

Agricultural
Marketing
Service

May 2023



Determinants of Refrigerated Container Provisioning for Agricultural Exports (Summary)

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This is a summary of “Determinants of Refrigerated Container Provisioning for Agricultural Exports” by Cyrus Ramezani and Chris Carr.¹ This research and analysis received funding from USDA’s Agricultural Marketing Service (AMS) through cooperative agreement number 20-TMTSD-CA-0008. The opinions and conclusions expressed are the authors’ and do not necessarily reflect the views of USDA or the Agricultural Marketing Service. The full report is available online at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4016088.

WHAT IS THE ISSUE?

Over the past several decades, the share of agricultural exports classed as “bulk” shipments has declined, while the share classed as “high-value products” has increased. Comprising such items as meat, other proteins, fresh fruits, and vegetables—high-value products are typically exported in specialized refrigerated containers (commonly referred to as “reefers”). Most U.S. trade in high-value products occurs through the Nation’s West Coast Ports (WCPs). From WCPs, reefers are shipped on container vessels to countries in the Asia-Pacific region, mirroring an overall growth in trade between the two regions. This demand for reefers is expected to continue to grow, despite periodic commodity price spikes and other disruptions that contribute to market volatility.

Although demand for reefer containers continues to rise, high variability in the demand for reefers complicates logistics. Refrigerated trade is affected by a number of factors, including global economic growth, currency fluctuations, consumer preferences, trade pacts, treaties and tariffs, short- and long-term macroeconomic trends, and seasonal import/export patterns. Fluctuations in reefer volumes, in turn, trigger variable demand for equipment used to transport containers at ports, by rail and trucks. Thus, reefer movements at WCPs must be better understood if ports are to mitigate shortages of reefer containers and related equipment, such as generator-sets and truck chassis.

The researchers’ main objective was to characterize the dynamic pattern of reefer transit through the major WCPs of Oakland, Los Angeles, Long Beach, and Tacoma and the implications for refrigerated agricultural exports.

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HOW WAS THE STUDY CONDUCTED?

The analysis was based on the Port Import Export Reporting Service (PIERS), which is a database containing several million bills of lading per year. Spanning 2010-20, the dataset contains information about the volume of bulk and containerized (dry and reefer) U.S. agricultural imports and exports by U.S. port of entry or exit. The authors use these data to create descriptive statistics on the seasonal trends for each WCP analyzed. Their analysis includes “candlestick graphs” that show the range of monthly variations in reefer movements. In addition to descriptive statistics, the authors use the PIERS data to develop a dynamic econometric model to identify the drivers of reefer exports from each port. In the model, volume (measured in 20-foot equivalent units (TEUs) and pounds) is a function of the month, lagged explanatory variables, and the lagged dependent variable (i.e., volumes from previous periods). Explanatory variables include monthly empty container exports (as a fraction of total container exports); average effective price of the agricultural products; U.S. dollar exchange rate (index); political uncertainty in China (index); U.S./China trade war measure (index); and an infectious disease measure (index). The use of lagged variables is consistent with time lags involved in getting agricultural exports to international markets. For example, the lagged variables help account for the timetables of various export arrangements, as well as time required to move commodities from their origin to their destination.

WHAT DID THE STUDY FIND?

Commodity-Export Trends by West Coast Port

Port of Oakland. Among the WCPs, the Port of Oakland had the largest share of reefer exports from 2010 to 2020. Of all the WCPs, Oakland was also the most balanced in terms of import-export and empty-loaded container volume. From 2010 to 2020, roughly 40 percent of outbound containers through the Port of Oakland carried agricultural exports. In fact, the largest volume of exports through this port was protein products, which grew significantly over the study period. Breaking down “protein products” more specifically—exports of meat, cheese, and dairy products rose, while poultry declined significantly. In terms of seasonality, the researchers found protein exports peaked from October through December.

Exports of all fruit products declined over the study period. Seasonally, fruit exports peaked in March and November. As expected, the protein category showed smaller seasonal variation than fruit.

Port of Los Angeles. From 2010 to 2020, roughly 30 percent of outbound containers through the Port of Los Angeles carried agricultural exports. After initially growing in the early part of 2010-20, total exports of protein products declined significantly. Breaking down protein products—exports of cheese, dairy products, and meat rose, while poultry declined significantly. Seasonally, protein exports from the Port of Los Angeles (as from the Port of Oakland) peaked from October through December.

As from the Port of Oakland, exports of all fruit products declined over the study period. Seasonally, fruit exports peaked in March and November. As expected, protein exports varied less from season to season than fruit exports did.

Port of Long Beach. From 2010 to 2020, roughly 25 percent of outbound containers through the Port of Long Beach carried agricultural exports. The total export of protein products grew significantly. Breaking down protein products—exports of cheese, dairy products, and meat rose over the study period, while again, poultry declined significantly. Seasonally, protein exports were similar across the months, with no discernible seasonal pattern. However, variation among the days within a given month was the highest in May.

As from the Ports of Oakland and Los Angeles, exports of all fruit products from the Port of Long Beach declined over the study period. Seasonally, fruit exports peaked in March and November. Unlike from the Ports of Oakland and Los Angeles, protein exports from the Port of Long Beach resembled fruit exports in their monthly variation.

Port of Tacoma. Exports of protein products from the Port of Tacoma rose significantly from 2010 to 2014, and then declined for the rest of the study period. From 2010 to 2020, the monthly exports of protein products from the Port of Tacoma (similar to the other WCPs) remained stable over the year, with no strong seasonal pattern. Breaking down protein products—exports of cheese, dairy products, and frozen fish rose, while meat and poultry declined significantly.

From the Port of Tacoma (unlike from the other WCPs), the export of all fruit products grew fourfold over the study period. Fruit exports peaked in November and December and were at their lowest in June.

Interrelated Factors on Reefer Exports for WCPs: Modeled Effects

Using their own dynamic econometric model, the authors explored the effects of multiple variables on vegetable and fruit exports, meat and protein exports, and all reefer commodity exports.² They found the following:

- During February, March, and August, similar seasonal rises in vegetable and fruit exports occur at the Ports of Oakland, Los Angeles, and Tacoma. This seasonal effect is most pronounced at Oakland because the largest share of the vegetable and fruit exports are shipped from this port.³
- From September to December, similar seasonal rises in meat and protein exports occur at the Ports of Oakland, Los Angeles, and Tacoma. This seasonal effect is most pronounced at the Port of Los Angeles because it has the largest share of meat and protein exports.
- For all categories at the Port of Long Beach and for meat and protein at the Port of Oakland, a rise in the share of empty containers was associated with a drop in refrigerated exports. This crowding effect was more pronounced among meat and protein exports than vegetable and fruit exports. This discrepancy is likely because meat and protein products are frozen and can be delayed. In contrast, vegetable and fruit products are chilled and must be shipped fresh.
- For all categories at the Port of Long Beach and for vegetable and fruit at the Port of Tacoma, higher effective prices led to more exports.⁴
- At the Ports of Los Angeles and Long Beach, a rise in exchange rate led to fewer refrigerated exports in one or more categories. However, at the Ports of Oakland and Tacoma, a rise in exchange rate had no significant effect.
- At the Port of Los Angeles (but no other ports), a rise in trade frictions between China and the United States lowered exports of refrigerated goods of all categories. The trade war's lack of impact at most ports may have resulted from the authors' inclusion of an index of China's economic and political uncertainty that had already captured the effect of trade frictions.
- At the Port of Los Angeles (but no other ports), a rise in the infectious disease index (measuring COVID-19 cases) led to a small reduction in vegetable and fruit exports.

RECOMMENDATIONS

Having synthesized the report's findings, the authors recommend several measures to boost agricultural exports from WCPs. Shippers should:

- Consider shifting the timing of reefer exports to periods when volume spikes are less pronounced;
- Seek to avoid exporting during September to December when the volume of empty containers returning to the Asia-Pacific region is highest; and
- Consider exporting from a different port (e.g., shift volume from the Port of Los Angeles to the Port of Long Beach), provided shipping costs justify the switch.⁵

² Harmonized System (HS) codes are a common way to classify traded products. The authors define the "meat and protein" category as the sum of HS-Codes 2 (meat and edible meat offal); 3 (fish and crustaceans); 4 (dairy produce); and 16 (preparations of meat and fish). The "vegetable and fruit" category is the sum of HS codes 7 (edible vegetables); 8 (edible fruit and nuts); and 20 (preparations of vegetables and fruit).

³ Here and in the following bullet points, a single port's share is of a given exported-commodity total for all the WCPs.

⁴ Effective prices are the total dollar value of an exported commodity divided by weight in pounds.

⁵ The authors note that shifting the timing and location of shipments may not be practical, given harvest constraints and contractual agreements.

PREFERRED CITATION

Williams, Maria and Austin Hunt. May 2023. *Determinants of Refrigerated Container Provisioning for Agricultural Exports (Summary)*. U.S. Department of Agriculture, Agricultural Marketing Service. Web.
<<http://dx.doi.org/10.9752/TS370.05-2023>>

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