Big Data on Vessel Traffic for Nowcasting Trade Flows in Real-Time

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Outline

Motivation

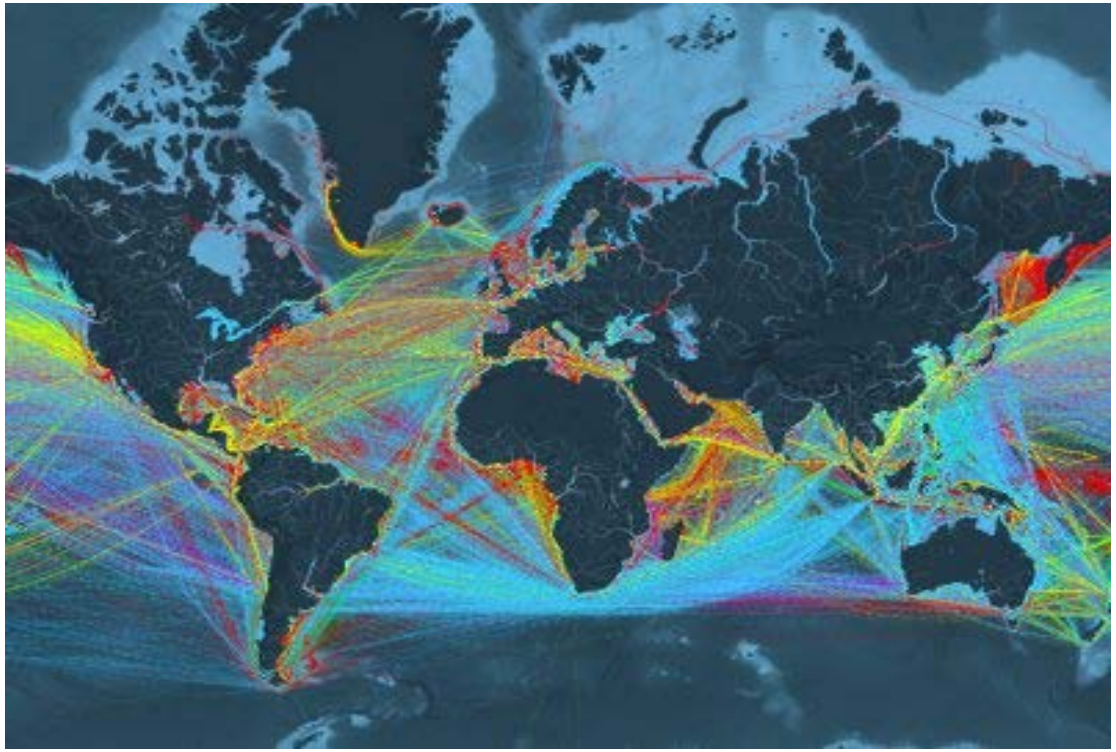
Key Questions and Findings

Data and Methodology

Validation Study

- Maritime statistics
- Trade statistics
- Direction of trade statistics

Relevance for Policy



Motivation: Explore Innovative Sources to Complement Official Statistics

- This work is aligned with:
  - IMF's Overarching Strategy on Data and Statistics (2018)
  - IMF's Staff Discussion Note on Big Data (2017) to provide **innovative**, **real-time**, and **granular** insights

- **Benefits** of Big Data on Vessel Traffic:
  - Possible improvements of timeliness and periodicity of official trade data
  - Provide additional granularity on trade flows
- **Challenges**:
  - No internationally accepted methodology→ Validation study using Malta as benchmark
  - Access to data → Multiple data providers (e.g., MarineTraffic.com)

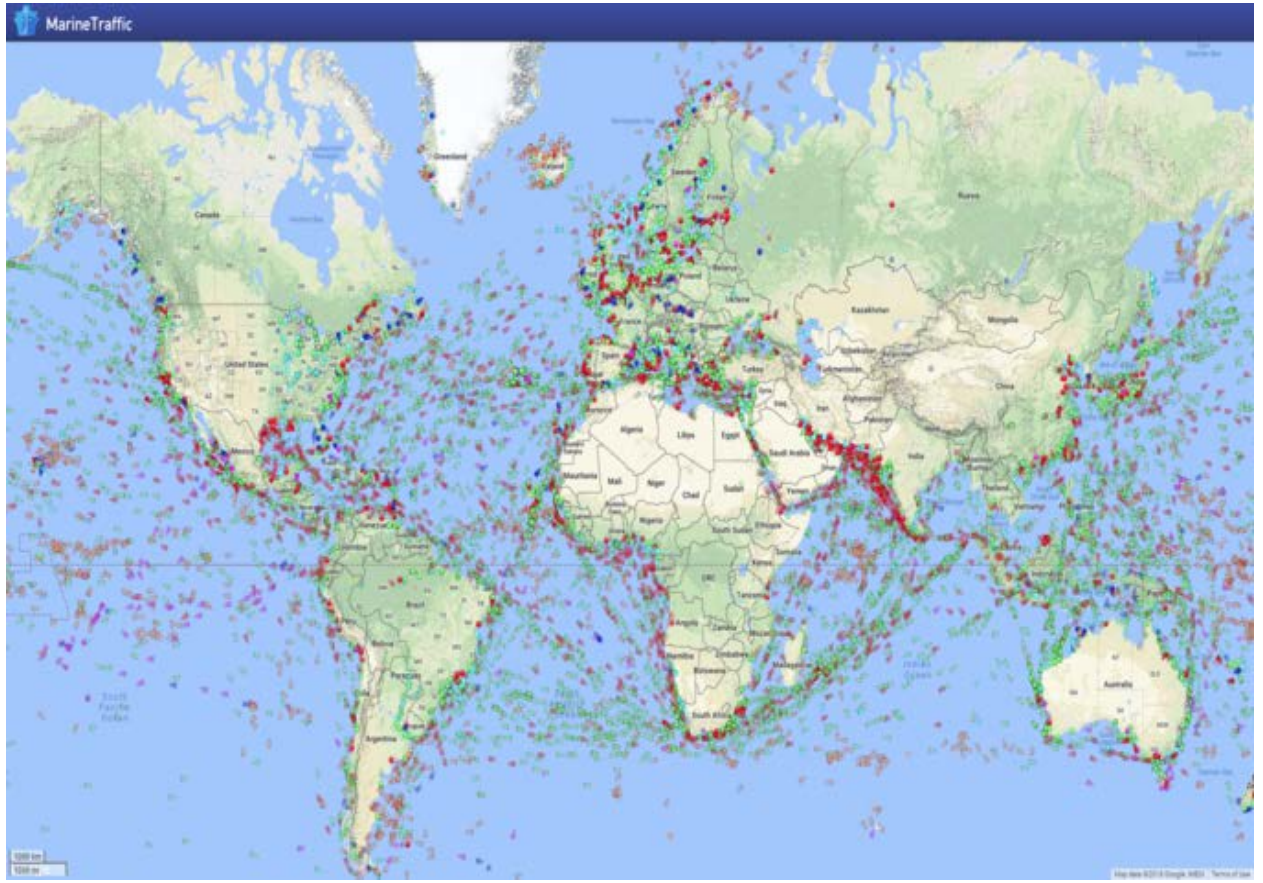
Key Questions and Findings

- Can Vessel Traffic Data track Official Maritime Statistics?
  - Yes. Vessel traffic data appear to show higher coverage of ships than official port statistics for Malta
- Can Vessel Traffic Data be used to Nowcast Official Trade Statistics?
  - Yes. Good correlation with movements of official trade data for Malta
- Can Vessel Traffic Data Offer a Breakdown of Trade Statistics by Partner Country?
  - Partly. Vessel traffic data are affected by shifts in maritime routes and transit trade

Data and Methodology

Automatic Identification System (AIS) Data for Real-Time Tracking of Ships

- Automatic Identification System (AIS) allows for real-time tracking of commercial vessels
- An "air traffic control system" for ships
- Introduced in 2004 after the International Maritime Organization (IMO) made it a requirement for major commercial vessels for safety reasons
- Real-time data tracked by several data providers and made available online



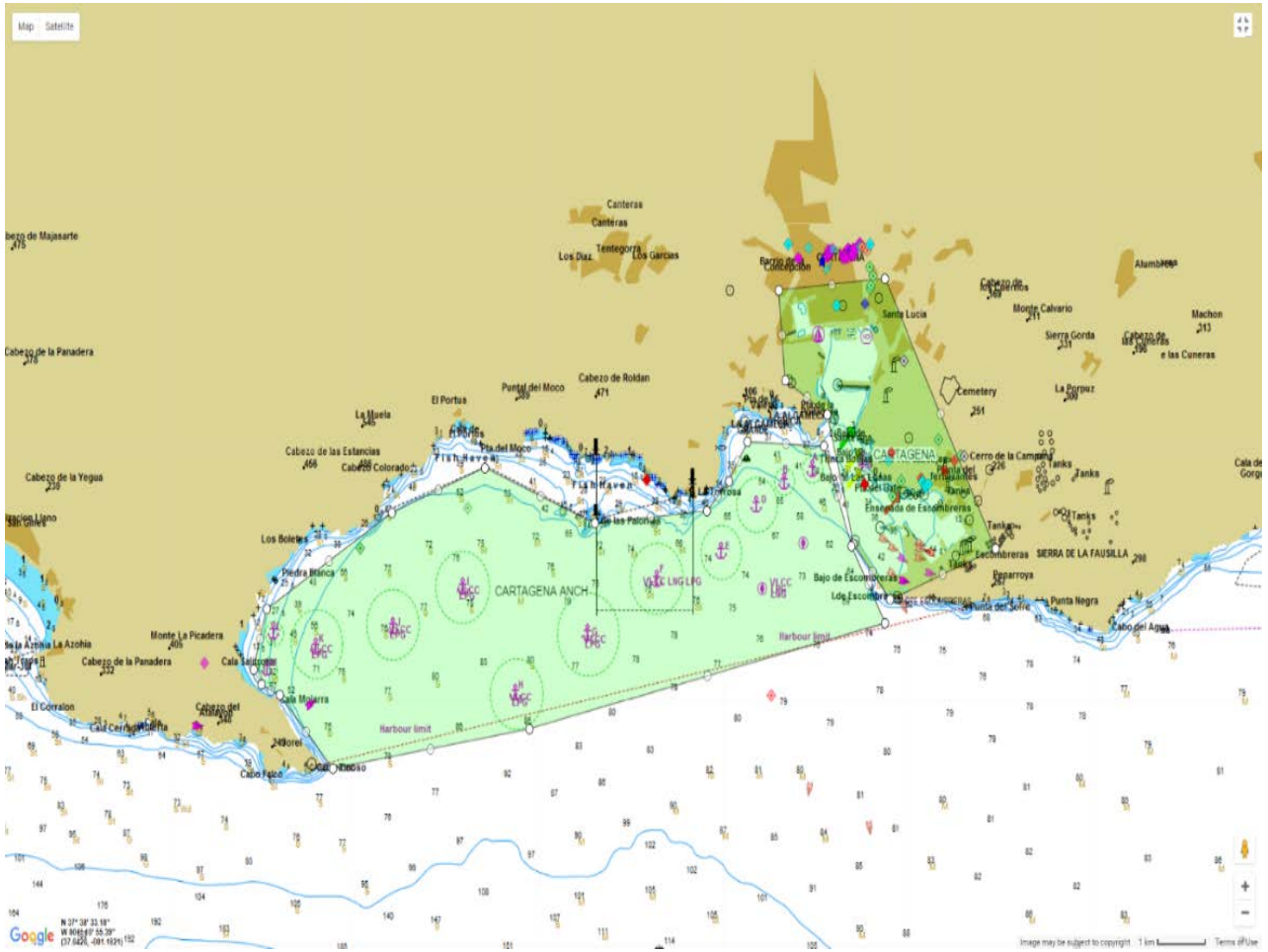
Visualizing Vessel Traffic Data

- For a visualization of the data, play this video

Port Calls: Fusion of Vessel Positions and Port Boundaries

- **AIS messages**, when aggregated, contain billions of ship positions and other voyage-related information in real-time
- **Port call data** are generated combining positional data and geofenced areas**.** Port calls focus only on vessel activity near a port, particularly on incoming and outgoing vessels
- **Defining** port and anchorage boundaries requires careful work. More than 7,000 ports being monitored by MarineTraffic

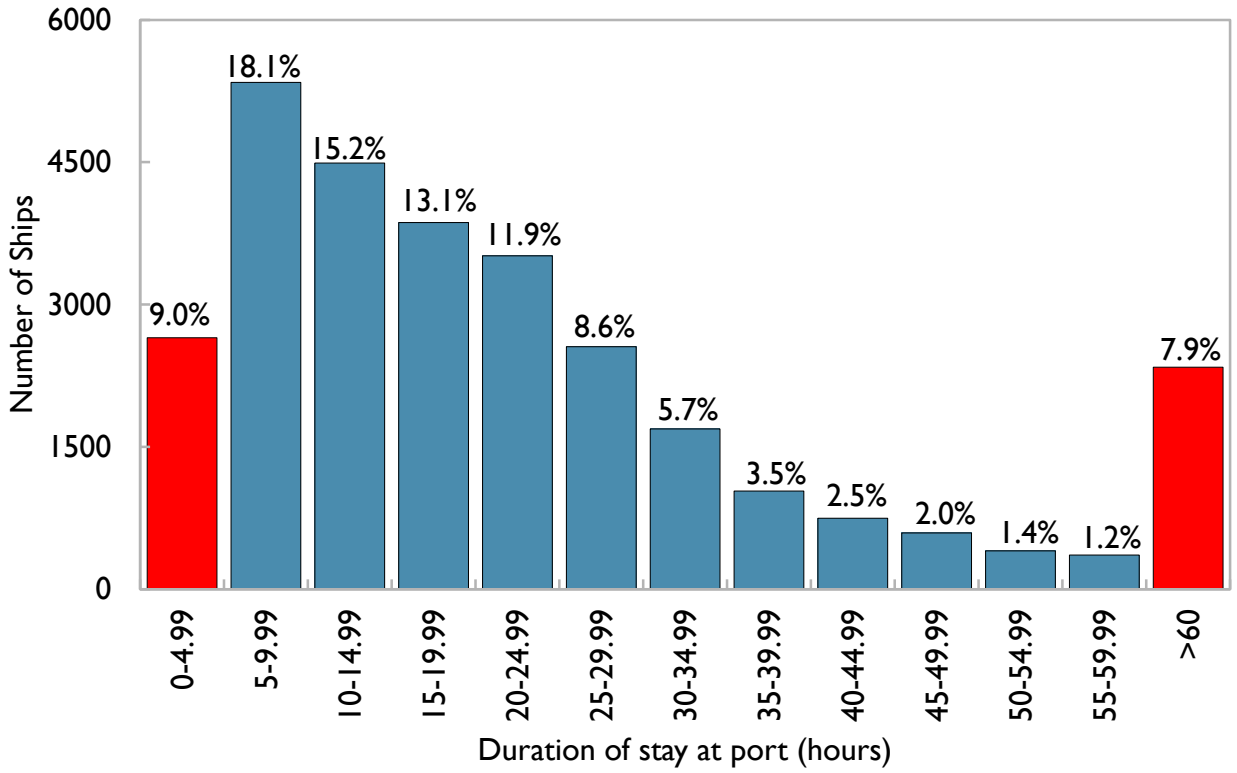
Defining Port and Anchorage Boundaries:
Port of Cartagena, Spain



Key Contribution of the Paper: Filter to Identify Ships Involved in Trade Activity

- Focus on:
- **Container** and **general cargo** ships
- Stays at port between **5-60 hours**

Filtering Genuine Cargo Shipments Based on Duration of Stay at Port
(Number of ships by duration of stay in Marsaxlokk and Valletta. Period: 2015-2018)

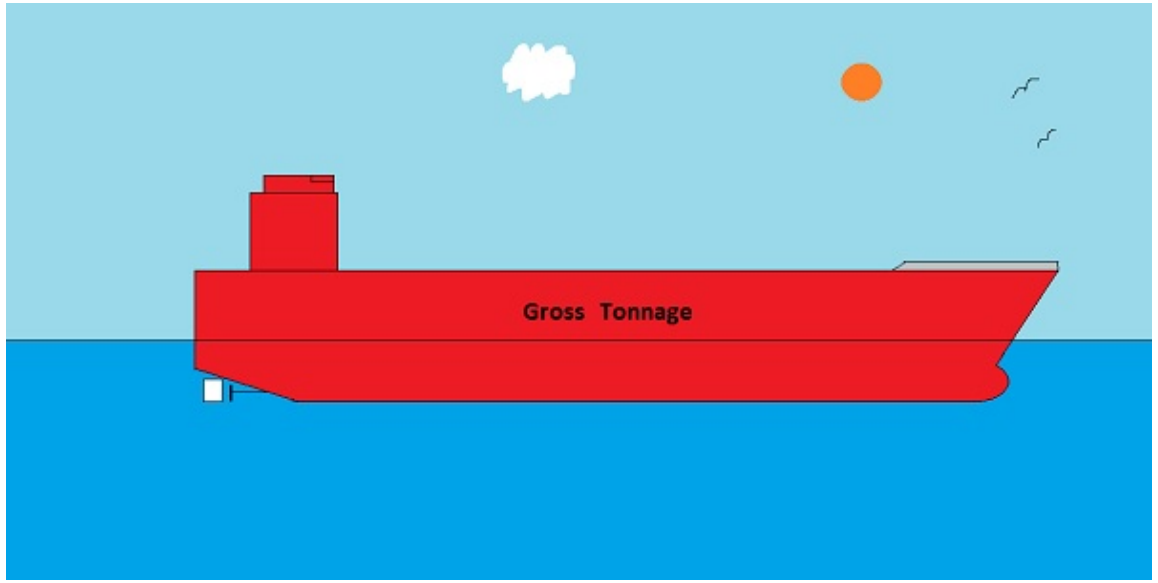


Sources: MarineTraffic, Staff estimates.

- Filtering (exclusion) rules:
- Ships in transit
- Anchorage and bunkering tankers
- Missing data pairs (e.g. ships arrived but not departed)
- Stays in port that do not reflect trade activity (i.e. drifting or repair/maintenance)

Three Indicators of Cargo Activity

- Cargo **number** indicator: number of cargo ships (filtered)
- Cargo **size** indicator: sum of gross tonnage of cargo ships (filtered)



Both Indicators are Comparable with Official Maritime Statistics

Three Indicators of Cargo Activity (continued)

- Cargo **load** indicator:

$$CWI_t = \sum_i DWT_{i,t} \frac{\left| d_{i,t}^D - d_{i,t}^A \right|}{\max(d_i)}$$

$DWT_{i,t}$ is the **deadweight tonnage** of ship i arrived in port on a given week t

$d_{i,t}^A$ is the reported **draught** of the ship upon arrival

$d_{i,t}^D$ is the reported **draught** upon departure

$\max(d_i)$ is the maximum **draught** reported by the ship in the sample

Draught

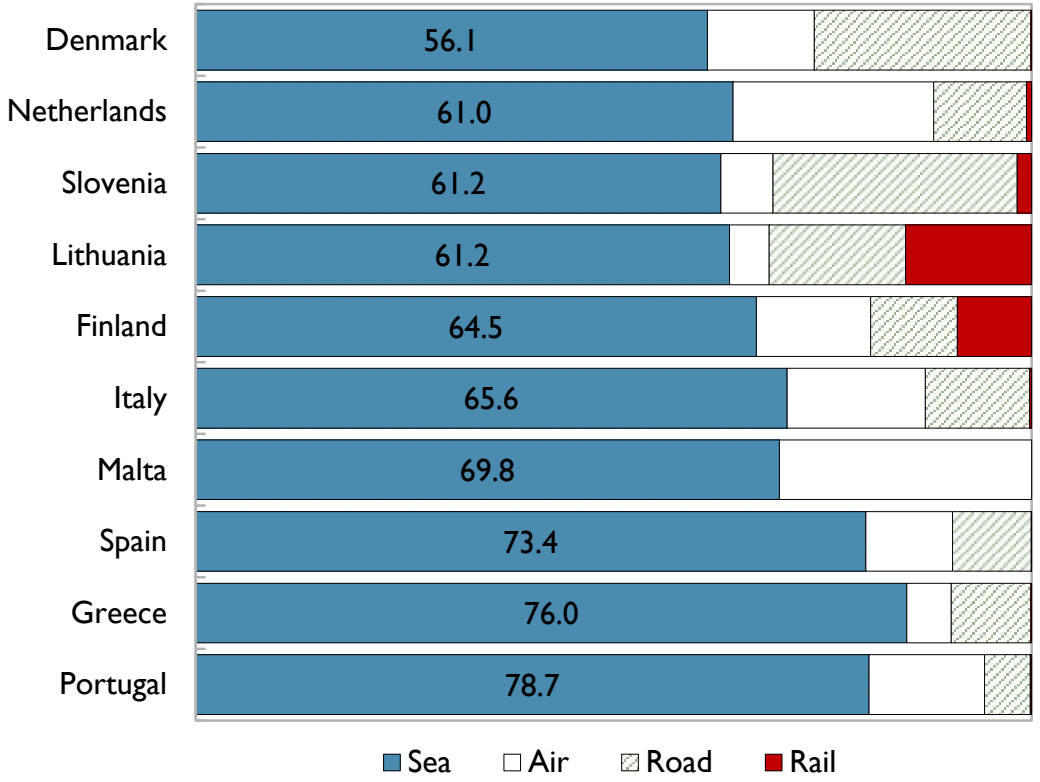
Proxy Indicator of Trade Volumes in Goods (Sum of Imports and Exports)

Validation Study

Why Malta as Benchmark?

- Small open economy
- Most international trade is seaborne
- High-quality official statistics available on Eurostat portal can serve as benchmark

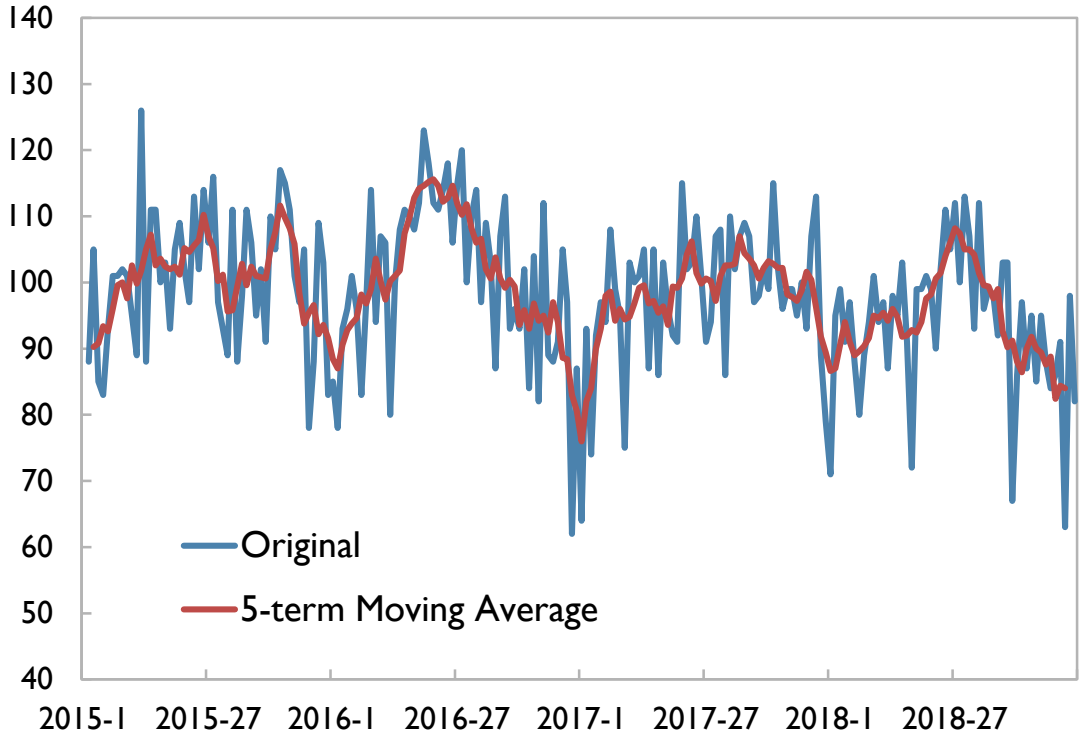
Countries with Largest Shares of Seaborne Imports in the EU
(Extra-EU Imports by Mode of Transport, percent of total extra-EU imports)
Period: 2016.



Source: Eurostat.

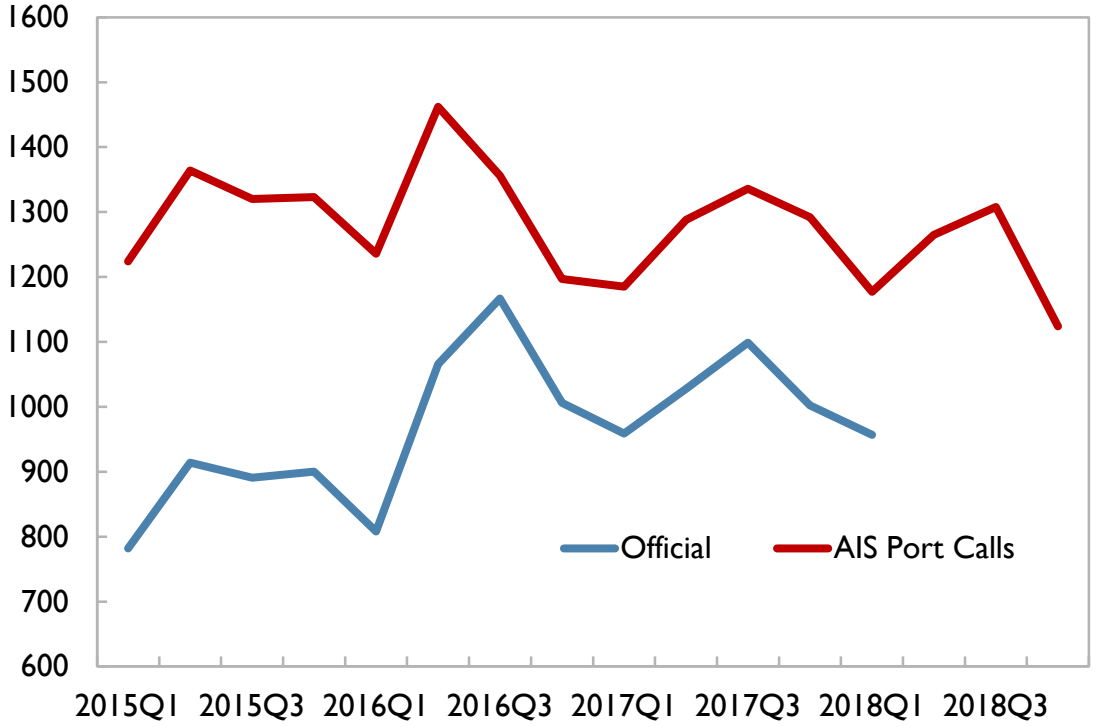
Our Cargo Number Indicator Broadly Tracks Official Maritime Statistics, Highlighting a Larger Coverage of Ships

Malta: Cargo Number Indicator (weekly)
Number of Ships arrived using AIS-based port calls. Period: 2015-2018.



Sources: MarineTraffic, Staff estimates.

Malta: Cargo Number Indicator Good Proxy of Official Port Statistics Cargo number indicator vs. Official number of ships arrived in Marsaxlokk and Valletta. Period: 2015-2018, quarterly.

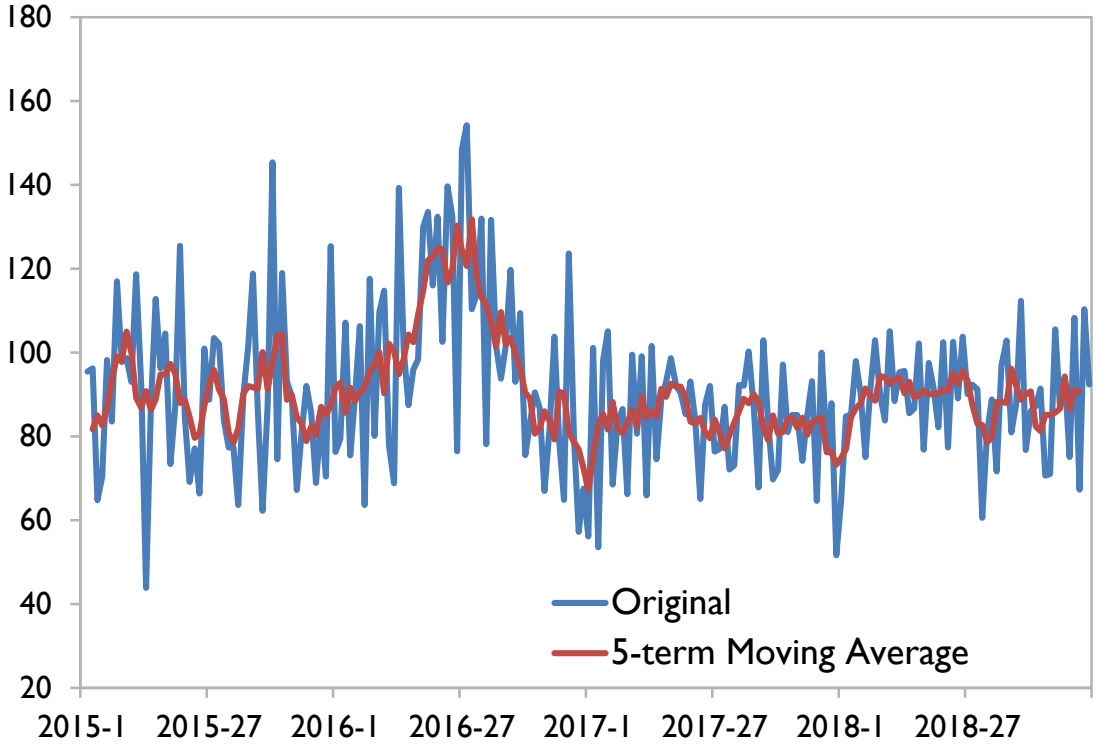


Sources: Eurostat, MarineTraffic, Staff estimates.

High Correlation with Official Trade Volumes

Malta: Cargo Load Indicator (weekly)

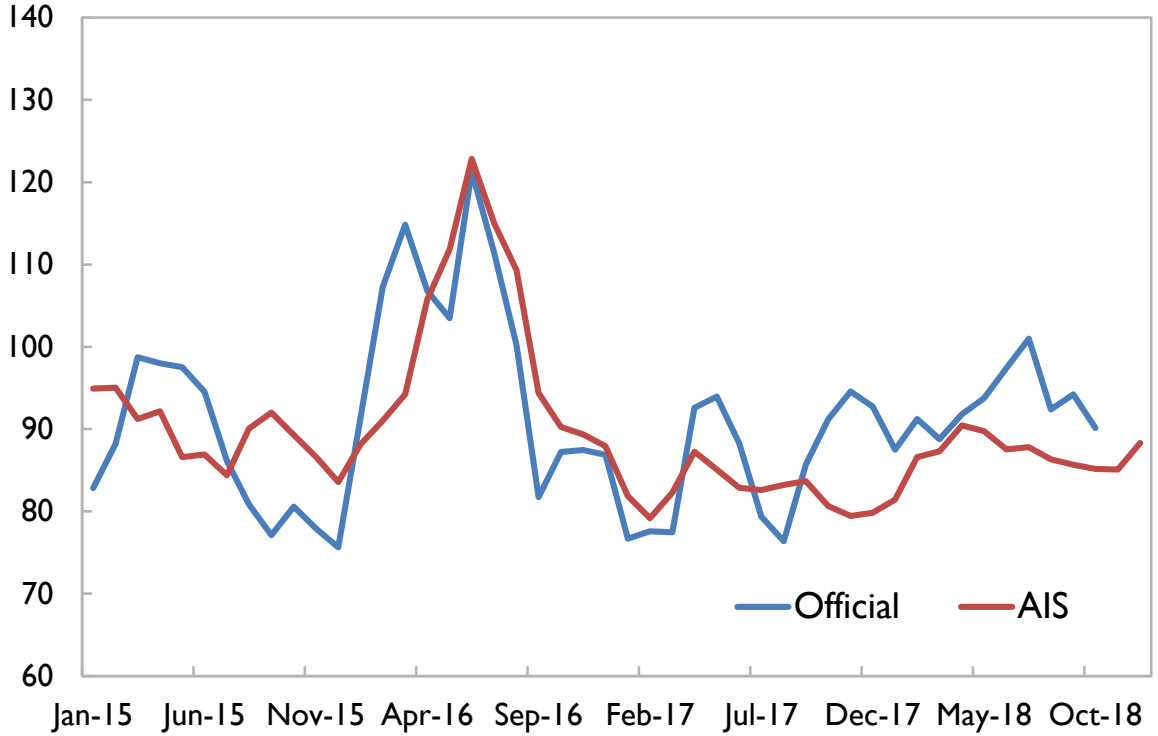
Deadweight tonnage adjusted for draught in AIS-based port calls. Index 2016=100. Period: 2015-2018.



Source: MarineTraffic, Staff estimates.

Malta: Cargo Load Indicator Highly Correlated with Official Trade Volume (correlation 0.65)

Cargo load indicator versus official trade volume index, 2016=100. Period: 2015-18

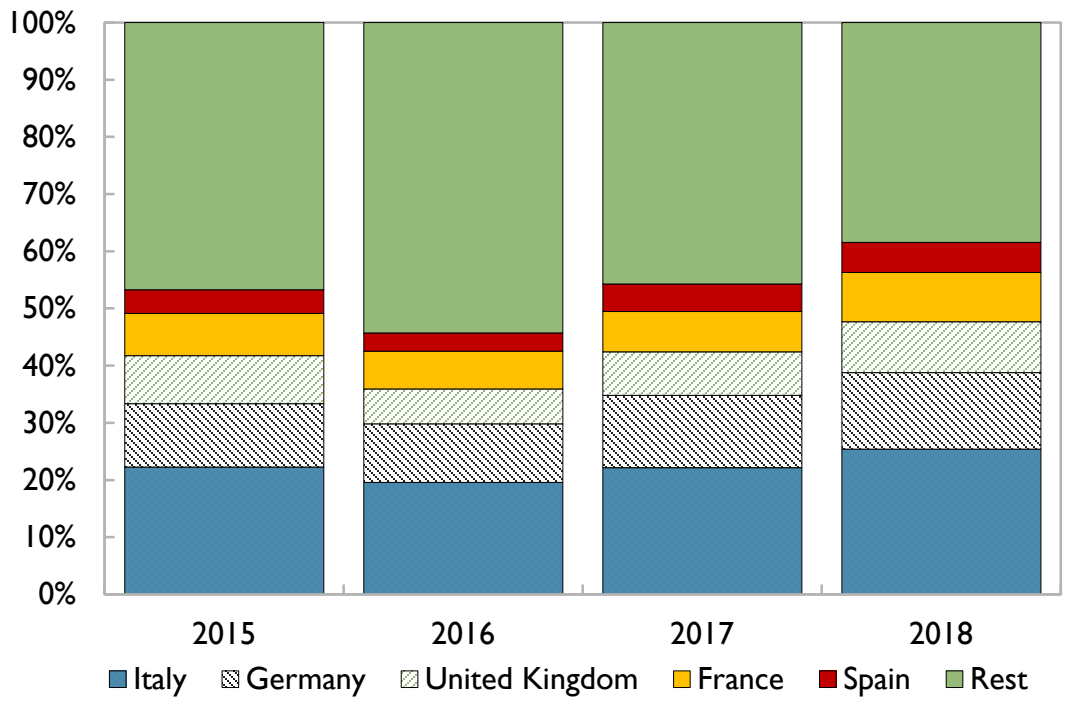


Sources: Eurostat, MarineTraffic, Staff estimates.

AIS Data Provides Breakdown by Partner Country that is Affected by Maritime Routes and Transit Trade

Malta: Imports by Country of Origin (Customs Data)

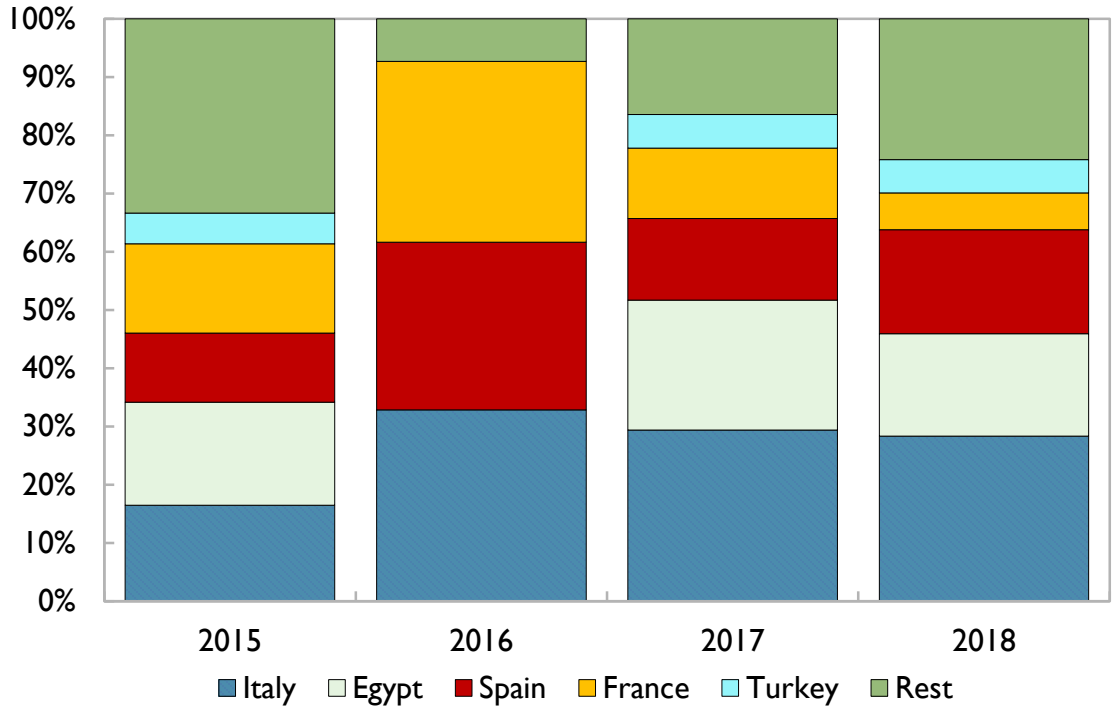
Share by Partner Country based on Direction of Trade Statistics. Period: 2015-2018.



Sources: IMF Direction of Trade Statistics.

Malta: Imports by Country of Last Port (AIS)

Share by Partner Country based on Cargo Load Indicator. Period: 2015-2018.



Sources: MarineTraffic, Staff estimates.

Relevance for Policy

- **International trade** has an important share of GDP in many countries. Tracking a country's trade in real-time may offer prompt and informative insights on economic activity

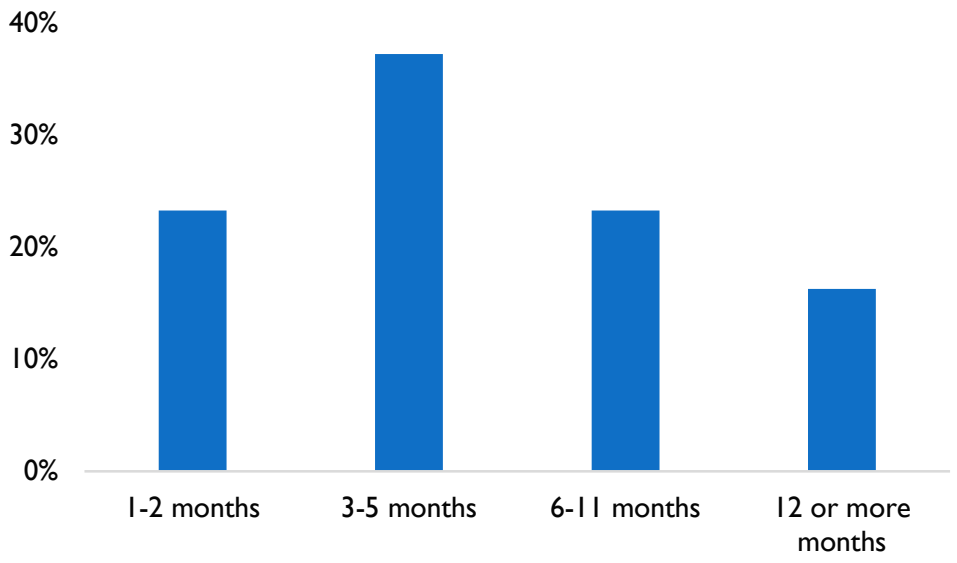
- The methodology can be **extended to other countries**, particularly those with a significant share of trade carried by ships

- On a global scale, vessel traffic data offers great potential for the **monitoring of world trade** flows on a real-time basis, which would be an invaluable input for multilateral surveillance.

- Our results do not question the accuracy of official trade statistics but offer ways to **enhance their timeliness, periodicity, and granularity**

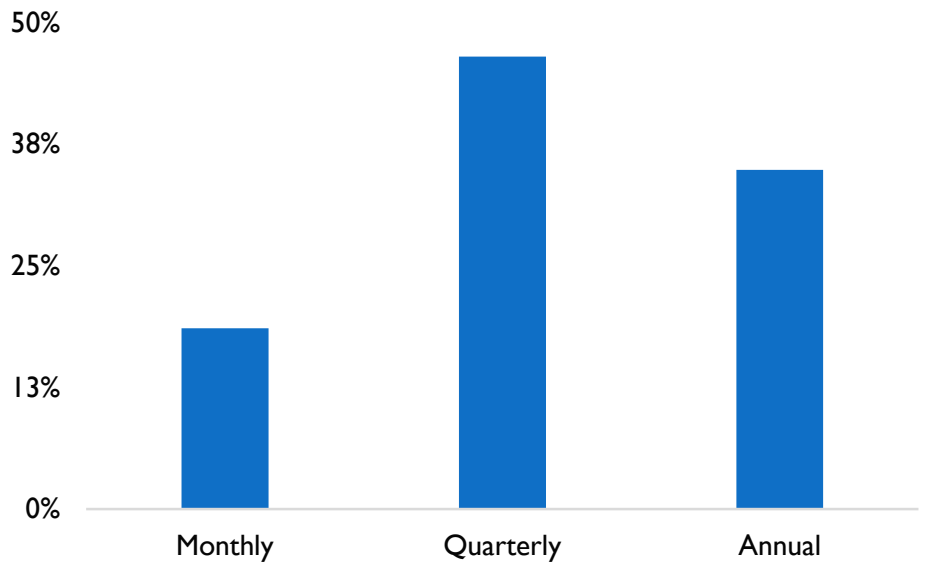
Application to Small States: Long Lags in Timeliness/Periodicity of Official Trade Data

Timeliness of Merchandise Trade Data
(in percent of all small states)



Source: Authors' calculations.
Note: Sample includes all small state members of the IMF (43 in total). Small states have population of less than 1.5 million people.

Periodicity of Merchandise Trade Data
(in percent of all small states)



Source: Authors' calculations.

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Thank you!

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