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Did the COVID-19 pandemic disturb intra-EU trade in agrifood products? Evidence from a counterfactual forecasting approach

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Abstract: In this study, we attempt to infer the effect of the COVID-19 pandemic on the intra–European Union (EU) agrifood trade from out-of-sample forecasts. We compare the actual level of trade during the COVID-19 period with counterfactual values derived from univariate forecasting models [regARIMA (Linear regression with autoregressive integrated moving average errors) and Holt-Winters methods]. We analyse agrifood imports and exports of specific EU countries and the EU-27 aggregate on the basis of monthly data for the period from January 2010 to February 2022. The findings reveal a significant decrease in trade activity in the first year of the pandemic that was negatively correlated to COVID-19 restrictions applied by EU countries. Surprisingly, COVID-19 restrictions do not significantly explain the diversified agrifood trade response among EU countries during the pandemic.

Keywords: agricultural products; COVID restrictions; EU countries; food products; foreign trade

Early in 2020, the world economy faced severe distortions to output, demand and trade resulting from the COVID-19 pandemic. The trade decrease was not as deep in many places as some had predicted (Caporale et al. 2022). Nonetheless, global gross domestic product (GDP) shrank by approximately 2.7%, and even with rapid growth in 2021, GDP remained approximately 2.8% below trend (IMF 2024). The COVID-19 pandemic decreased revenues in services, including food delivery salaries, as expenditures on food away from home decreased worldwide. Simultaneously, food retail revenues grew substantially because of increased food purchases for home consumption, especially in the early stages of the pandemic. As the pandemic

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developed, because of society-wide anxiety, it was hard to find many basic food products in physical shops, and access to food away from home also was limited. The low price and income elasticities of demand for food in aggregate made the agrifood trade more resilient to COVID-induced changes than were the other manufacturing and services industries. Schmidhuber and Qiao (2020) and Arita et al. (2022) among others reported this result for the early months of the pandemic.

Empirical research using the full range of relevant data is needed to carefully establish the effects of the pandemic on agricultural and food prices and quantities. In particular, several significant questions related to international trade need to be explored empirically. First, were the changes in foreign trade in agrifood goods over time correlated with the level of pandemic restrictions applied? Second, to what extent were the expected decreases in agrifood exports and imports in European Union (EU) countries in the first phase of the pandemic made up for by February 2022?

Third, did trade responses significantly differ across commodity groups? Fourth, did agrifood trade responses differ across countries depending, for example, on their level of their economic development or trade position as an importer or exporter? In this context, the issue of country differences in COVID-related policies is also central. In general, foreign trade in agricultural products was expected to be negatively correlated with the restrictions applied, with the most substantial decreases in exports and imports in the first year of the pandemic. Furthermore, heterogeneous behaviour was expected among the countries and the commodity aggregates under analysis.

Investigators in a few studies have addressed these and related questions with similar questions in hand. First of all, we must stress that the existing literature on the effect of COVID-related shocks on agrifood trade remains scarce, and most such studies are descriptive. Analyses focused on total merchandise trade, including that at global, regional or country levels, proved a significant decrease in export values during the first wave of the pandemic (Barbero et al. 2021; Davidescu et al. 2022; Khorana et al. 2023). After this early stage of the COVID-19 pandemic, the exports have recovered as producers and exporters adapted to pandemic containment measures. The same applied to agricultural trade; however, the quantified effect of COVID-19 was much smaller than that on trade in nonagricultural goods (Arita et al. 2022; Pawlak et al. 2024). On the basis of Switzerland's situation, Büchel et al. (2020) confirmed that imports were related to the stringency of government measures in the exporter country. However, de Lucio et al. (2022) found that the stringency in containment measures at the destination countries decreased Spanish exports, whereas imports did not decrease as sharply. These findings indicate that the relationship between trade restrictions and trade flows was ambiguous.

For agrifood trade, Espitia et al. (2020) and Engemann and Jafari (2022) showed the variability of trade responses across commodity groups and found that the trade of staples was most resilient to the global pandemic, whereas that of other agrifood products decreased considerably. However, they did not attempt to use data-rich methods to see how the pandemic period differed from forecasts in the way that we have done. Koppenberg et al. (2021), Arita et al. (2022) and Engemann and Jafari (2022) considered the variations in trade dynamics between countries and regions in the world. In their analyses, they found that countries highly dependent on trading partners, least developed countries and low-income countries were most likely to experience large COVID-related shocks. These studies were not detailed about EU patterns, but we provide this focus. Investigators in many studies examined the consequences of food trade disruptions for poorer countries with larger food security vulnerabilities (Adjognon et al. 2021; Ahmed et al. 2021; Amare et al. 2021; Rudin-Rush et al. 2022; Tabe-Ojong et al. 2023). These are related to but distinct from our topic.

Although the EU countries are key players in the world's agrifood trade, the trade within EU countries has not been thoroughly explored in assessments of COVID-19 effects. Some analyses consider Europe (Engemann and Jafari 2022) or the EU as a group of countries (Espitia et al. 2020). However, trade of the disaggregated EU remains to be explored and understood.

Our objective is to provide assessment of how the COVID-19 pandemic caused trade to deviate from expected patterns for food and agriculture in the EU. We compare different EU countries' trade responses to COVID-induced shocks. According to Engemann and Jafari (2022), Europe changed its position in agrifood trade from being a net exporting to a net importing region, and European intraregional trade was less prone to reductions than its interregional trade. Approximately 70% of the EU agrifood trade is within the European single market (Eurostat-Comext 2024); hence, intra-EU trade effects of the pandemic are crucial to understand for the EU's international position. In turn, understanding variations in the diversification of trade effects in agricultural and food products is also essential. These two research problems are in the scope

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of our study. In this article, we provide a country-level assessment of the effects of the COVID-19 pandemic on the intra-EU agrifood trade. We also verify the relationship between the restrictiveness of COVID-related policies and intra-EU agrifood trade flow responses. Nonetheless, in this study, we do not provide the commodity-by-commodity and country-by-country detail needed truly to disentangle the complex of factors that affect food and agricultural trade from year to year.

Our research contributes to the existing literature on the implications of the pandemic on agrifood trade in three significant ways. First, we shed light on the changes in agrifood trade patterns during the COVID-19 pandemic in countries that are key players in the world's agrifood trade. Second, we compare the magnitude of changes in trade in agricultural products and processed food, providing a deeper understanding of such patterns. Third, we go beyond regional-level analysis and develop country-specific insights, thereby offering a more nuanced view of the trade responses. Our study also has practical implications for post-pandemic policy, which we discuss in the final section.

MATERIAL AND METHODS

Data. To analyse the effect of the COVID-19 pandemic on the foreign trade of agrifood goods, we used monthly time series of intra-EU exports and imports (in euros) from January 2010 to February 2022 (until the outbreak of war in Ukraine). The data for the EU countries, according to the two-digit Harmonised System – Combined Nomenclature, come from the Eurostat-Comext database (Eurostat-Comext 2024). We analysed exports versus imports, trade in agricultural commodities versus trade in processed food and trade by individual countries versus the EU-27 aggregate. We excluded the United Kingdom from the EU sample because of Brexit in 2020. We included Malta in the EU-27 aggregate; however, because of many missing observations, we excluded Malta from the analyses of individual countries.

Agricultural trade covers both live animals and animal products (chapters 1 to 5 of the Harmonised System – Combined Nomenclature) and vegetable products (chapters 6 to 14). The food aggregate covers animal or vegetable fats and oils and their cleavage products; prepared edible fats; animal or vegetable waxes (chapter 15) and prepared foodstuffs; beverages, spirits and vinegar; and tobacco and manufactured tobacco substitutes (chapters 16 to 24).

We also used information on restrictions applied in the EU countries during the pandemic – namely, the stringency index (*SI*) (Hale et al. 2021) based on nine indicators of lockdown-style policy, ranging from 0 (no restrictions) to 100. The source of policy information is Oxford University's Oxford COVID-19 Government Response Tracker data (2024). We calculated average monthly restrictions from daily data. We calculated the *SI* indicator for the EU-27 aggregate as the average of national indicators weighted by the volume of agrifood trade in 2019 (just before the COVID-19 pandemic). The heat map of the *SI* shows the heterogeneous response of the EU countries to the seasonal pattern of the COVID-19 pandemic waves [Figure S1 in the Electronic Supplementary Material (ESM)].

Methods. We first compared the actual level of intra-EU trade during the pandemic period (from March 2020 to February 2022) with counterfactual forecasts derived from univariate time series projections. We calculated the forecasts by using the subsample ending in February 2020 (the pre-COVID period). For robustness, we applied two methods to calculate forecasts for the COVID-19 period, as well as an average, as our forecast for the no-COVID scenarios. We calculated forecast errors in percentage terms and as cumulative errors in levels. Figure S2 in the ESM includes a sketch of the forecasting procedure. The negative errors during the COVID-19 period indicate when intra-EU trade was lower than that predicted for the no-COVID scenario. The forecast errors for individual countries were the starting point for further analysis.

For forecasting, we used time series models that covered the existence of stochastic (time-varying) trends and seasonality. The first model is a regression model with seasonal autoregressive integrated moving average errors (regARIMA). The regARIMA can be described as a linear regression in which the errors follow an ARIMA process (Box and Jenkins 1970), rather than a white noise process. This procedure uses additional explanatory variables, X_{it}, that capture the effect of moving holidays (Easter effects) and different forms of outliers, including structural changes in the level and trend of time series. The specification of ethe extended seasonal ARIMA model (i.e. the regression variables and their timing, the number of ordinary and seasonal differences or the number of autoregressive and the moving average lags) was automated within the X-13-ARIMA procedure (X-13-ARIMA-SEATS Reference Manual 2023).

The second method applied to forecast trade aggregates was the multiplicative Holt-Winters model (Hyndman et al. 2008). We limited smoothing constants (α, β, γ) to the range from 0 to 1 and specified

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them through an optimisation process, minimising within in-sample errors. We assumed initial values of the level, trend change and seasonal component as in Hyndman et al. (2008).

RESULTS AND DISCUSSION

Intra-EU agrifood trade during the COVID-19 pandemic. We first used our approach and data to illustrate the development of intra-EU imports and exports of agricultural products and processed food during the COVID-19 pandemic in relation to our aggregate of policy measures. Figure 1 shows two almost identical panels (one for intra-EU imports and one for intra-EU exports) indicating the differences between actual trade volumes and our (from an average of regARIMA and Holt-Winters models) ex post forecasts computed on pre-pandemic data. The right axis of each panel shows the trade-weighted restrictions in place at the time (*SI*) in the EU. Overall, in the first 12 months of the COVID-19 pandemic, as the *SI* increased, trade within the EU decreased precipitously compared with findings for the no-COVID scenario.

The average monthly decrease in agricultural goods imports and exports in the second quarter of 2020 was 7.52% and in food was 2.96%. The culmination of negative trade effects occurred in May 2020 and was expressed in an approximately 12% decrease in trade in agricultural goods and food compared with the forecasts.

These results are in line with the global estimates by Espitia et al. (2020), who predicted that in the first quarter after the outbreak of the pandemic, the world's export supply of food might be lower by 12.7%, whereas many important staple foods, including rice, wheat and potatoes were expected to have decreases in export supplies of more than 15%. However, Beckman and

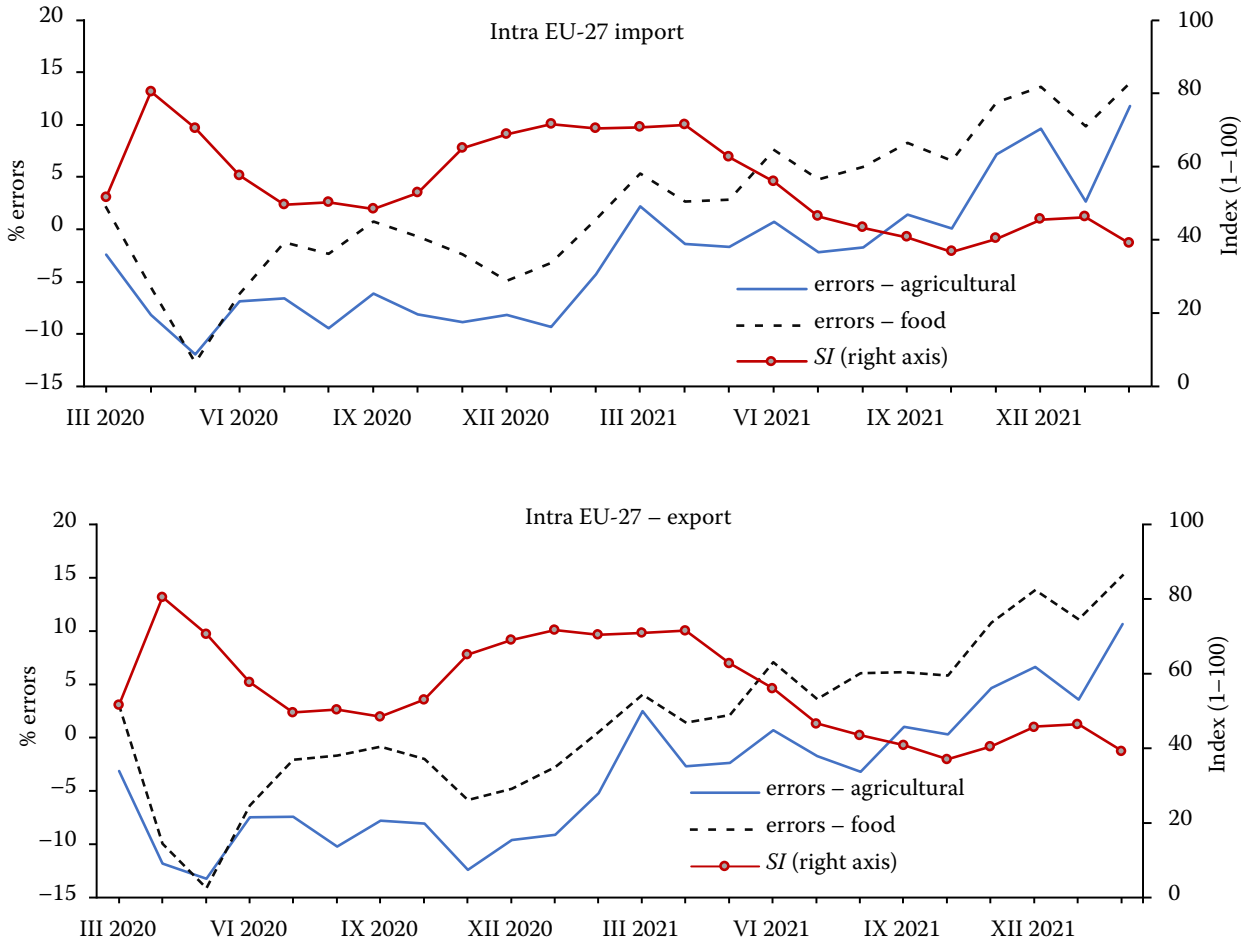

Figure 1. Differences between COVID and no-COVID scenarios (forecast errors) for agrifood trade in the EU aggregate on the background of stringency index (*SI*)

Source: Author calculations based on Eurostat-Comext (2024) and OxCGRT (2024) data

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Countryman (2021) found that an increase in trade in some important food commodities and products, such as wheat, sugar, oilseeds and meat, was accompanied by a decrease in trade in farm commodities, including live animals, plant-based fibres, beverages and tobacco. Engemann and Jafari (2022) found that the global trade in staples was relatively resilient to the global pandemic, whereas the global trade of other agrifood products decreased considerably.

We documented the statistically significant negative correlation between forecast errors and the SI for EU-27 aggregate from –0.69 to –0.56, more negative for food products than for agricultural goods throughout the COVID-19 period. Figure 1 shows the deepening of trade decreases in the first pandemic wave (May 2002) and the second wave (early 2021). After spring 2021, the level of intra-EU trade, especially in processed food, reached or exceeded the trade projected by the forecasting models (no-COVID scenario).

Our general observation was that the higher the policy restrictions, the greater the decrease in trade flows. This result is consistent with similar findings by Arita et al. (2022) that government policy restrictions along with human mobility were the most evident channels in which the pandemic affected agricultural trade. This finding is also in line with results for total merchandise trade by Barbero et al. (2021), who noted that the negative effect of governmental actions on trade flows was more intense when the exporter and the importer had the same per capita incomes, whereas the most negative effect on exports appeared between high-income countries. Here, the difference between overall merchandise trade and agrifood trade appeared where the COVID-induced agrifood trade disruptions affected lower income countries to a greater extent (Arita et al. 2022).

By the beginning of 2022, trade in agricultural commodities did not make up for the decreases experienced during the pandemic, and the cumulative trade values were lower than those predicted under the no-COVID scenario (Figure S3 in the ESM). In contrast, the decreases in food trade in late 2021 or early 2022 were at least as high as the projections based on pre-COVID data. Notably, in both cases, the pattern of trade changes over time took on a unique shape, resembling a sinusoid. In the initial phase, trade decreased, but it compensated for the losses in the subsequent phase.

Intra-EU agrifood trade by individual countries. In the four panels of Figure 2, we display the median (Me), first quartile (Q1) and third quartile (Q3) of import and export forecast errors for the EU-27 members during the period from March 2020 to February 2022 to show the countries most and least affected by the COVID-19 pandemic. The data reveal that the time series pattern of errors for the EU-27 aggregate in Figure 1 is replicated in most of the individual EU countries. Both Figure 1 and 2 show that intra-EU food trade (exports and imports) decreased mainly in the first phase of the pandemic, whereas the effect in the second phase was not unidirectional. Agricultural commodities had similar trade decreases in both the first and second phases.

We also found that the implied effect of the COVID-19 pandemic differed widely across EU members for both agricultural trade and food trade (Figure 2). Some countries experienced considerable decreases in intra-EU exports and imports; for other countries, intra-EU trade did not decrease much or even increased during the pandemic.

Imports of agricultural commodities fell the most relative to the no-COVID scenario in Hungary, Croatia, and Bulgaria (average negative pandemic declines below –18%) and the Czech Republic, Romania, Slovenia and Poland (between –10% and –11%). In contrast, Belgium and Ireland averaged above their no-COVID projection scenarios (errors averaging over positive 5%). The most significant declines in agricultural commodity exports were in Denmark and Romania (monthly trade was about 20% lower than predicted by the pre-COVID time series; Constantin et al. (2022) discussed Romanian agricultural exports' relatively poor resilience to the COVID-19 pandemic in more detail), and Finland and Lithuania (lower by 14–15%). Conversely, agricultural exports averaged more than 8% higher than the forecast in Latvia and Croatia.

There is also a considerable variation among countries in food trade relative to projections (Figure 2). Intra-EU food imports decreased the most in Croatia, the Czech Republic and Romania (8–10%), while food imports rose in Belgium and Ireland (7–10%). Intra-EU food exports fell most in Ireland (more than 20%), and Estonia, Lithuania and Romania (about 10%). In contrast, food trade rose in Bulgaria and Slovenia (10–12%). Tables S1 and S2 in the ESM present a more detailed picture of intra-EU agrifood trade during the COVID-19 pandemic.

We also examined regression estimates in which the dependent variable was the COVID-19 trade effect using our forecast errors for individual quarters for EU members (Tables S1 and S2 in the ESM). The explanatory variables on the right-hand side include GDP per capita in purchasing power parity in 2019, the export-import ratio in trade in agricultural goods and food

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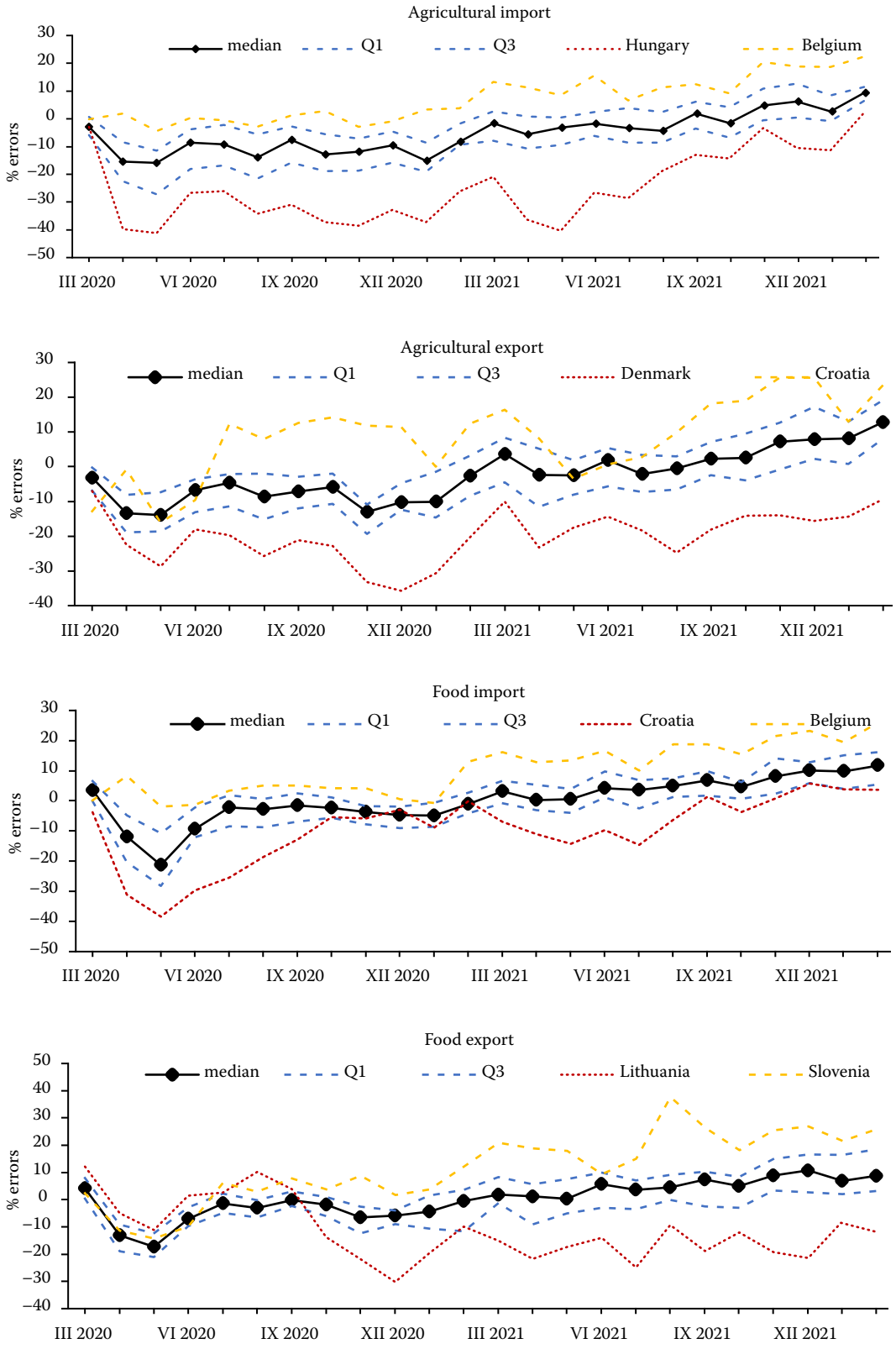

Figure 2. Differences between COVID and no-COVID scenarios (forecast errors) for intra-EU agrifood trade for representative EU members

Source: Author calculations based on Eurostat-Comext (2024) data

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before the pandemic, membership in the Eurozone, access to the sea and the level of the countries' COVID-19 restrictions (*SI*) in individual quarters. Attempts to explain the patterns in trade deviations from projections were only partially successful. We think it is important to report these results to avoid the confirmation bias that often distorts econometric and other empirical studies (Leamer 1983).

In our models, the measure of COVID-19 restrictiveness (*SI*) was not a significant factor that differentiated forecast errors among countries. Furthermore, GDP per capita and access to the sea had a positive effect on the import of agricultural goods during the pandemic. For agricultural exports, membership in the Eurozone had a positive effect only in the third and fourth quarters of 2020. For food imports, we found a positive effect of GDP in 2020 and of net exporter status. Our explanatory variables did not help explain food export patterns.

However, COVID-19 policy measures incorporated into the SI help explain the differences between the no-pandemic and pandemic scenarios over time in many individual EU countries (Figure 3). For most countries and trade aggregates, Spearman correlation coefficients were negative, which is consistent with our data approach. Sweden, Belgium, France and Estonia had the highest negative correlation coefficients for analysed export and import aggregates. Exceptions included positive coefficients for most trade aggregates in Greece, for agricultural exports in Bulgaria and for imported agricultural commodities in Romania. For these cases, local factors were crucial (e.g., weather conditions in Balkan countries). Also, a local driver

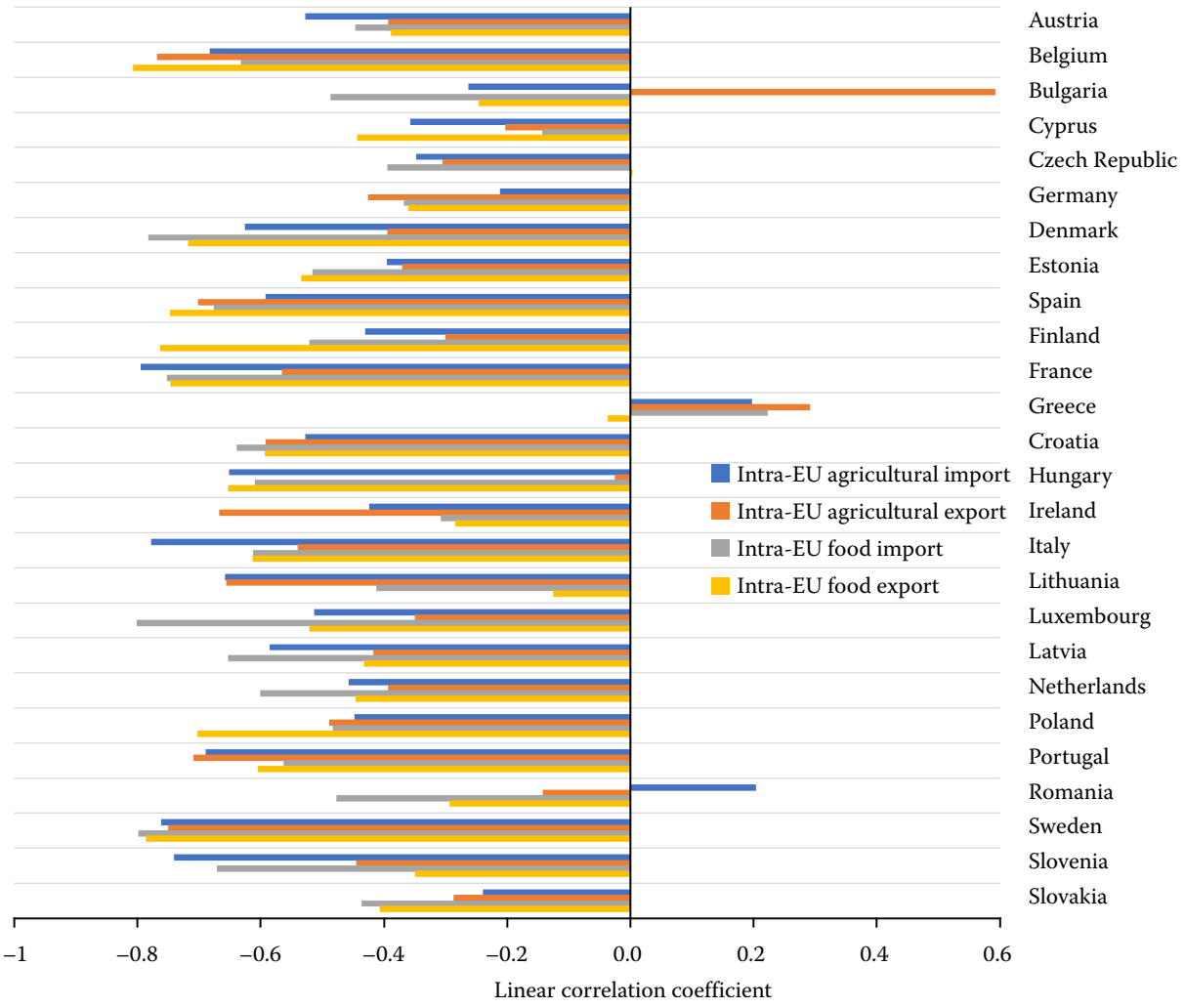

Figure 3. Correlation coefficients between forecast errors and stringency indexes in the analysed EU countries from March 2020 to February 2022

Source: Author calculations based on Eurostat-Comext (2024) and OxCGRT (2024) data

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of trade was the increasing bilateral trade flows between Bulgaria and Romania.

All of these factors affected the period when specific countries made up for (with noted exceptions) the trade decreases experienced during the pandemic (Table S3 in the ESM). For most countries, it was possible to compensate for trade decreases in food; however, recovery of pre-pandemic trade levels differed significantly among countries. Bulgaria, Lithuania, Luxembourg and Portugal made up for food export decreases fastest. Belgium, Finland and Ireland regained pre-pandemic food imports quite smoothly. In agricultural trade, only a few countries overcame the COVID-19 shock and returned to pre-pandemic trading values. In the case of agricultural exports, the most successful countries included Greece, Croatia and Latvia, recalling that Ireland's imports did not decrease at all during the pandemic. Because the pace of return to pre-pandemic trade levels was not clearly related to the trade position (net exporter or net importer) of individual countries, we expect that local and sector-specific factors were decisive for agricultural trade recovery, which calls for further investigation.

CONCLUSION

We found significant decreases in intra-EU trade in agrifood goods associated with the COVID-19 pandemic; hence, the pandemic contributed to the weakening of the spatial integration of agrifood markets with all their negative consequences. This finding is consistent with foreign trade theory because COVID-induced trade-reducing logistics constraints are broadly similar to non-tariff barrier constraints; we observed a much stronger and more persistent decrease in agricultural exports and imports. Although the EU-27 food trade recovered from the losses caused by the pandemic by the end of 2021, the cumulative effect of COVID-19 on the EU-27 trade in agricultural goods was still negative in February 2022. According to our research, only a few countries overcame the COVID-19 shock and returned to pre-pandemic agricultural export and import levels.

Our data indicate large differences between the counterfactual scenario and the actual trade data in most individual countries. Most EU countries experienced significant decreases in intra-EU exports and imports, whereas for other countries, intra-EU trade did not decrease much or even increased. Policy seemed to have effects that were sometimes not what was intended, and negative economic consequences may not have been fully anticipated. The COVID-19 policy restrictions (*SI*) were negatively correlated with trade changes over time, both for the entire EU-27 and for a large majority of countries. However, the restrictiveness index (*SI*) does not explain the differences between countries' pandemic trade patterns in our analyses. Therefore, we suggest the following directions for future research of the agrifood trade during the COVID-19 period: the use of more granular bilateral trade data in a panel set-up, enumeration of country-specific demand and supply factors for agrifood trade and better treatment of relations between pandemic restrictions and trade (nonlinear and with interactions).

REFERENCES

Adjognon G.S., Bloem J.R., Sanoh A. (2021): The coronavirus pandemic and food security: Evidence from Mali. Food Policy, 101: 102050.

Ahmed F., Islam A., Pakrashi D., Rahman T., Siddique A. (2021): Determinants and dynamics of food insecurity during COVID-19 in rural Bangladesh. Food Policy, 101: 102066.

Amare M., Abay K.A., Tiberti L., Chemberlin J. (2021): COVID-19 and food security: Panel data evidence from Nigeria. Food Policy, 101: 102099.

Arita S, Grant J, Sydow S, Beckman J. (2022): Has global agricultural trade been resilient under the coronavirus (COVID-19)? Findings from an econometric assessment of 2020. Food Policy, 107: 102204.

Barbero J., de Lucio J.J., Rodriguez-Crespo E. (2021): Effects of COVID-19 on trade flows: Measuring their impact through government policy responses. PLoS ONE, 16: e0258356.

Beckman J., Countryman A.M. (2021): The importance of agriculture in the economy: Impacts from COVID-19. American Journal of Agricultural Economics, 103: 1595–1611.

Box G.E.P., Jenkins G.M. (1970): Time Series Analysis: Forecasting and Control. San Francisco, Holden-Day: 553.

Büchel K., Legge S., Pochon V., Wegmüller P. (2020): Swiss trade during the COVID-19 pandemic: An early appraisal. Swiss Journal of Economics and Statistics, 156: 22.

Caporale G.M., Sova A.D., Sova R. (2022): The COVID-19 Pandemic and European Trade Flows: Evidence from a Dynamic Panel Model. International Journal of Finance and Economics, 29: 2563–2580.

Constantin M., Piștalu M., Pătărlăgeanu S.R., Chirescu A.D. (2022): The resilience of agricultural comparative advantage during the COVID-19 pandemic. In: Pamfilie R., Dinu V., Vasiliu C., Pleșea D., Tăchiciu L. (eds): 8th BASIQ International Conference on New Trends in Sustainable Business and Consumption. Graz, Austria, May 25–27, 2022: 147–154.

https://doi.org/10.17221/253/2024-AGRICECON

Davidescu A.A., Popovici O.C., Strat V.A. (2022): An empirical analysis using panel data gravity models and scenario forecast simulations for the Romanian exports in the context of COVID-19. Economic Research – Ekonomska Istraživanja, 35: 480–510.

De Lucio J., Minguez R., Minondo A., Requena F. (2022): Impact of Covid-19 containment measures on trade. International Review of Economics and Finance, 80: 766–778.

Engemann H., Jafari Y. (2022): COVID-19 and changes in global agri-food trade. Q Open, 2: qoac013.

Espitia A., Rocha N., Ruta M. (2020): COVID-19 and Food Protectionism. The Impact of the Pandemic and Export Restrictions on World Food Markets. Policy Research Working Paper 9253. Washington, D.C., World Bank: 30.

Eurostat-Comext (2024): International trade. [Dataset]. Eurostat, Brussels. Available at https://ec.europa.eu/eurostat/comext/newxtweb/ (access May 10, 2024).

Hale T., Angrist N., Goldszmidt R., Kira B., Petherick A., Phillips T., Webster S., Cameron-Blake E., Hallas L., Majumdar S., Tatlow H. (2021): A global panel database of pandemic policies (Oxford COVID-19 Government Response Tracker). Nature Human Behaviour, 5: 529–538.

Hyndman R., Koehler A.B., Ord J.K., Snyder R.D. (2008): Forecasting with Exponential Smoothing: The State Space Approach. Heidelberg, Springer: 362.

IMF (2024): Real GDP growth. [Dataset]. International Monetary Fund, Washington. Available at https://www.imf.org/external/datamapper/NGDP_RPCH@WEO/OEMDC/ADVEC/WEOWORLD (accessed May 10, 2024)

Khorana S., Martinez-Zarzoso I., Ali S. (2023): An anatomy of the impact of COVID-19 on the global and intra-Commonwealth trade in goods. Review of International Economics, 31: 550–579.

Koppenberg M., Bozzola M., Dalhaus T., Hirsch S. (2021): Mapping potential implications of temporary COVID-19 export bans for the food supply in importing countries using precrisis trade flows. Agribusiness, 37: 25–43.

Leamer E.E. (1983): Let's take the con out of econometrics. The American Economic Review, 73: 31–43.

OxCGRT (2024): Oxford University's Oxford COVID-19 Government Response Tracker.[Dataset] Blavatnik School of Government, University of Oxford. Available at https://github.com/OxCGRT/covid-policy-tracker (accessed Apr 18, 2024

Pawlak K., Malak-Rawlikowska A., Hamulczuk M., Skrzypczyk M. (2024): Has food security in the EU countries worsened during the COVID-19 pandemic? Analysis of physical and economic access to food. PLoS ONE, 19: e0302072.

Rudin-Rush L., Michler J.D., Josephson A., Bloem J.R. (2022): Food insecurity during the first year of the COVID-19 pandemic in four African countries. Food Policy, 111: 102306.

Schmidhuber J., Qiao B. (2020): Comparing Crises: Great Lockdown versus Great Recession. Rome, FAO: 41.

Tabe-Ojong Jr. M.P., Nshakira-Rukundo E., Gebrekidan B.H. (2023): COVID-19 and food insecurity in Africa: A review of the emerging empirical evidence. European Review of Agricultural Economics, 50: 853–878.

X-13 ARIMA-SEATS Reference Manual (2023): Washington, D.C., Time Series Research Staff, Center for Statistical Research and Methodology, U.S. Census Bureau. Available at https://www2.census.gov/software/x-13arima-seats/x13as/unix-linux/documentation/docx13as.pdf (accessed May 10, 2024)

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