Dynamic effects of shocks to shipping costs on the food import bill

Contributed by:
Emiliano Magrini, ElMamoun Amrouk

Introduction

International trade continues to play a crucial role in supporting global food security by linking food surplus with deficit areas and enabling access to basic food products through imports (FAO, 2022). The latest FAO estimates show that the global food import bill (FIB) reached almost USD 2 trillion in 2023 and will likely hit a new record in 2024.[1] However, the high degrees of interconnection among countries and regions contribute to the spread of trade disruptions (Wassénius et al., 2023). Concerns about the capacity of international markets to guarantee access to food and agricultural products also arise when macroeconomic, geopolitical, or climate shocks strike.

Recently, global trade has faced pressure from shipping restrictions in the Panama Canal and shipping disruptions related to attacks on commercial vessels in the Red Sea (IMF, 2024). These events came on top of the interruptions to maritime transportation due to the war in Ukraine that impacted transit at the Black Sea ports. These disruptions led to shipping companies rerouting ships through longer routes and increasing sailing speeds and fuel consumption, thus impacting carbon emissions (UNCTAD, 2024).

Another direct consequence of these events was the impact on the cost of importing food and agricultural products. Maritime shipping accounts for the largest share of transportation costs, and more than 80 percent of global trade in grains and oilseeds occurs by sea (OECD, 2022). Moreover, the cost of trading food and agricultural products, relative to the value of the shipped goods, is high compared to other sectors (Beghin and Schweizer, 2021) and reaches 20 to 30 percent of the value of imported products for the least-developed countries (Korinek and Sourdin, 2010).

This feature article aims to examine the dynamic effects of shocks to shipping costs and focuses on the impact on the FIB due to changes in ocean freight rates in the short term, i.e. relying on data sampled monthly. Given the inelastic nature of agrifood import demand in the short run, the use of monthly information on trade and ocean freight rates provides policymakers with timely insights for assessing the consequences of increased shipping costs for the levels of current account and foreign reserves. The analysis distinguishes between modes of maritime transportation - dry bulk and container - and examines how these shocks affect net food-importing developing countries (NFIDCs)[2].

Data and methodology

The variable of interest in this analysis is the total value of the FIB in nominal terms, constructed by aggregating trade flows of over 900 agricultural and food items at the Harmonized System six (HS-6) digits level for each country. Monthly import data from the Trade Data Monitor (2023) is used for the calculation. Regarding ocean freight rates, the analysis uses the Baltic Dry Index for dry bulk shipping and the Harper-Petersen Charter Rates Index (Harpex) for container shipping. These indices provide weighted averages of freight rates for significant sea routes worldwide[3].

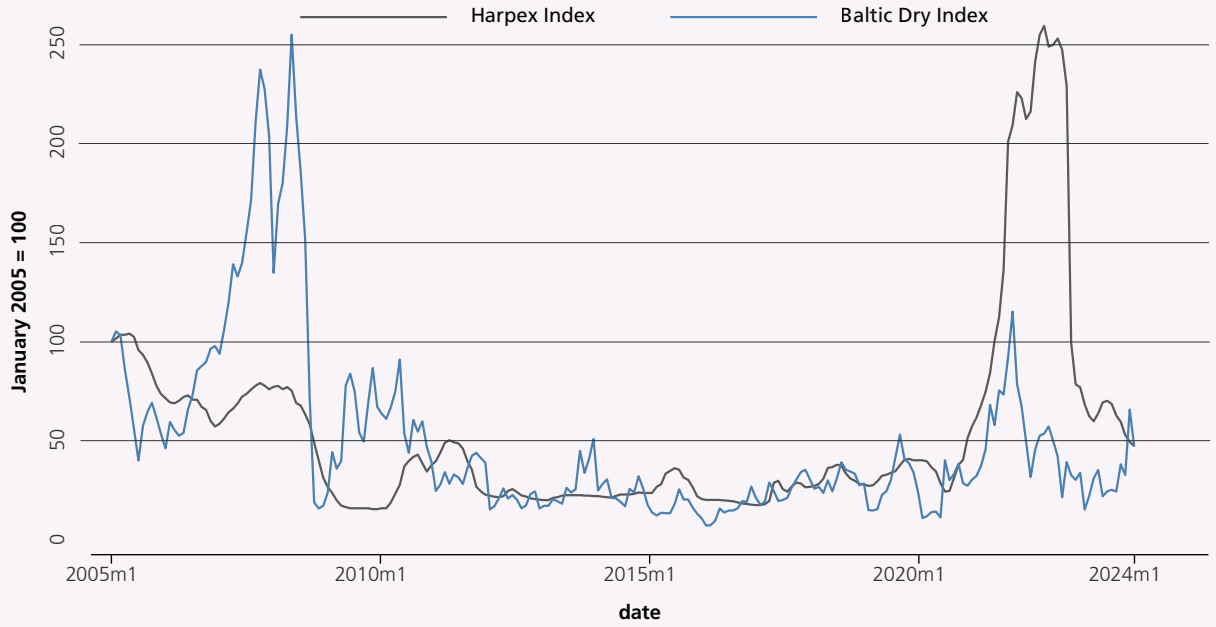
The analysis distinguishes between container and bulk transportation costs for two reasons. First, both modes are important for products in the FIB, at least in terms of total value. Dry bulk is crucial for grains, oilseeds and sugar, which are typically shipped in vessels chartered for point-to-point routes, while other products travel by container liner shipping (Wellesley et al., 2017). The choice of the shipping modality also depends on the size and port infrastructure available at the destination. Second, the two transportation modes seem to react differently to demand, supply and disruption shocks from the global economy, and they impact the FIB differently. Figure 1 displays the two freight rates, indexed to January 2005. While their paths are similar, the magnitude and duration of the response to major events in international markets over recent years appear quite different. For example, the Baltic Dry Index reacted more

[1] For details please refer to the section on the *"Global food import bill"* on page 86.

[2] Net food-importing developing countries (NFIDCs) are included in a list of countries maintained by the World Trade Organization's (WTO) Committee on Agriculture (2024). The selection criteria and the list of countries can be found at https://www.wto.org/english/tratop_e/agric_e/ag_intro06_netfood_e.htm.

[3] The analysis focuses on the impact of an overall change in the freight rates. It does not identify the specific causes of the rate shift, such as, for example, supply and demand factors, specific components of the shipping costs (e.g. insurance premiums), weather (e.g. drought in Panama Canal) or geopolitical (e.g. attacks in the Red Sea) disruptions, and/or policy interventions (e.g. trade restrictions).

Figure 1. Dry-bulk and container freight rates



Source: Refinitiv Eikon and author's calculations.

strongly during the 2007-2008 financial crisis, whereas the opposite was true during the post-COVID-19 pandemic period from 2021 to 2022.

The analysis includes additional variables to control for other factors that influence the FIB values beyond the shipping costs. It uses the West Texas Intermediate (WTI) price as a proxy for fuel costs and the Agricultural Price Index from the World Bank's commodity price data to control for the value of agricultural products. For global demand, it employs the World Industrial Production index developed by Baumesteir and Hamilton (2019).

The dynamic effect of shipping costs on the FIB is estimated using an econometric technique called panel local projections (Jordá, 2005). Specifically, the technique estimates the cumulative percentage change of the FIB over a period of 20 months after the shock to the shipping costs. For each period, it regresses the cumulated monthly changes of the FIB on the contemporary percentage changes of the freight rate and other control variables.[4] Separate regressions are used for the two transportation modes.

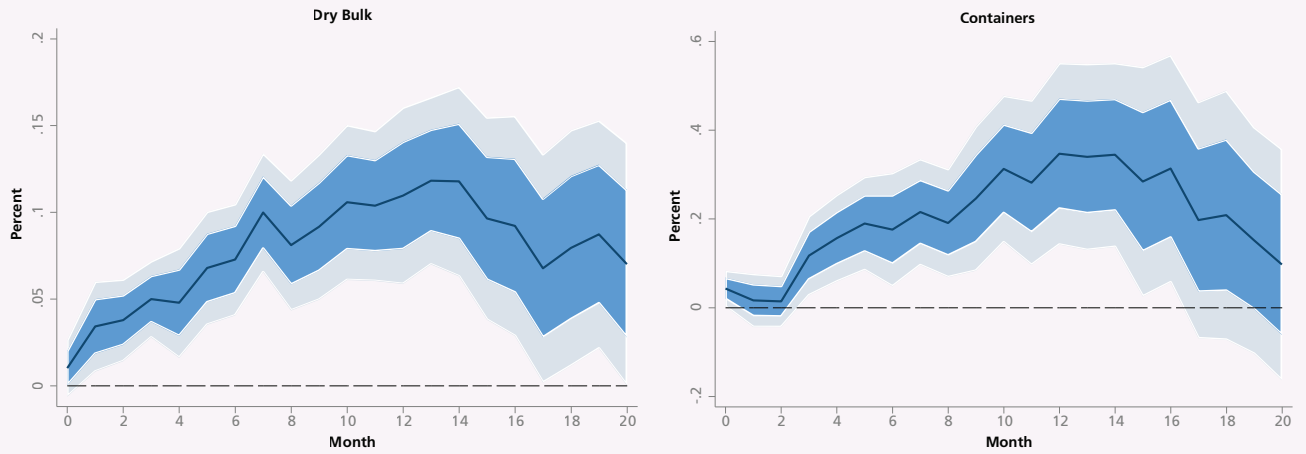
The dynamic effects of shipping on the FIB

Figure 2 illustrates the cumulative impact of a 1 percent increase in shipping costs on the total value of the FIB using data for 192 countries or territories and distinguishing between dry bulk (left panel) and container (right panel) shocks. In both cases, the impact is positive and statistically significant. In the left panel, the cumulative effect of a 1 percent shock to the Baltic Dry Index reaches its maximum level of 0.12 percent after thirteen months before reverting towards zero. By contrast, in the right panel, the cumulative effect of a 1 percent increase in the Harpex Index peaks at 0.34 percent after 12 months. More than half of the changes in the FIB occur within the first six months from the shocks, emphasizing the need for policymakers to focus on short-term effects due to the fast propagation of trade disruptions across maritime transportation routes.

It is important to note that the results are expressed in terms of the total value of the FIB. This means that the cumulative response to a 1 percent increase in ocean freight rates represents the net impact of the positive effect induced by an import price increase and the negative effect due to the reduction in traded volumes. The results suggest that the import demand for food and agricultural goods does not, at least in the short run, react enough to the price shocks that are induced by changes in the shipping costs. The increase in the overall expenditures triggered by higher import prices is not compensated by the reduction in traded volumes, highlighting the relative inelastic nature of food demand. The results also mean that, following an

[4] Local projections have recently become an appealing alternative to the standard structural vector autoregression (SVAR) approach to estimate causal dynamic effects, because they allow direct identification of the variables' response to shocks by using univariate methods without the need to impose structural restrictions (Jordà, 2023). Moreover, the flexibility of the local projections allow using panel data, handling nonlinearities and increasing the tolerance to functional misspecifications with respect to SVAR. For this analysis, these advantages are convenient since the relationship between the FIB at country level and the shocks to shipping costs is an empirical question without a robust theoretical framework that would help to identify the relationship between the different aggregates of interest in a SVAR framework.

Figure 2. The dynamic effects of shipping costs on the FIB



Note: The figure shows the cumulative impact of a 1.0 percent increase in shipping costs on the value of the FIB.
Source: Refinitiv Eikon and author's calculations.

increase in shipping costs due to a shock, countries spend more on food supplies from the global market, at least in the short run.

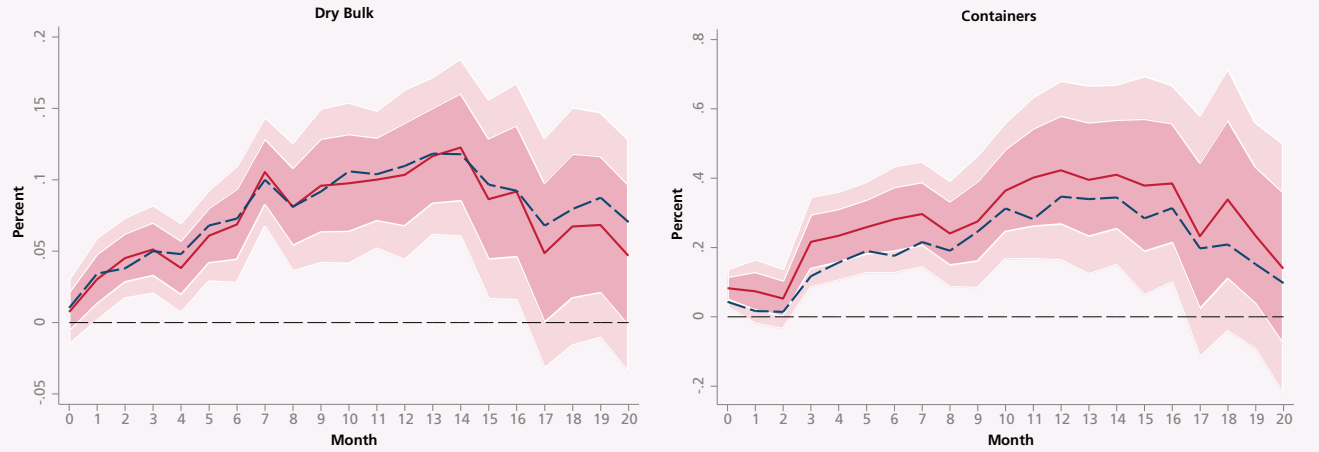
In other words, during the first months following the shocks, the change in the FIB is primarily driven by the price effect. These results are important for several reasons. First, the consequences of a shock for maritime transportation costs may quickly affect importing economies by increasing the value of the FIB and potentially influencing domestic prices and inflation, as demonstrated by Carrière-Swallow et al. (2023). Second, the overall effects of import price shocks on the current account component of the balance of payments may put pressure on the domestic economy, especially in net-food importing developing countries. Third, an increase in the total value of the FIB translates into a loss of foreign currency, which can pose a significant constraint to accessing imports and other intermediate goods for many low- and middle-income countries.

Regarding the substantial difference between the impacts of shocks to container (0.34) versus dry bulk (0.12) costs, two possible explanations were identified. First, the share of containerized agrifood products grew significantly in recent years. While bulk transportation still dominates by volume, the value traded using container shipping is higher (Del Rosal, 2024a, 2024b). Second, there are market-specific factors. Bulk shipments typically serve single point-to-point voyages and usually return almost empty to the origin, while container deliveries are handled by liner shipping companies traveling on predetermined routes that visit several ports (Rojon *et al.*, 2021; Wellesley et al., 2017). If trade imbalances are significant, meaning ships travel fully loaded towards importing countries but return with empty containers, companies charge higher prices to compensate for losses incurred on the return journey (OECD and WTO, 2017). Consequently, the impact to the FIB of the initial shock to container freight rates may be amplified by the round-trip effect due to backhaul problems (Wong, 2022).

Finally, the analysis investigates whether maritime transportation shocks affect countries differently based on their level of food import dependency by isolating the response of net food importing developing countries (NFIDCs). Figure 3 shows an interesting pattern. For dry bulk costs, there are no substantial differences between the NFIDCs' cumulative response (solid red line) and the baseline estimate using the full dataset (dashed blue line). Conversely, a 1 percent shock to container shipping costs increases the NFIDCs' food import bill by 0.43 percent after 12 months, with over half of the total cumulative effect occurring in just three months.

These results can be explained by three factors. First, food and agricultural products in NFIDCs are necessities with a few substitutes (Adam, 2011), making the reactions to import price shocks more inelastic in the short run compared to the full sample of countries. Second, NFIDCs have high trade imbalances and need to compensate backhaul problems with liner shipping companies (Rojon et al., 2021), which exacerbates the effect of the shock on container costs. Third, importing agrifood products by sea is relatively more costly for NFIDCs than for other countries, as the transport costs represent a higher share of the FIB for these countries (OECD, 2022). They also pay more due to geographic and economic remoteness (Korinek and Sourdin, 2010). NFIDCs are physically more distant from major exporters, served by fewer shipping routes, and marginalized by the global shipping network (Rojon et al., 2021; Fugazza and Hoffmann, 2017). Consequently,

Figure 3. The dynamic effects of shipping costs on the FIB of the NFIDCs



Note: The figure shows the cumulative impact of a 1.0 percent increase in shipping costs on the value of the FIB.
Source: Refinitiv Eikon and author's calculations.

NFIDCs are more exposed, in the short run, to disruptions in the maritime transportation system and increases in shipping costs.

Conclusion

Recent restrictions and disruptions to maritime transportation have added pressure on the capacity of international trade to contribute to global food security.

The results of this study have several policy implications. First, as shipping costs positively impact the FIB in the short term, substantial increases like those observed recently may burden countries with current account deficits and those at risk of foreign currency depletion. To mitigate these short-term consequences, tailored policy instruments are needed to limit potential damages to the country's macroeconomic framework. For example, countries should avoid loose monetary policies which may exacerbate the effects of the shocks on the current account while they may provide temporary and well-targeted fiscal support to the most exposed segments of the population. In the longer term, coordinated international actions are necessary to lower trade costs through more efficient and secure shipping routes and networks.

Second, since not all shocks are the same, national authorities must consider the extent of increases to dry bulk and container transportation costs. Countries highly dependent on container shipping for their imports are more vulnerable to cost increases. This vulnerability is even higher for NFIDCs, making it essential for these countries to address transportation shocks. Potential solutions include national and international actions. Nationally, authorities should invest in infrastructure and logistics to develop sustainable systems that better integrate countries into major shipping routes. According to the Organisation for Economic Co-operation and Development (OECD) and the World Trade Organization (WTO) (2017), this solution would not necessarily require large and expensive interventions in all national ports, but rather deeper integration into existing regional hubs, the development of new multimodal transportation corridors, and improved logistics services to reduce time and operational costs. Internationally, coordinated investment and policies would increase collaboration between countries and create efficient regional systems based on hub-and-spoke models.

References

Adam, C. 2011. On the Macroeconomic Management of Food Price Shocks in Low-income Countries. *Journal of African Economies*, 20(suppl_1): i63–i99. Oxford, UK, Oxford University Press. https://doi.org/10.1093/jae/ejr008

Baumeister, C. & Hamilton, J.D. 2019. Structural Interpretation of Vector Autoregressions with Incomplete Identification: Revisiting the Role of Oil Supply and Demand Shocks. American Economic Review, 109(5): 1873–1910. Pittsburgh, USA, The American Economic Association. https://doi.org/10.1257/aer.20151569

Beghin, J.C. & Schweizer, H. 2021. Agricultural Trade Costs. Applied Economic Perspectives and Policy, 43(2): 500–530. Milwaukee, USA, Agricultural & Applied Economics Association. https://doi.org/10.1002/aepp.13124

Carrière-Swallow, Y., Deb, P., Furceri, D., Jiménez, D. & Ostry, J.D. 2023. Shipping costs and inflation. Journal of International Money and Finance, 130: 102771. Amsterdam, Elsevier. https://doi.org/10.1016/j.jimonfin.2022.102771

Del Rosal, I. 2024a. Maritime connectivity and agricultural trade. Journal of Agricultural Economics, 75(1): 153–168. Oxfordshire, UK, Agricultural Economics Society. https://doi.org/10.1111/1477-9552.12548

Del Rosal, I. 2024b. Does containerisation reduce the constraints imposed by distance in seaborne trade? Maritime Policy & Management, 51(1): 35–49. London, Taylor & Francis. https://doi.org/10.1080/03088839.2022.2115572

FAO. 2022. The geography of food and agricultural trade: policy approaches for sustainable development. The state of agricultural commodity markets 2022. Rome, FAO. https://doi.org/10.4060/cc0471en

Fugazza, M. & Hoffmann, J. 2017. Liner shipping connectivity as determinant of trade. Journal of Shipping and Trade, 2(1): 1. Berlin, Springer Nature. https://doi.org/10.1186/s41072-017-0019-5

IMF (International Monetary Fund). 2024. Red Sea Attacks Disrupt Global Trade. In: IMF. Washington, DC. [Cited 5 April 2024]. https://www.imf.org/en/Blogs/Articles/2024/03/07/Red-Sea-Attacks-Disrupt-Global-Trade

Jordà, Ò. 2005. Estimation and Inference of Impulse Responses by Local Projections. American Economic Review, 95(1): 161–182. Pittsburgh, USA, The American Economic Association. https://doi.org/10.1257/0002828053828518

Jordà, Ò. 2023. Local Projections for Applied Economics. Annual Review of Economics, 15: 607–631. San Mateo, USA, Annual Reviews. https://doi.org/10.1146/annurev-economics-082222-065846

Korinek, J. & Sourdin, P. 2010. Clarifying Trade Costs: Maritime Transport and Its Effect on Agricultural Trade. Applied Economic Perspectives and Policy, 32(3): 417–435. Milwaukee, USA, Agricultural & Applied Economics Association. https://doi.org/10.1093/aepp/ppq007

OECD (Organisation for Economic Co-operation and Development). 2022. Maritime Transportation Costs in the Grains and Oilseeds Sector: Trends, Determinants and Network Analysis. OECD Food, Agriculture and Fisheries Papers 179. Paris, OECD Publishing. https://doi.org/10.1787/b1cdf6b7-en

OECD & WTO (World Trade Organization). 2017. Aid for Trade at a Glance 2017: Promoting Trade, Inclusiveness and Connectivity for Sustainable Development. Aid for Trade at a Glance. Paris, OECD Publishing. https://doi.org/10.1787/aid_glance-2017-en

Rojon, I., Lazarou, N.-J., Rehmatulla, N. & Smith, T. 2021. The impacts of carbon pricing on maritime transport costs and their implications for developing economies. Marine Policy, 132: 104653. Amsterdam, Elsevier. https://doi.org/10.1016/j.marpol.2021.104653

Trade Data Monitor (2023). Retrieved from https://tradedatamonitor.com/ on 1st December 2023.

Wassénius, E., Porkka, M., Nyström, M. & Søgaard Jørgensen, P. 2023. A global analysis of potential self-sufficiency and diversity displays diverse supply risks. Global Food Security, 37: 100673. Amsterdam, Elsevier. https://doi.org/10.1016/j.gfs.2023.100673

Wellesley, L., Preston, F., Lehne, J. & Bailey, R. 2017. Chokepoints in global food trade: Assessing the risk. Research in Transportation Business & Management, 25: 15–28. Amsterdam, Elsevier. https://doi.org/10.1016/j.rtbm.2017.07.007

UNCTAD (United Nations Conference on Trade and Development). 2024. Navigating Troubled Waters: Impact to Global Trade of Disruption of Shipping Routes in the Red Sea, Black Sea and Panama Canal: UNCTAD Rapid Assessment. UNCTAD Policy Briefs. Geneva, Switzerland, UNCTAD. https://doi.org/10.18356/27082822-114A

Wong, W.F. 2022. The Round Trip Effect: Endogenous Transport Costs and International Trade. American Economic Journal: Applied Economics, 14(4): 127–166. Pittsburgh, USA, The American Economic Association. https://doi.org/10.1257/app.20190721

WTO. 2024. Net-food importing developing countries. In: WTO. Geneva, Switzerland. [Cited 29 May 2024]. https://www.wto.org/english/tratop_e/agric_e/ag_intro06_netfood_e.htm