## **Economic and Geopolitical Changes Impacting Logistics of the Global Supply Chain for Bulk Grains**

Feb 23 2023
To the
USDA Agricultural Outlook Forum
Washington DC

#### **Topical Breakout:**

Supply Chain Challenges and Solutions Transportation & Global Supply Chain Disruptions



By Dr. William W. Wilson CHS Chair in Risk Management and Trading University Distinguished Professor William.Wilson@ndsu.edu

Dept of Agribusiness & Applied Economics North Dakota State University Fargo, USA



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- •William W. Wilson, Prithviraj Lakkakula and David W. Bullock, 2021. LOGISTICAL COMPETITION FOR CORN SHIPMENTS FROM THE UNITED STATES AND UKRAINE TO TARGETED INTERNATIONAL MARKETS, Agribusiness and Applied Economics Report No. 811 October 202
- Dynamic Changes in Rail Shipping Mechanisms for Grain, USDA -AMS, available at
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- •Wilson, W. and Lakkakula, P. 2021. Secondary Rail Car Values in Grain Transportation and Basis Values, *Agribusiness*, AGR-19-0103 Volume37, Issue3 https://doi.org/10.1002/agr.21677 Summer 2021
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- •Lakkakula, P., William Wilson "Origin and Destination Basis Interdependencies with Shipping Costs in Soybeans: A Panel Data Analysis" (2021) *Journal of Agricultural and Resource Economics*. 46(1):69–84 ISSN: 1068-5502 (Print); 2327-8285 (Online)
- •Johansen, S., W. Wilson and B. Dahl. 2015. VALUING SWITCHING OPTIONS IN INTERNATIONAL GRAIN MARKETING, Agribusiness and Applied Economics Report No. 737, March 2015 http://purl.umn.edu/201309

### **Overview**

- Transportation & Global Supply Chain Disruptions
  Geopolitics, China's reopening economy, climate change, as well as shortages of labor, commodities, and energy, continue to inject strain and uncertainty that challenge supply chains. This session will focus on factors behind the volatility in shipping rates, delivery times, changes in commodity flows, storage and stockholding, buyer-seller relations, and implications for agricultural markets.

  Moderator: Adam Sparger, Director, Transportation Services Division, Transportation & Marketing Program, AMS, USDA, Washington, DC (5 minutes)-1:30-1:35 PM
- Economic and Geopolitical Changes Impacting Logistics of the Global Supply Chain for Bulk Grains

Major supply chain changes that affect the global bulk grain trade, including increases in rail and barge shipping costs, shifting commodity flows and risk and geopolitical developments.

**Speaker:** William W Wilson, North Dakota State University, University Distinguished Professor of Agricultural Economics, CHS Endowed Chair in Risk and Trading, Fargo, ND

#### **Major Changes Impacting Ag**

- Soybeans, oilseeds and Refined diesel and Sustainable Aviation Fuel (RD and SAF)
- AgTechnologies
- Russia
- China
- Climate change! And Water Shortages
- Changing commodity flows
- Escalating and volatile grain shipping costs (rail, barge, ocean) in US and ROW

#### **Heading into Feb 24 2022**

- 2021 drought in northern plains US
- Emergence of Renewable Diesel and Sustainable Aviation Fuels
- Pressure on sustainability and climate initiatives
- Oil prices increasing (from negative values) to \$66/b to \$140
- China restrictions on fertilizer and other ag chemicals
- Post-covid economic expansion
- <u>Labor shortages</u> constraining rail, trucks, and other logistical functions
- HRW drought in 2022
- Supply chain problems
- Feb 24 2022: Russian Invasion of Ukraine "Special Military Operation"

### Confluence of Numerous Bullish Factors Impacting Commodity Markets

#### Manifested with much attention to

- Import (container) logistics
- Congestion
  - Increased transit and dwell times
- Increased demand (post-covid)
- Labor shortages
- Food plant closures due to shortages
  - Labor
  - Ingredients
  - Etc.
- Near-shoring, etc.
- Inflation ...
- Exacerbated by JIT
  - min stocks or min stockholding throughout the supply chain)

#### **Important in Ag Inputs/Outputs**

- Labor shortages
- Congestion
- Reduced rail performance
- Increased fuel costs
  - Increased ocean rates
  - Increase rail FSC
- Increased fertilizer and other input costs

### **Emergence of Supply Chain Disruptions**

#### **Evolution**

- Adoption of PSR
  - Reduced dwell time
  - Increased speed
  - Increased op. margin
  - Reduced labor
- China trade war
  - RR's reduced labor
- Post-2020 (not strictly Post-Covid)
  - Labor shortage: Difficulty in hiring, and training
  - Increased (unexpected) demand
  - Rail congestion (Chgo, LA)
    - Increased dwell time
    - Reduced train speed
  - Increased oil prices

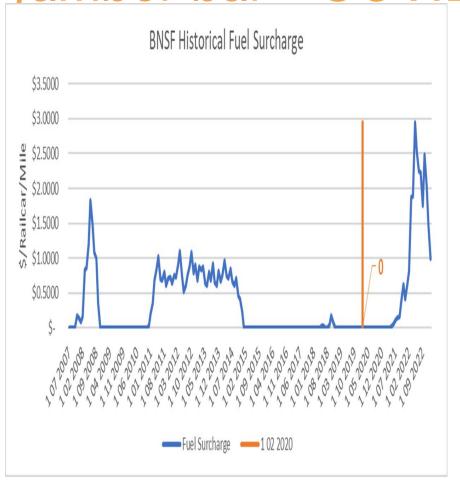
#### **Impacts**

- Rail performance deteriorated briefly!
  - Train speed
  - Dwell time
  - Cars late
  - Velocity
  - 2<sup>nd</sup> car values
- Rail embargoes on facilities
  - Foster Farms..."Your failure to deliver is about to kill millions of chickens"
  - STB intervenes

### **Bulk Grains: Rail Supply Chain Problems**

## Fuel Service Charge—biggest risk (initially) on supply chain!

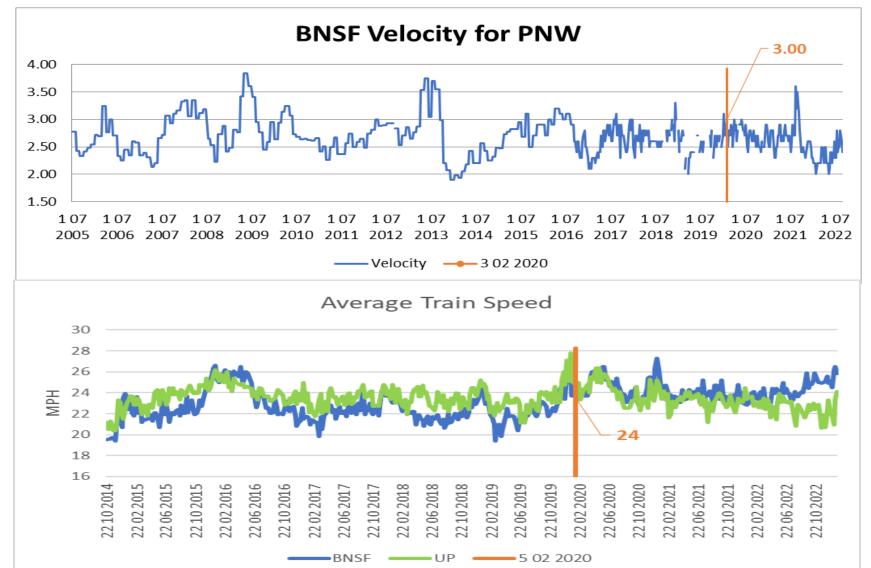
[amber bar---COVID]



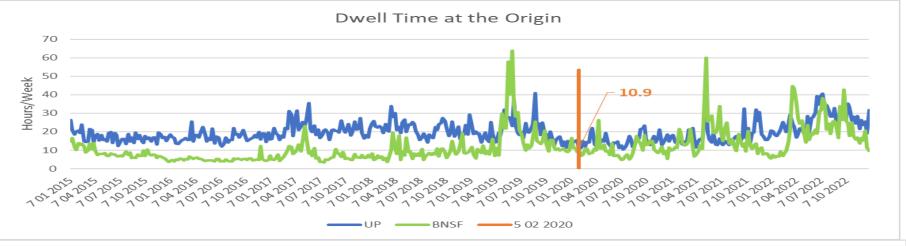
Adjusted monthly e.g.,

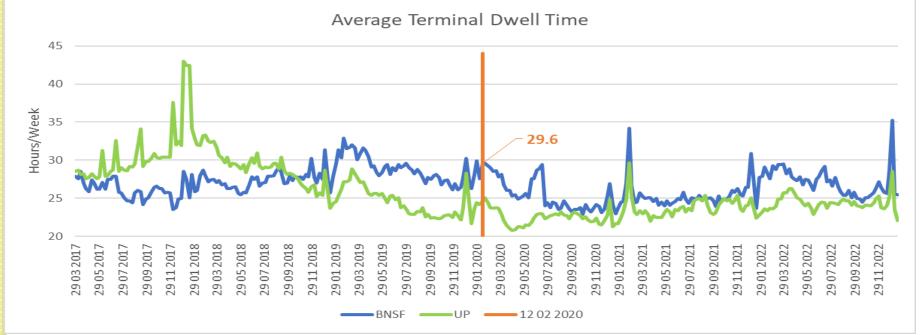
Distance	1405
Cost/car mile	0.68
Surcharge per car \$/car	955
Surcharge per bu \$/bu	0.25
Surcharge\$ per MT	9.36

## Rail Performance: Velocity and Train Speed



## **Dwell Time: Origin and Terminal**





#### **PNW Supply Chain**

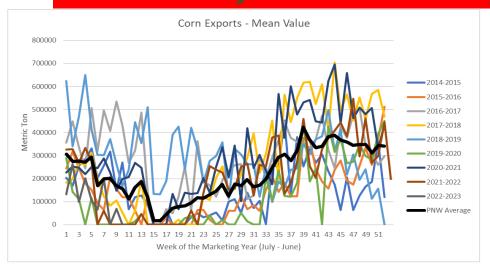
- Important US supply chain
- Logistics: Get the right product, to the right customer, at the lowest possible cost!
- Export demand--random:
  - Wheat, corn, soybean and now soybean meal
  - Growing, volatile and seasonal
- Supply chain Functions Include
  - Inbound rail
  - Unload capacity
  - Storage capacity
  - Ship loading capacity
- POINT: accommodated supply ch disruptions rather well, though some abberations

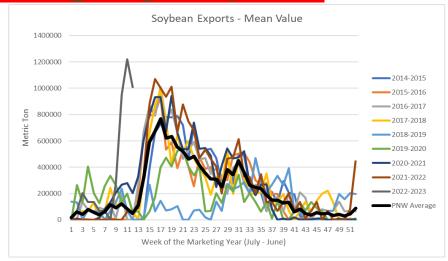
#### **Analysis**

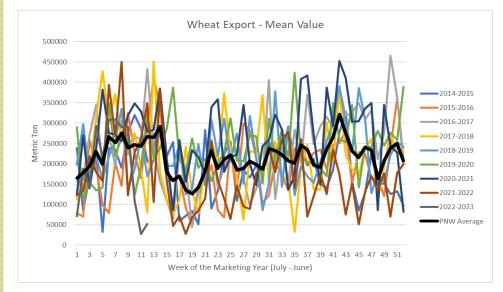
- Stochastic cost minimization
- Costs include:
  - Rail: Primary, secondary, fsc and tariff
  - Demurrage: Rail unload, vessel loading
  - Other
- Risks (uncertainty) due to:
  - Export demand
  - Secondary rail market values
  - Velocity
  - Rail transit time
  - Ship arrival
  - FSC—biggest initial risk!
  - other
- Determine Optimal Rail Car (Primary shuttle trains) to Order
  - Strategies: primary, supplement w/2<sup>nd</sup> (Sale of surplus trains, or buying of short trains)
    - i.e., order in anticipation of ship(s) arrival

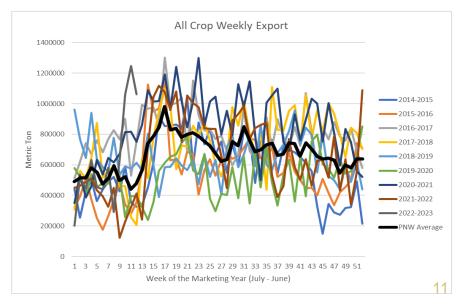
## **Export Shipments/demand:**

## Volatile, seasonal, highly 'spot'







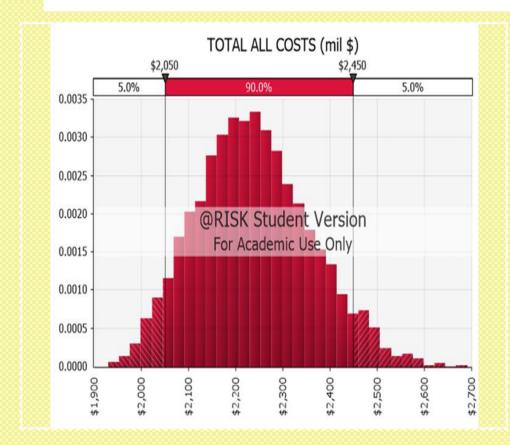


### Result

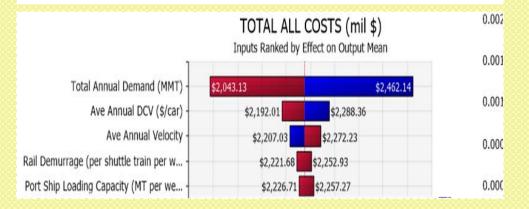
#### Decision:

- Determine number of primary shuttle trains to buy, in anticipation of exports to meet 'ship arrival'
- Surplus can be sold to secondary market
- Risks:
  - Transit time
  - Shipping costs: primary, secondary, fsc, and demurrage (rail and vessel)
  - Ship arrival (by week)
- Optimal Strategy: Buy more primary trains than expected demand!
  - Treating excess orders as surrogate for buffer stock due to potential for unexpected increases in demand

#### **Distribution of Total Costs**



## Importance of Risky Variables Impacts on Costs



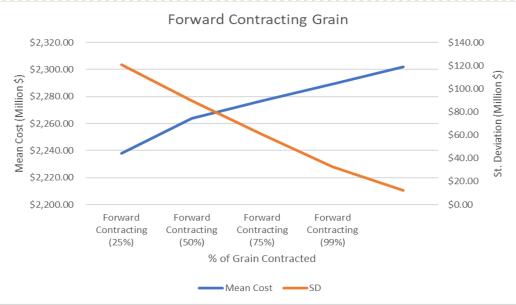
#### **Summary**:

- Optimal car order up to 140% of expected demand (over-purchase, and sell residual)
- Costs are volatile
- Very little demurrage or 'ships-held'
- Most important variables are:
  - Export Demand
  - 2<sup>nd</sup> car value
  - RR velocity
  - Demurrage (rail)

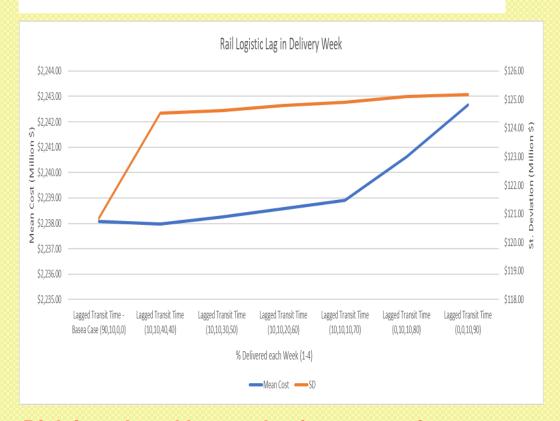
### **Base Case: Results**

#### Forward Contracting and Rail Strategy





#### Rail Transit Time



Risk is reduced by purchasing more primary shuttle trains

Risk is reduced with greater share of exports sold forward

Risk is increased with increased/volatile rail transit time

## Summary: Performance of the PNW Supply Chain

- Multiple complicated mechanisms exist and used to efficiently manage supply chain risks and costs
  - Primary and secondary car values, demurrage (rail, ship), forward contracting for grain, etc.
  - Compounded by risks related to
    - Export demand weekly: seasonal, volatile
    - Transit time
    - Ship Arrivals (timing)
- Biggest Risks Impacting Performance:
  - Export Demand which is volatile, Seasonal and has become more risky (due in part to geopolitics)
- Key sensitivities:
  - Buy more primary shuttles than expected (real option)
  - Reduce risk
    - More forward contracts (now (today) ---shortening forward coverage!)
    - More primary shuttles

## **Increased Geopolitical:**

#### Impacts on Trade and Logistics Volatility

#### World Trade Impacted BY

- Expanded production/exports
   outside of US: Wheat, soybean,
   corn
- Increased dominance of China: exerting market power or procurement and diversification

#### Interventions in trade

- Distorts the US competitive adv
- Encourages competitive rivals
- Discourages further investment in US ag logistics

### More geo-political interventions now than ever before:

- Ukraine
- Russia:
  - United Grain, VTB etc.
  - export growth, taxes, quota, friendly/unfriendly countries, etc.
- China:
  - Brazil resolution on phyto
  - Targeting of import origins, COFCO
- Grain Corridor
- US: RD, RFS, BioFuels, Climate, etc.
- EU: Farm to Fork
- Increased optional origin, and/or switching in transactions

## **Ukraine** *Invasion and Geopolitical Disruption of Grain Trade Flows: Corn*

#### **Crop Estimates**

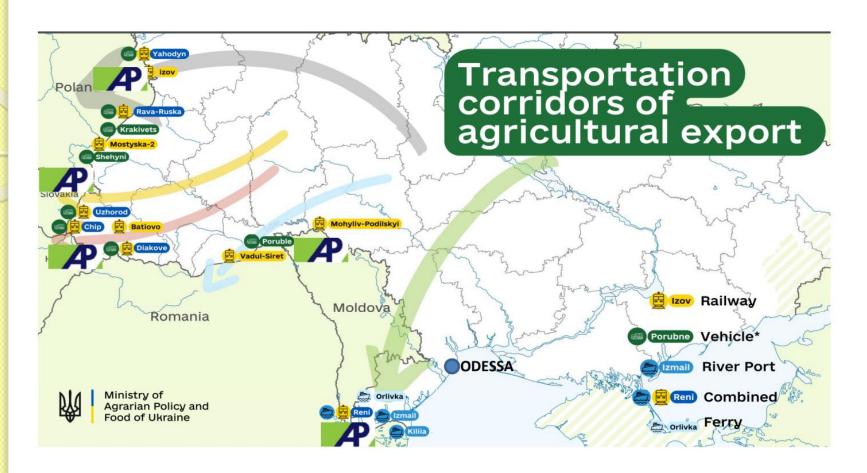
- 2021 Crop: 100 mmt
  - Corn exports: 23.5
- 2022 Grain crop: <60 mmt</li>
  - (Ukrainian Agrarian Council August 19).
  - Min of Ag at 68 mmt
  - Corn Exports: 15 mmt
- 2023:
  - reduced plantings by 30-50%
    - (up to 70%)
  - Current exports:
    - All grains: 15-20 mmt
    - Corn 10-15 mmt

Logistics: A. Dykun (Ukr ag council)

- importance of full-scale restoring of sea export of Ukrainian grain.
- "Unblocking exports by sea will significantly strengthen the stability of the economy and alleviate the acuteness of the food crisis.
- But only under the condition of stable export of <u>6 mln tonnes of grain per</u> month at least until March.
- Otherwise, farmers will not plant in spring", – A. Dykun summarized. (APK)

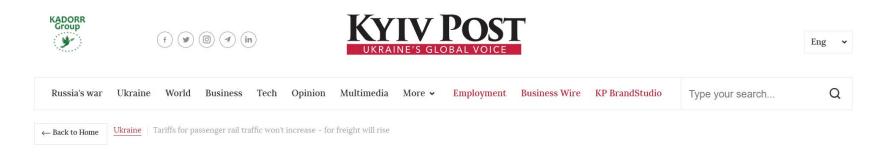
#### 2022 and 2023 Corn Crop: Most recent est.





- Traditionally Rail to Odessa, Nikolaev etc.
- Shift away from Odessa
- Rail/truck/rail to/through Romania, Poland, Moldova

## Rail Rate Increases for 2022 Crop! +70%



#### Tariffs for passenger rail traffic won't increase – for freight will rise

By Interfax-Ukraine. Published June 30 at 10:37 am







### Solidarity Lanes:

## **May** 16



Brussels, 12.5.2022 COM(2022) 217 final

COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS

An action plan for EU-Ukraine Solidarity Lanes to facilitate Ukraine's agricultural export and bilateral trade with the EU

**European Commission - Press release** 





Commission to establish Solidarity Lanes to help Ukraine export agricultural goods

Brussels, 12 May 2022

WORL

Ukraine Is Struggling to Export Its Grain, and Here's Why

After Russia's blockade of Black Sea routes, Ukraine looks for alternative shipping options to help stave off global food shortages

## Ukraine Grain Shippers Carve Out Alternative Export Routes via Baltic Sea

By Alonso Soto and Megan Durisin | June 17, 2022

THE INDICATOR FROM PLANET MONEY

How to get 20 million tons of grain out of Ukraine

June 1, 2022 · 6:33 PM ET



HMS Defender and HNLMS Evertsen passing the Bosphorus (Photo courtesy of Yoruk Isik, https://twitter.com/YorukIsik)

Ukrainian Grain: How To Lift Russia's Black Sea Blockade?

Poland has become a route for Ukrainian grain exports

EU steps up effort to bring millions of tonnes of grain out of Ukraine

Russian blockade of ports forces search for alternative routes to supply countries relying on cereals from wartorn country

Turkey, U.N. Eye Sea Lane for Grain Through Ukraine's Mines
Proposal would provide freighters a safe passage through the defensive mines in Black Sea ports

M.europe EUROPE DECODED

Watch: These are the four options to get 20 million tonnes of grain out of Ukraine COMMENTS

By Jorge Liboreiro • Updated: 07/06/2022

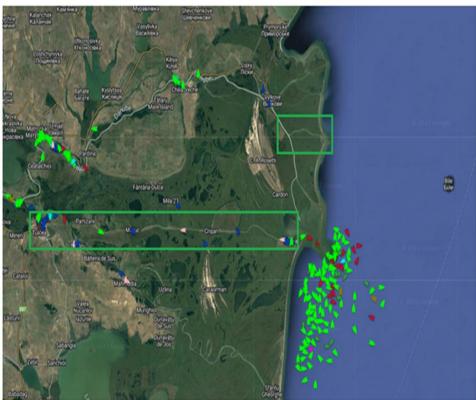
Ukraine grain exports via Poland and Romania face bottlenecks, says deputy foreign minister

UBLISHED SUN, JUN 12 2022-7:47 AM EDT

C PELITERS

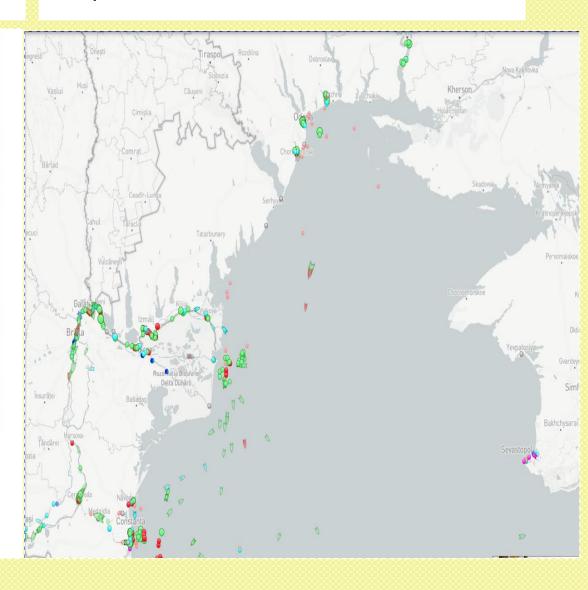


#### July 10, Sulina Canal



Dozens of coastal freighters wait at the entrance to the Sulina Canal, highlighted center left. The Bystry Canal entrance to the Danube is to the north near Vylkove, top center. Snake Island (Bile) sits just off the coast, center right. Illustration courtesy <u>Pole Star</u>.

#### Ships: Feb 21 2023



#### Backlog of ships strains Ukraine-Russia Black Sea grain export deal

- Longer inspection times at Istanbul monitoring centre prompt calls for bigger teams to handle increased demand
- The number of vessels waiting to sail to or from Ukrainian ports reached a record high of 120
- Delays have prompted calls for more inspectors to be added to meet demand from the large number of craft using the route.
- Ukraine is eager to export as much grain as possible to create space in its silos for newly harvested crops. It has grown increasingly anxious about the backlog, according to two officials familiar with the workings of the deal.
- Russia had been reluctant to send additional

Inspections slowed: 10-15 days = \$500,000

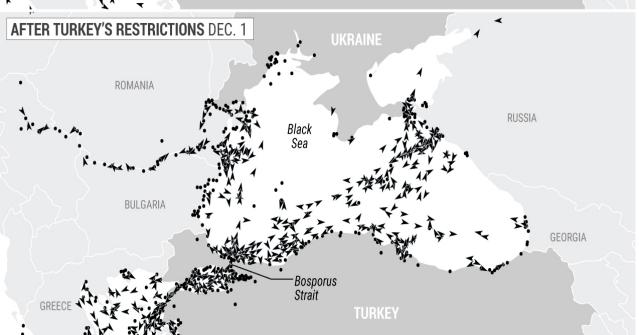


## Delayed Exports Due to Inspections (probably premeditated)

#### Traffic in the Bosporus Strait

Source: Marine Traffic





#### **Inspections Creates Congestion**

- Congestion caused by cumulative effects of
  - Increased grain flows
  - Stalled inspections
  - Dec 5 oil agreement (\$60 oil)
  - Among others

- See Maritime Trade Problems in the Black Sea and Beyond Regional countries are struggling to adapt to new realities.
- By: Antonia Colibasanu
  - Dec 8 2022

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## **Grain Corridor Agreement: Challenges**

- Agreement is in place
- Inspections are lagging (perhaps due to Russian influence)
- Risks of originating at Black Sea
  - Normal wait time risk
  - Risk of further bombing, stalling ships transits
  - Wait times for transit and inspections
- Black Sea origins are taking a sharp discount due to
  - Risks defined above
  - Increased ocean shipping costs and risk premiums
  - Ship owners prefer placing smaller/older vessels to Odessa
  - Alternative routes (Constanza, Western-rail) are becoming more competitive w/the escalating costs ex-Odessa

### **Grain Corridor: Bottom Line**

- Due to closing Black Sea ports
  - Ukraine normally exports 5-7 mmt/month
  - Alternative capacity is max 1.5 mmt/m
  - Agreement expands capacity by 3 mmt/m
- Two agreements:
  - 1 w/Ukr
  - 1 w/Russia
  - Shipments from 3 ports in Ukraine, and Russia (food/ag exempt from sanctions)
    - Ukr cap at these ports about 3 mmt/m
- Facilitated 9mmt+ exports

- Agreement through Nov 19 (120 days)
  - Extended for 120 days
  - Russia insisted UN resolve other trade frictions (ship war insurance; western banks, etc.) inhibiting their exports
- Today's Challenge: unraveling financial/banks and vertical Russian suppliers that are on sanctions
- Agreement expires Mar 2023, current being re-negotiated

#### **Evolution 1**

- Commencing with the war, Black Sea Shipping became much more complicated
- Insurance on vessels, and subsequently grain, were escalated
- Ship owners were reluctant to take vessels into Odessa
- Demurrage risk was/is huge:
  - Ships in port accrued demurrage
  - Due to 'war' force majeure was allowed and shippers did not have to pay demurrage

#### Evolution 2

- After Nov 12 (Putin's' temp. withdrawal)
  - No cap on demurrage: 100 days=\$6million
  - Force majeure eliminated
- Grain corridor Insurance (required):
  - 1.4% for value of grain
  - 1.2% for value of ship/mechanical
  - 2023: some insurance cancelled
  - Demurrage applied
    - \$60k/d (8 days free), for a panamax;
    - Subject to max [\$4.5 million] negotiated
  - Shippers
    - Using smaller ships
    - Using older ships
- Trades went from:
  - 80/20 FOB and CIF
  - 100% CIF (originator had to bear cost/risk of ships!)

## Current Developments on Port Snags: Insurance and Demurrage

## Pre-War: Min Cost Market shares by origin port area and destination

Destination	U.S. Gulf	U.S. PNW	U.S. Total	Ukraine	Brazil	Argentina
China	66	23	89	10	0.6	0.6
<b>Japan</b>	11	43	54	23	18	5
Indonesia	13	8	21	43	7	29
The EU	4	0	4	77	18	2
South Korea	35	13	48	4	25	23
Vietnam	2	0	2	0	48	50
North Africa	3	0	3	20	16	60
Middle East	2	0	2	13	80	4
ROW	41	8	49	8	26	16

#### **Features**

- Conditions
  - War
  - Grain Corridor
  - Reduced exp supply
  - Increased China demand
  - Bzl phyto approved for China
- Very tight stocks!
- Monthly
  - Demands
  - Supplies

#### **Specification**

- Logistics ex Ukraine
  - 3 routes (Odessa, Constanza, Poland)
  - Increased costs
  - Added grain corridor cost
  - Increased ocean shipping ex Black sea
- Stochastic optimization cost min.
- Cost:
  - Origin basis
  - Interior shipping costs
  - Ocean shipping
- Supply-capacity constraint by route/port: Monthly

## Corn Trade: Post War and Under Grain Corridor

UKRAINE EXPORT LOGISTICS: Key Parameters				
			Pre-War	War
Export Supply		mmt/yr	23 to 24	10 to 15
Interior Basis		\$/mt	+39 to 50	-115
Logostics Costs				
Routes			Odessa	Odessa, Constanza,
			region	Poland
Export Costs F	arm to FOB	\$/mt	31	70 to 130
Grain Corridor	Costs		0	27
Ocean Rates		\$/mt e.g., to Egypt	19	25 to 80 (Odessa)
Capacity		mt/m	7	1.5-3
China Imports (ı	mean)	mmt	3	18
Trade Policies				
Brazil phyto to	China		Yes	No
EU on GM			Yes	?
other				

### **Export Logistics**

- Radical increase in costs, transit time and transit time risk and congestion (2months and 2-3 weeks wait time)
  - Transit time risk

#### Comments

- Rail increase +70%
- Elevations increase: 8 to 30
- Barge to Constanza has increased radically; but likely declines
- Capacity is critical: Need all routes!
- Export logistics costs will go from the lowest in the world (at 31) to among the highest in the world!
- Price to grower: < cost of production post-war</li>

#### Comment:

- Average waiting time now between 30 and 45 days.
- Pay higher penalties to the vessel owner. average penalty is \$27/ton of crop.

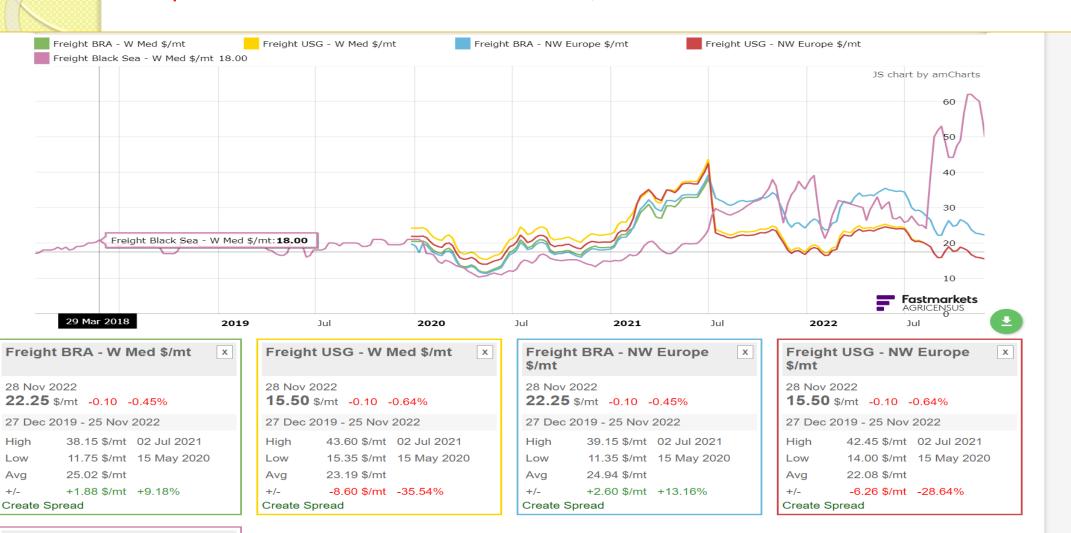
## Ocean rates (Nov 28):

To W Med, NW Eur

Freight Black Sea - W Med

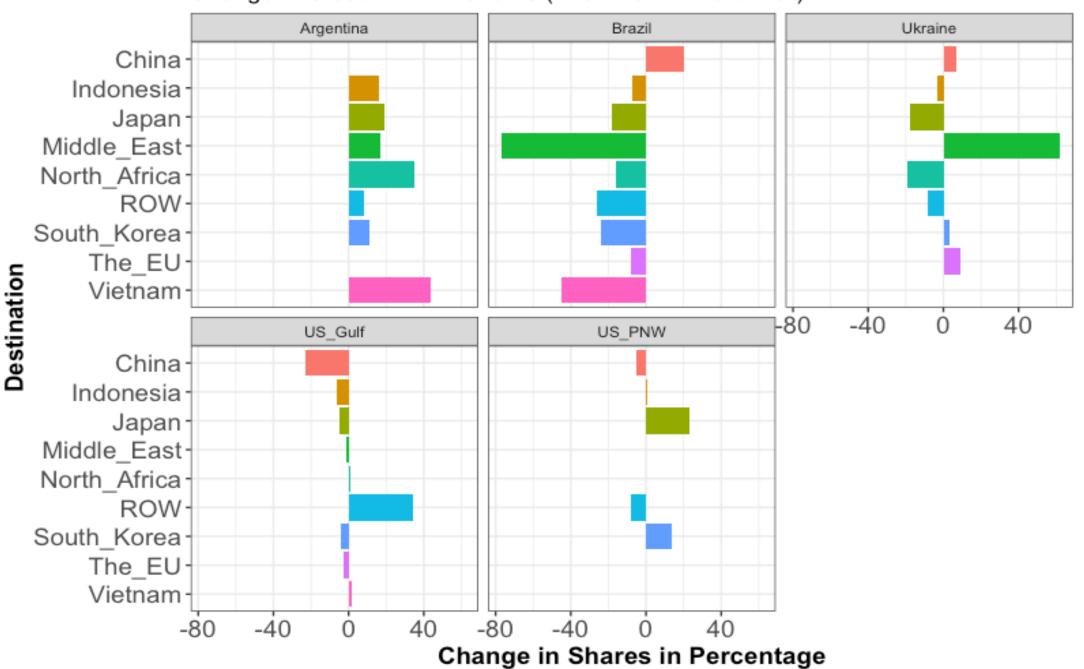
\$/mt

Spread: USGulf Under Black Sea Feb 25 2022 - 12\$/mt; Nov 28 - 34.50\$/mt

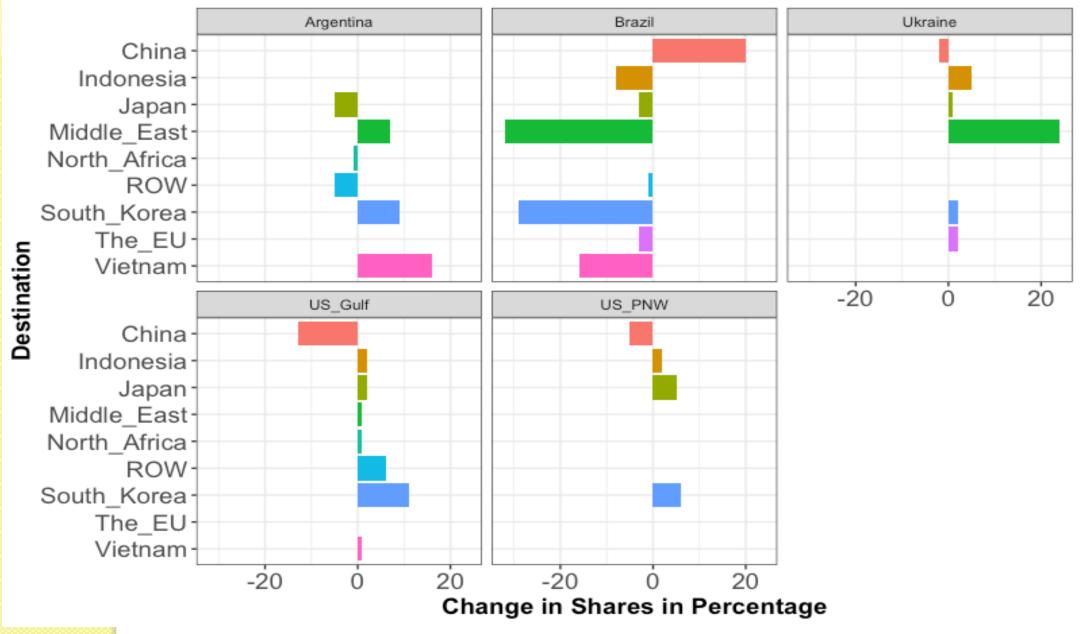


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Change in Global Market Shares (After War - Before War)



Impact of Chinese Removal of Phytorestrictions on Brazil (Without Phyto - Phyto)



## Impacts of GeoPolitical on Logistical Infrastructural Risk!

- Change Brazil Phyto to facilitate China imports:
  - Impacts of Panama Canal (lost ship transits)
  - 280-285 ships/year

#### With Corridor Cost (\$27/mt)

Destination

China

Japan

Indonesia

The EU

Odessa	Constanza	Rail - W Border
16.0%	0.1%	0.0%
5.2%	0.0%	0.0%
42.6%	0.0%	0.0%

72.0%

#### Without Corridor Cost (\$27/mt)

Destination	Odessa	Constanza	Rail - W Border
China	16.6%	0.0%	0.0%
Japan	5.3%	0.0%	0.0%
Indonesia	43.2%	0.0%	0.0%
The EU	<mark>84.7%</mark>	<mark>0.0%</mark>	0.0%
South Korea	7.9%	0.0%	0.0%
Vietnam	0.1%	0.0%	0.0%
North Africa	0.3%	0.0%	0.0%
Middle East	77.5%	0.0%	0.0%
ROW	0.0%	0.0%	0.0%

South Korea 7.7% 0.0% 0.0% Vietnam 0.1% 0.0% 0.0% North Africa 0.1% 0.7% 0.0% 77.5% 0.0% 0.0% Middle East ROW 0.0% 0.0% 0.0%

14.9%

# Ukr Exports With and Without Grain Corridor costs \$27 [Grain Corridor Targets Africa/Middle East]

0.0%

## **Implications**

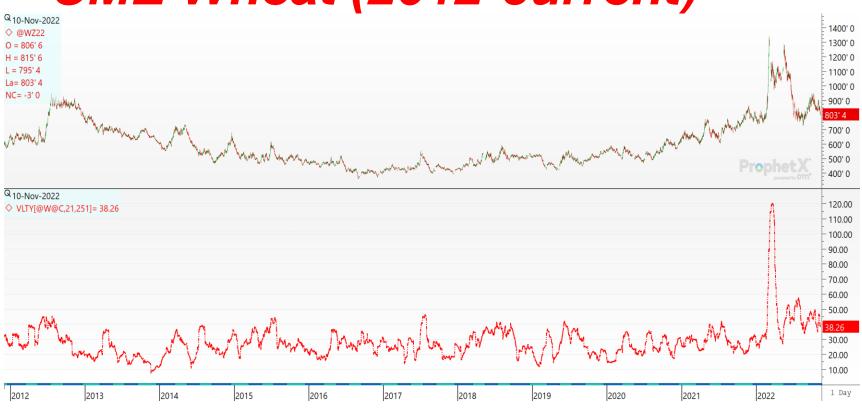
#### • More risk:

- Futures
- Basis
- Oil
- Logistics cost and execution
- Inverted markets (persistent for 3-4 yrs)
  - New-crop old-crop spreads are inverted for each of corn, soybean and wheat to a lesser extent
  - Persistent shortage
  - Buyers-buying hand to mouth
  - Near-Nil stocks

#### Change in trade flows!

- Increased pressure to manage the supply chain (to reduce risks!)
- Affects competition, logistics planning and investments

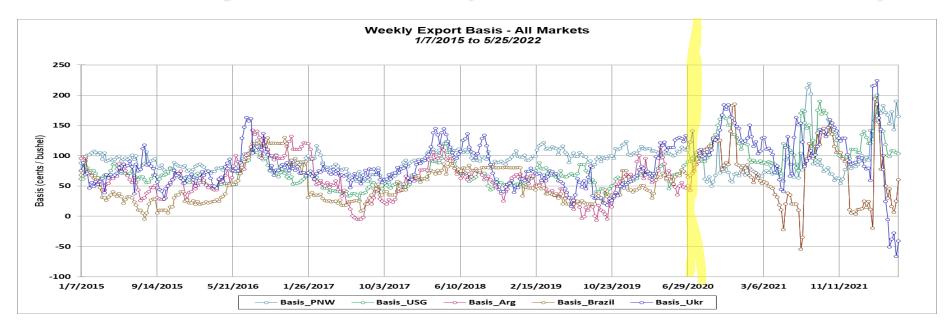




#### Volatility in wheat

- Normally: .15
- Current: up to .49
- Sat Night: .80 (Putin's withdrawal from Grain Corridor)

## Volatility in Basis (international corn)



- International basis:
  - Correlated; however, correlation is lessening
  - Significant 'structural break' in August 2020!
- Soybean similar
- Wheat: Greater price (basis) dispersion internationally than ever before (FOB prices vary from \$300 to 450/mt due to geography, quality geopolitical and logistical risk)

## Developments and Impacts

#### Supply chain Developments

- Numerous causes
- None are transitory, though improving
- Likely: Multi-year event, though w/some moderation

#### Impacts

- More volatility: F, B, shipping costs
- Increase in transit times and risk, wait times, demurrage, etc.
- Risk of shortages (prob of shortage)

## Implications for buyers of grains and oilseeds

- Supply Chain Strategies
- Manage risks
  - F and B
  - Logistics more strategically
- Increase in stock-holding
  - Highly strategic
  - Models exist to determine optimal stocks

## **Supply-Chain Disruptions**

## Summary/Discussion

#### Ag trade and competition

- Robust demand and new products/sectors
- More geo-political interventions now than ever before:
- Turbulent times creates uncertainty
  - Disrupts supply chains
  - Complicates investments
  - Creates option value e.g.,
     Constanza
  - Diverts some investment to non-US origins
- Elevated Price (F, B and T) and Risk (Volatility):
  - 2-3 years

## Implications: Supply Chain Problems

- <u>Likely improving</u>, but, continued challenges with labor, fuel/oil and other inputs to the supply chains
  - Ag Inputs: Exacerbated by lack of 'local (national)' mfg
- Implications on Trading
  - More transactions with optional origin
  - More trades which 'switch' origins
  - Increase in value of 'switching options'
  - Shift in Ukr trades: from FOB to C&F
  - Increase in stock-holding (buffer stocks)