

# Impact of the Middle Corridor: Simulation Analysis of Infrastructure Investment in Central Asia and the Caucasus

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Yuki Inoue (The University of Tokyo)

Ryuichi Shibasaki (The University of Tokyo)

Hirofumi Arai (Economic Research Institute for Northeast Asia)

# China Railway Express

2011 First container train between Chongqing and Duisburg

2014 China's Belt & Road Initiative (一带一路) was announced

2016 China-Europe Railway Express (中欧班列) was established

→ Rapid growth in new routes and cargo volume



# During Russia-Ukraine War (2022-)

Russia



China

- Rapid growth (29.2%) of trade
- Reduction of maritime shipping (which mainly used St. Petersburg port)

Land transport

Far East ports +  
Siberia Railway

Europe

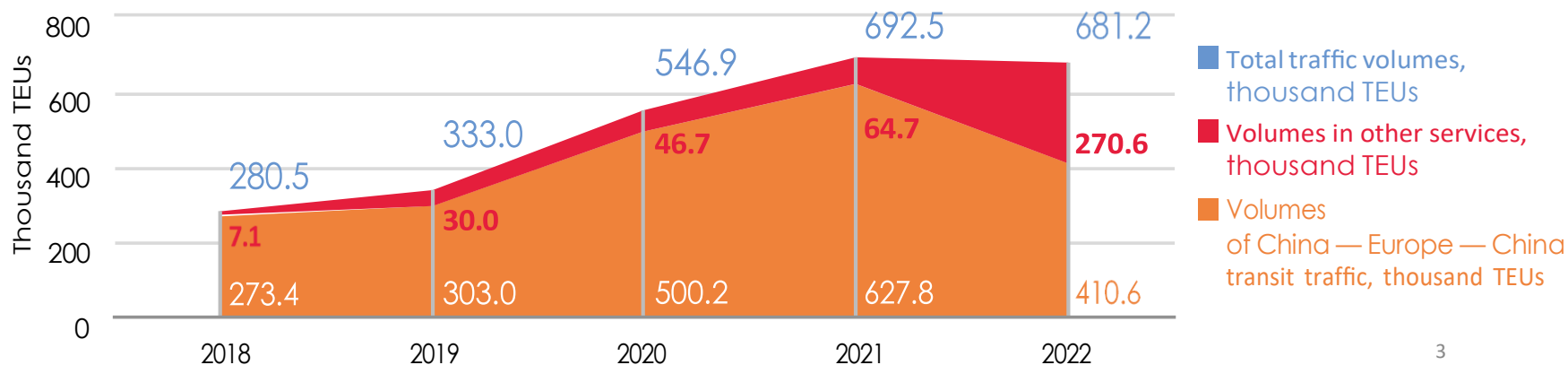


Asia

- Reduction of rail transport via Russia (Company's self-restraint > Sanction)

Maritime shipping

Middle Corridor



Source: Eurasian Rail Alliance Index

# The Middle Corridor



<https://middlecorridor.com/en/>

(EU-) Turkey - Georgia - Azerbaijan - Caspian Sea (Ferry) - Kazakhstan - China

Alternative route of Siberian Railway



# Challenges of the Middle Corridor

- Border crossings are necessary at least 4 times, resulting in higher costs and longer waiting times
- Some bottlenecks

(1) Difference in rail gauge

China & Turkey: 1435mm;

Kazakhstan, Azerbaijan, &

Georgia: 1520mm

Lift on/off wagons

(2) Caspian Sea ports

Lift on/off ferry



Transshipment facility in China-Kazakhstani border (Hurgos) <sup>5</sup>

# Research Objectives

(1) Analyze how infrastructure improvements along the Middle Corridor result in increase in cargo volume



Source: <https://www.recordchina.co.jp/pics.php?id=881670>  
Source: <https://middlecorridor.com/en/press-center/news/regular-block-train-service-between-lianyungang-in-china-and-istanbul-in-turkey-launched-on-the-middle-corridor>

(2) Analyze the **potential role of the Middle Corridor** as an alternative route to conventional land transport via Russia **in emergency case**



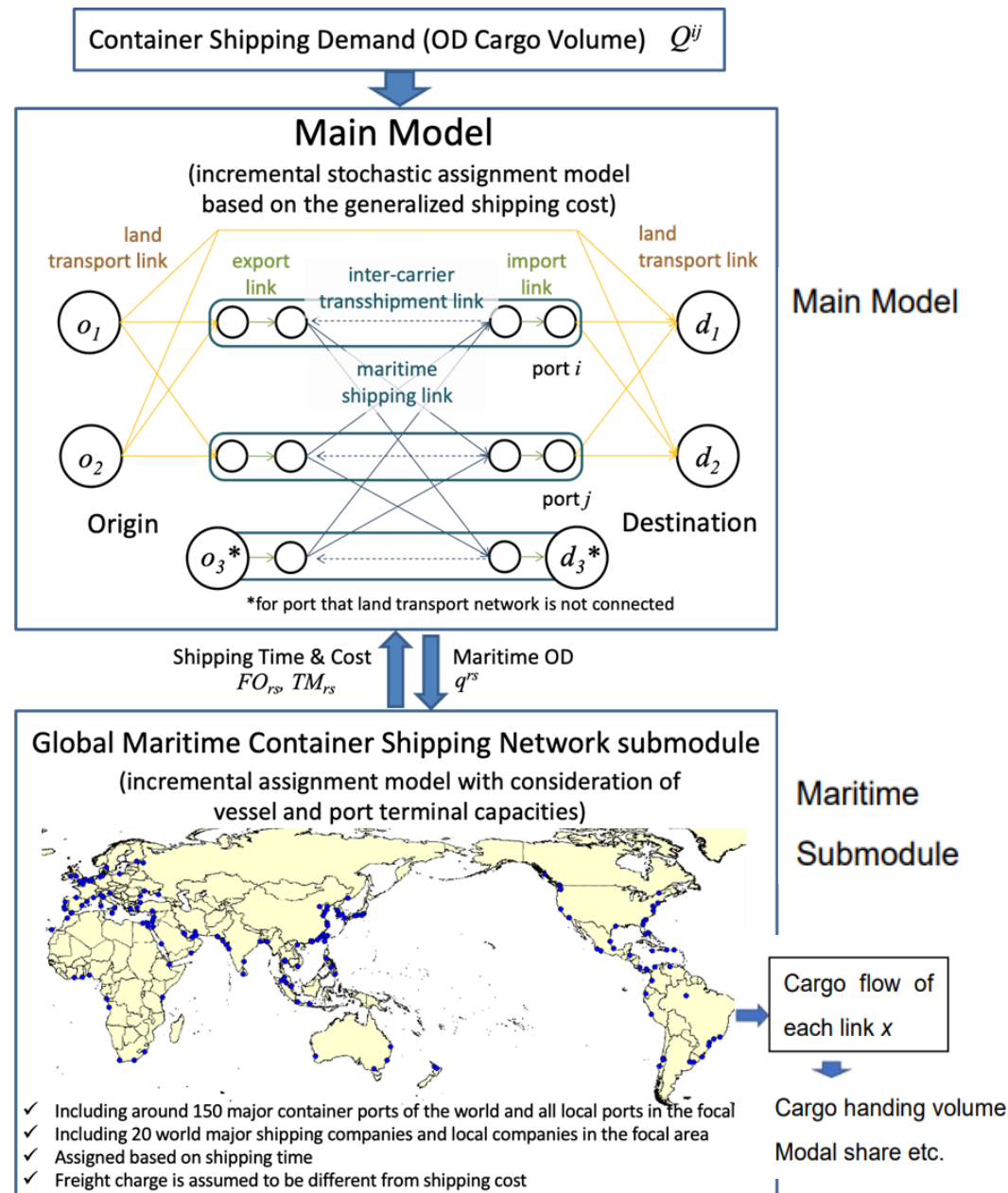
→ We focus on the cargo volume change in the Caspian Sea shipping in this study, because it is the largest bottleneck in the Middle Corridor

# Global Logistics Intermodal Network Simulation (GLINS) Model

- **Network assignment model** including land, maritime, and air transport network globally **under the given regional cargo shipping demand**

Covered area:

- Major rail/roads in 24 countries of Eurasia continent
- 208 major ports in the world
- 194 major airports in the world



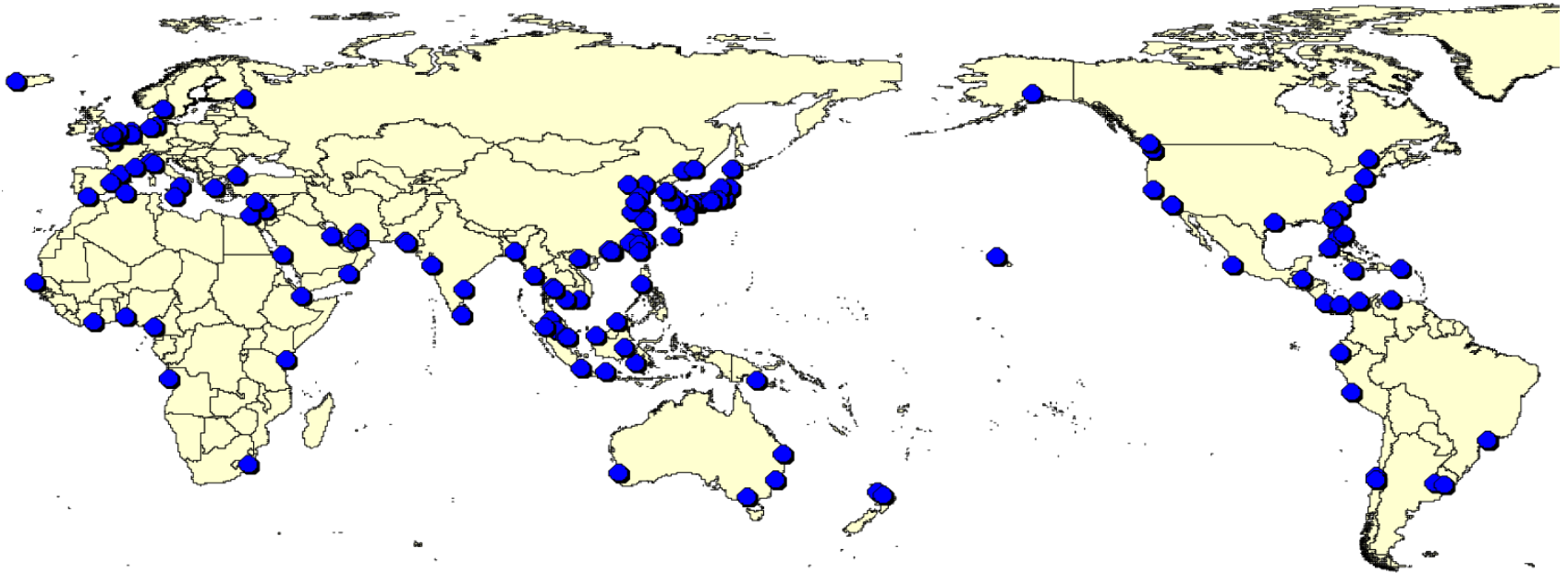
# Target Area of Research



- Covering 24 countries in Eurasia

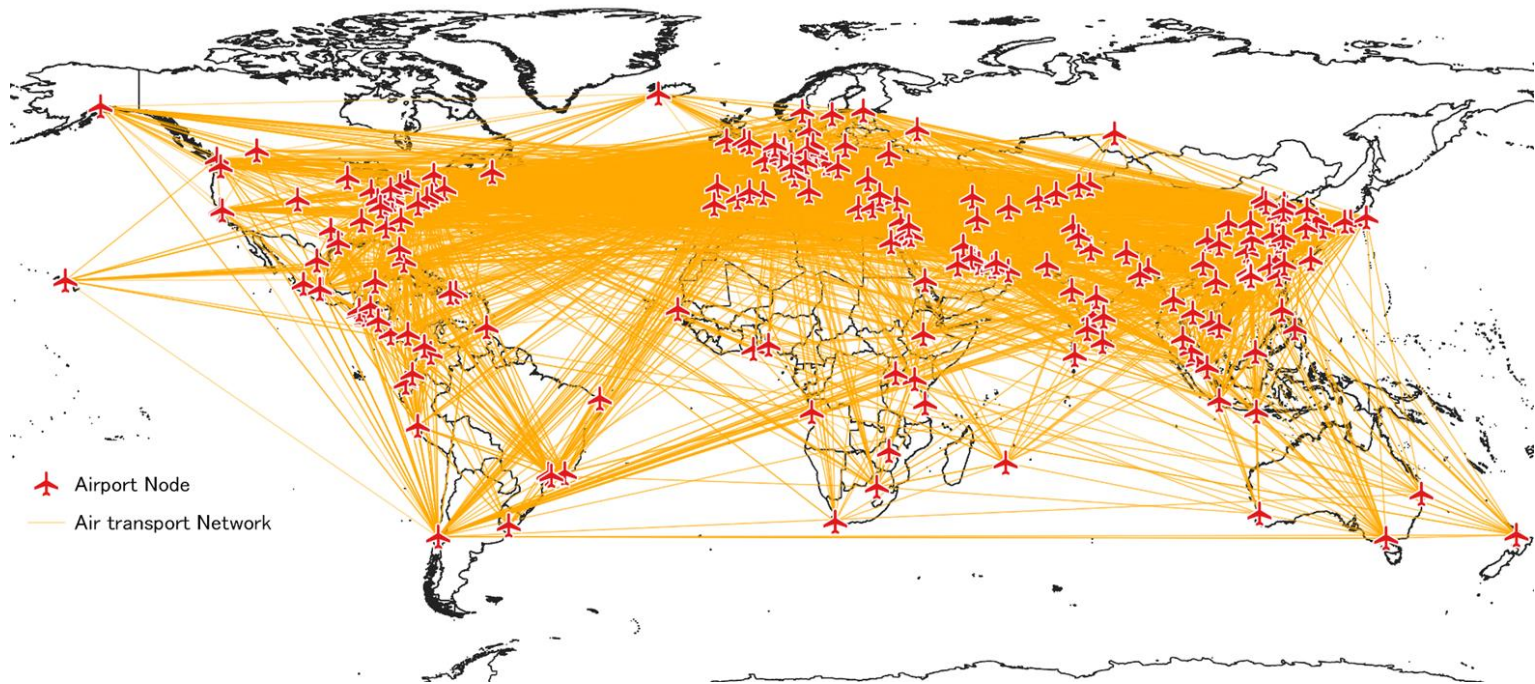


# Target Area of Research



- Covering 208 ports
- 1093 container liner services

# Target Area of Research



- Covering 7741 routes with an annual frequency of 12 or more flights
- 194 airports with an annual cargo throughput of 15,000 tons or more

# Policy option 1: Railroad Improvements

- Challenges:
    - (1) Aging signaling equipment, locomotives, and wagons
    - (2) Shortage of container wagons
  - Countermeasures:
    - (1) Equipment upgrades
    - (2) Mass introduction of wagons
- Considered as **an increase of rail frequency** in the model



Source: <https://business.nikkei.com/atcl/report/15/111600051/020400010/?P=3>  
Source: Wikipedia

# Policy option 2: Caspian Ferry Improvements

- Challenges:

- (1) Low frequency service
- (2) Insufficient fleet
- (3) Lack of port facilities and inefficient cargo handling

- Countermeasures:

- (1) Increase in vessels (3 to 6 ships in 2022)
- (2) Improve efficiency of port operations by updating equipment and systems

→ Considered as **an increase in frequency of ferry services**



Kuryk Port



# Policy option 3: Smooth Border Crossings

- Challenges in Central Asian borders:
    - (1) Long time required to cross the borders
    - (2) Inadequate arrangements for border crossings
  - Countermeasures:
    - (1) Facilitate border crossings by updating equipment and systems
    - (2) Special border crossing agreements for bonded transport of transit cargo
- Considered as reduction of border coefficients regarding additional time and costs at borders

# Policy option 4: Subsidy System

- The subsidy system is taken place in the CERE
  - Chinese local government would subsidize a portion of the transport costs
- Considered as **reduction the distance-proportional rail freight charges along the Middle Corridor**



# Scenario Analysis [1]: Infrastructure Investment

Scenario	Frequency of rail and ferry services (1, 2) (services/week)	Coefficient on border barriers (3)	Rail distance-proportional cost (4) (US\$/km)
Base	Set by links based on literature and field surveys	Set by borders based on field survey and calibration	1.0 (no subsidy)
S-1	<u>4 times as the base scenario</u>	same as above	same as above
S-2	same as the base scenario	<u>1/3 as the base scenario</u>	same as above
S-3	same as above	same as the base scenario	<u>0.6 (with subsidy)</u>
S-4	<u>same as S-1</u>	<u>same as S-2</u>	same as the base scenario
S-5	<u>same as S-1</u>	<u>same as S-2</u>	<u>same as S-3</u>

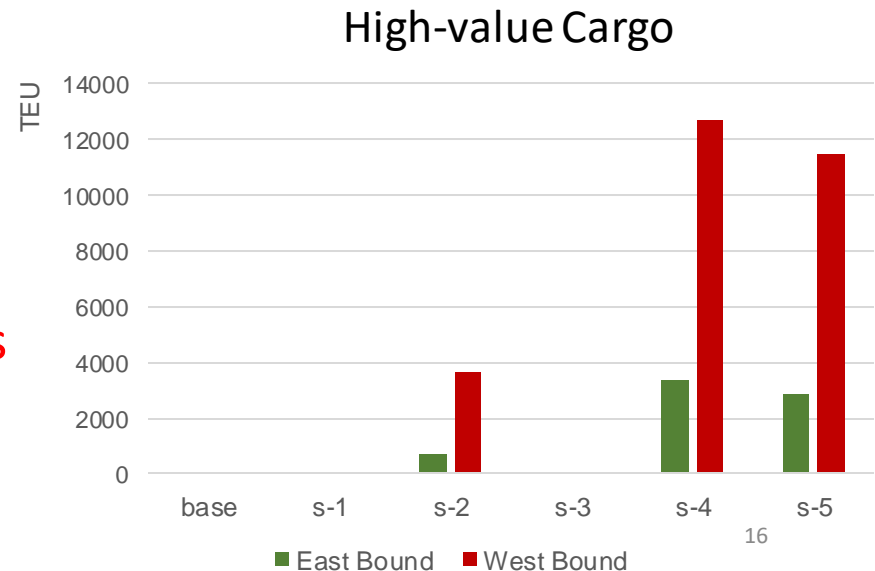
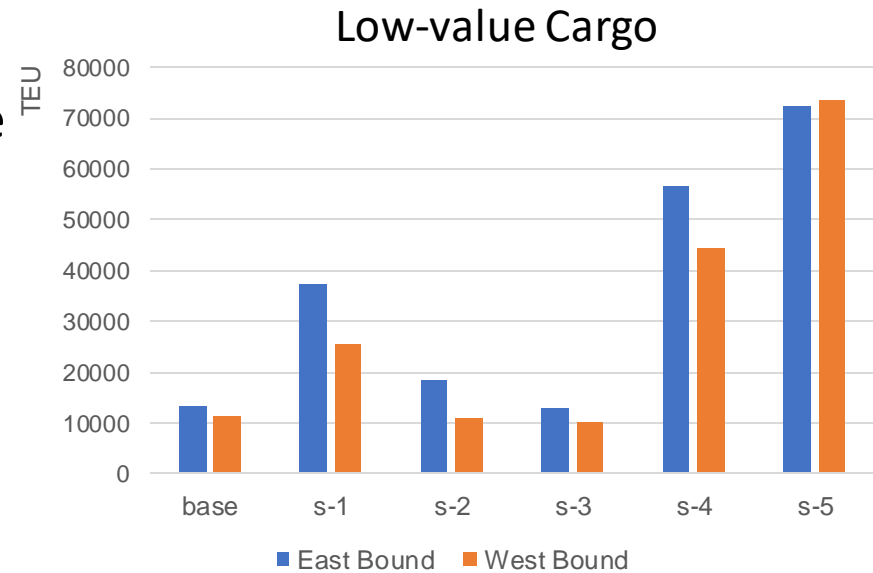
# Results [1-1]: Caspian Sea Shipping Cargo Volume

- s-1: Low-value cargo volume increases in both directions compared to the base
- s-2: Some high-value cargo shifts from air transport
- s-3: No significant change

→ Transport capacity is the most significant current problem

- s-4: Both cargo volumes increase
- s-5: High-value cargo volume decreases

→ Freight charges do not affect the high-value cargo





# Results [1-2]: Caspian Sea Shipping Cargo Volume by Origin Cities

Zone (city)	Shanghai	Chong-qing	Moscow	Baku	Tbilisi	Almaty	Berlin	Amsterdam	Istanbul
Country	China	China	Russian Federation	Azerbaijan	Georgia	Kazakhstan	Germany	Netherlands	Turkey
base	1	0	1,281	1,701	79	32	0	26	25
S-5	2	1	10,127	6,245	429	863	9	81	1,193

- Little use of cargo originating from China and Europe

→ Potential of the Middle Corridor for these cargo is quite low

- In s-5,

(1) Increased use from Moscow and cities along the Middle Corridor (Baku, Tbilisi, and Almaty)

(2) Cargo from Istanbul increases more than 40 times than the base scenario

# Discussions [1]

- ✓ **Frequency increases in rail and Caspian Sea shipping** are the policies that most significantly encourage the use of the Middle Corridor
- ✓ **Reduction of border barriers** can generate the demand for **high-value cargo**
- ✓ **Subsidy system can affect** only low-value cargo **only if the other policies are implemented**
- ✓ Analysis by origin cities clarifies:
  - (1) **Little amount of use between China and Europe** is expected even though transport conditions are improved
  - (2) **Significant increase** in cargo volume **from Istanbul** can be expected
- Potential for use on land transport routes across the Bosphorus should be examined for future

# Scenarios [2]: Function as an Alternative Route in Emergency Case

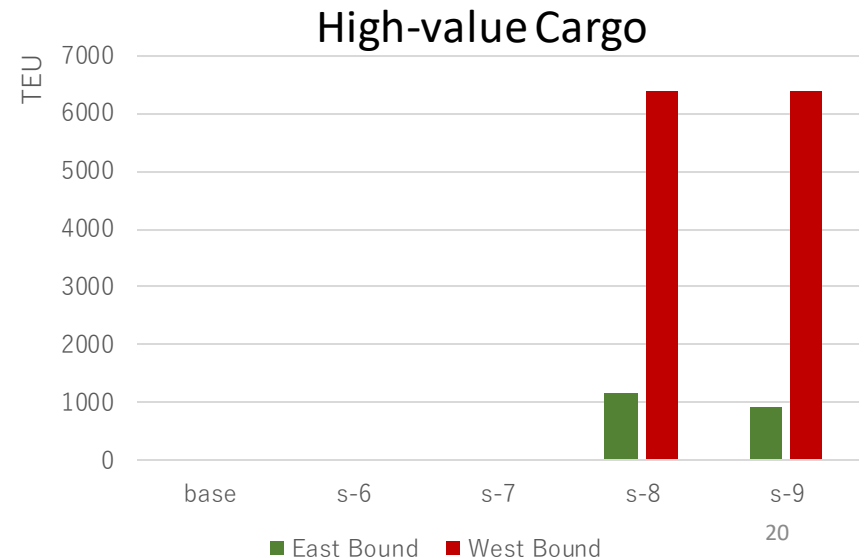
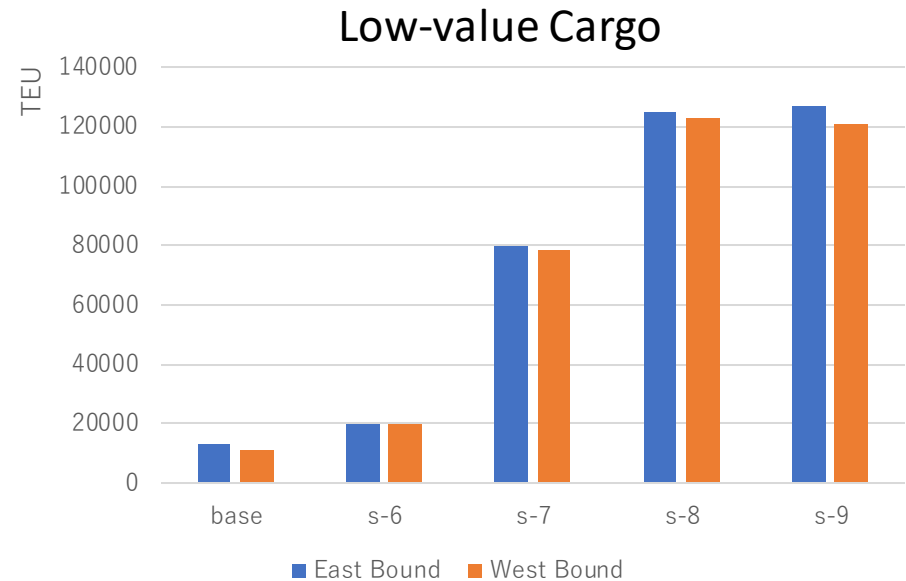
Two additional settings:

- (1) Border crossing conditions between EU/Ukraine and Russia/Belarus
- (2) Export/import cost increase for Russian ports in the Baltic and Black Seas

Scenario	Land border barrier coefficients between EU/Ukraine and Russia/Belarus	Export/import cost in Russian ports	Service frequency of rail and ferry (services/week)	Border barrier coefficients along the Middle Corridor countries	Rail distance-proportional cost (US\$/km)
s-6	<b><u>Equivalent value to borders with regional conflicts (<math>\lambda=10</math>)</u></b>	<b><u>6 times as the base scenario</u></b>	same as the base scenario		
s-7	same as above		<b><u>same as s-1</u></b>	same as above	same as above
s-8	same as above		same as above	<b><u>same as s-2</u></b>	same as above
s-9	same as above		same as above	same as above	<b><u>same as s-3</u></b>

# Results [2-1]: Caspian Sea Shipping Cargo Volume

- s-6: Cargo volume increases but **small**
- s-7: **Significant increase** compared to the base and s-6  
→ Transport capacity problem has been removed
- s-8: **Use of high-value cargo**, and low-value cargo volume also increases
- s-9: **No significant change** in cargo volume from s-8





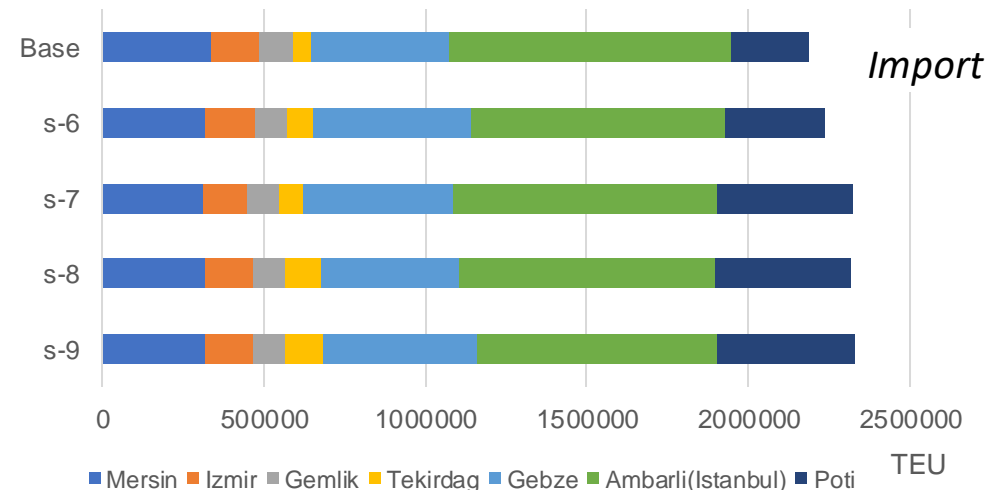
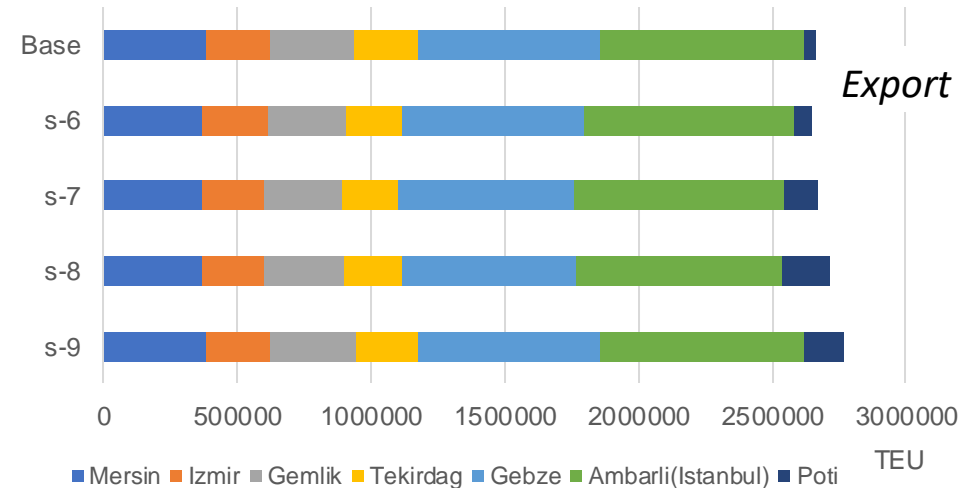
# Results [2-2]: Caspian Sea Shipping Cargo Volume by Origin Cities

Zone (city)	Shanghai	Chong-qing	Moscow	Baku	Tbilisi	Almaty	Berlin	Amsterdam	Istanbul
Country	China	China	Russia	Azerbaijan	Georgia	Kazakhstan	Germany	Netherlands	Turkey
Base	1	0	1,281	1,701	79	32	0	26	25
s-6	4	0	157	1,555	211	40	8	63	1,257
s-7	4	0	7,169	4,685	793	401	3	38	625
s-9	53	0	25,644	3,758	599	799	79	336	14,817

- Limited use of cargo from China and Europe despite of decrease in convenience of Russian railroads
- s-6: Increase in cargo originating from Istanbul and Tbilisi
- s-7&s-9: Increase in all cities, especially in Istanbul

# Results [2-3]: Cargo volume of Turkish/Georgian ports

- Import/export cargo volume of 6 Turkish ports (Mersin, Izmir, Gemlik, Tekirdag, Gebze, Ambarli) and 1 Georgian port (Poti)
- Import/export cargo volumes are expected to increase by policies
- Export volume of Poti:  $s-8 > s-9$   
→ Possibly due to competition between Turkey and Georgia



## Discussions [2]

- Difficulty in operating the China Railway Express do not enhance cargo to shift to the Middle Corridor
  - Increased use of Caspian Sea and Black Sea shipping in situations where transportation routes via Russia are hindered
- The impact of each policy would be limited to the areas along the Middle Corridor

# Future works

- Establishing restrictions on **air transport** that arise under special circumstances
- Adding hinterland networks in Romania, Greece, and other countries on the west coast of the Black Sea
  - **The advantage of the Middle Corridor** exists over other services in terms of distance
- Updating data (currently using 2018)
  - Affecting changes in transport demand after the pandemic and **changes in Russian transport demand** due to economic sanctions
- **Analysis of cargo to Ukraine assuming postwar reconstruction demand**