., & Ding, J.-y. (2020). Pig farmers' willingness to recover their production under COVID-19 pandemic shock in China – Empirical evidence from a farm survey. *Journal of Integrative Agriculture, 19*(12), 2891-2902. doi: https://doi.org/10.1016/S2095-3119(20)63411-6