

# A comparison of Brazil-USA port infrastructure and its implications for trade, transport costs and emissions.

Jorge Chami Batista and Nicholas-Joseph Lazarou

Universidade Federal do Rio de Janeiro and UCL Energy Institute

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- An analysis of how non-containerised goods are transported from Brazil's districts to US districts.
- Conclusions about Brazil's and USA ships' times at ports, number & size of ships on route and relation to export competitiveness. Implications for transport costs; emission policies.

## 1 Motivation

## 2 Transport of non-containerised goods from Brazil to USA

- Port Throughput
- Time spent at port
- Number vs size of ships
- Link to transport costs? Implications for trade?
- Emissions Policies

## 3 Conclusions

# Motivation

- Clark, Dollar, Micco (2004): Latin America reduced its average tariff rate from 31% to 11%. Reductions in artificial trade barriers  $\Rightarrow$  relative importance of transport costs as a determinant of trade increased.
- Well studied determinants of transport costs: Distance, volume, markups.
- Limao and Venables (2001): Poor infrastructure accounts for more than 40% of predicted transport costs.

## Motivation

- Clark, Dollar, Micco (2004), Latin America: Port efficiency (composite score of infrastructure variables) important determinant of shipping costs.
- Improvement from 25th to 75th percentile reduces shipping costs by 12%. (Bad ports equivalent to being 60% further away from markets for the average country.)
- Reductions in inefficiencies (associated with transport costs) from the 25th to 75th percentiles: increase bilateral trade by 25%.
- Sant' Anna, Kannebley Jr (2016), Brazil: An additional hour of port procedures causing ship delay in median port: reduction of municipal exports 2%. Reduction of 10% in port delay in port increases number of exported product categories by 1%.

## Motivation: Project Aims

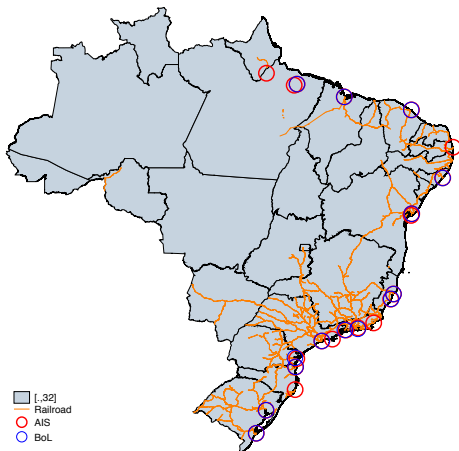
- Discuss Brazil's export competitiveness in the USA (compared to the rest of the world) for selected commodities.
- Analyse determinants of competitiveness and whether transport costs (port efficiency) affects it.
- Use of a unique dataset, connecting bill of lading information, US Census imports from Brazil, freight rates, ship movements.
- Corollary: Trade implications from policies that affect cost of transport (emission regulations).

## Structure of Presentation

- An analysis of how selected non-containerised goods from Brazil's districts to US districts are transported according to dataset.
- Variables described for Brazil and USA:
  - Port throughput (in thousands of tonnes), total, by ship type, by HS2 code.
  - Mean time spent at ports (in days), total, by route, by ship type, by HS2 code.
  - Number of ships per port, total, by route, by ship type, by HS2 code.
  - Voyage duration (in days, mean and standard deviation), by origin-destination, by HS2 code.
- Sample period: April 2012-March 2013

# Data Coverage in Brazil

Brazilian Ports and Railroad network

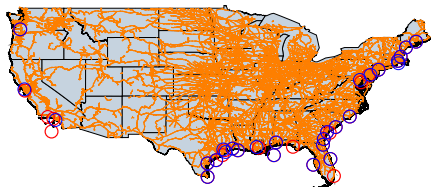


- All ports recovered in vessel tracking (AIS) and bill of lading (BoL) data are connected to Brazilian rail network.
- Most ports identified in AIS and BoL match, with some exceptions.



# Data Coverage in Brazil

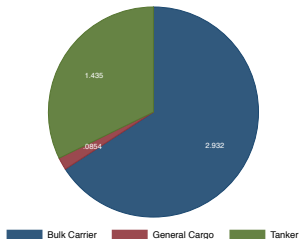
USA Ports and Railroad network



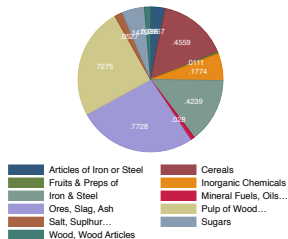
- Ports connected to USA rail network.
- Most ports identified in AIS and BoL match, with exceptions.
- Nearly twice many destinations compared to origin points.

# Description of ship types transporting commodities (Brazil-USA)

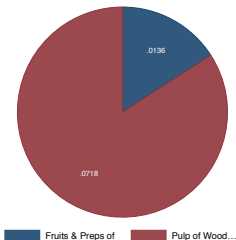
Exports by ship type (Millions of Tonnes)



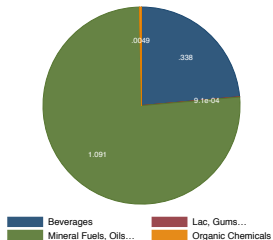
Exports (HS2), by Bulk Carrier (Millions of Tonnes)



Exports (HS2), by General Cargo (Millions of Tonnes)

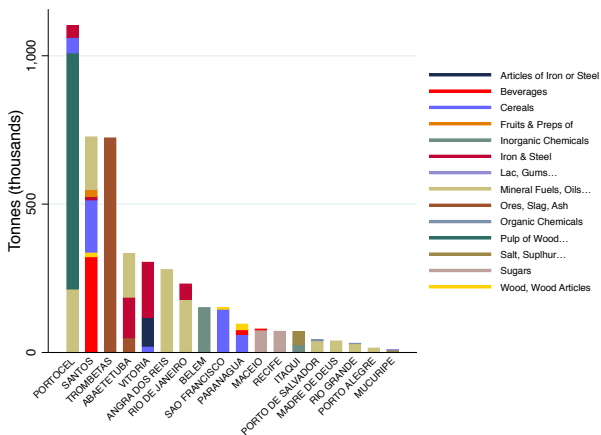


Exports (HS2), by Tanker (Millions of Tonnes)



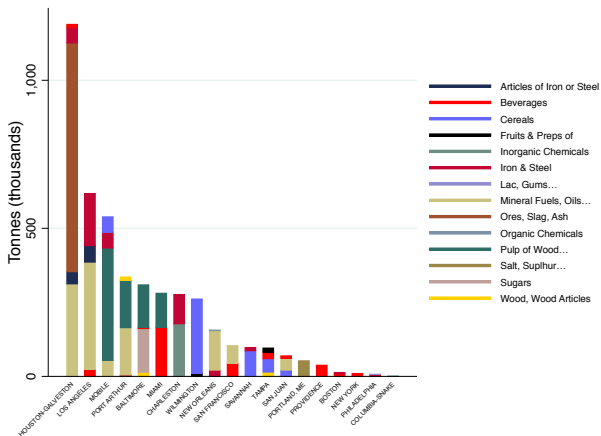
Sample period: April 2012-March 2013

## Brazil port throughput, by HS code, April 2012-March 2013



- Higher throughput for ports which export >1 good (relatively homogeneous, use same equipment).
- More ports exporting 1 commodity but lesser volume (exc. Trombetas).

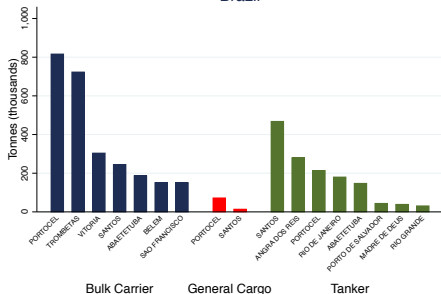
# USA port throughput, by HS code, April 2012-March 2013



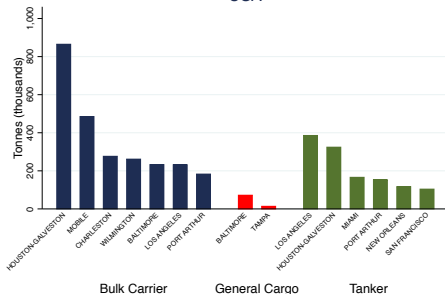
- Top five US ports import 200,000 tonnes less than what top 5 Brazil ports export.
- Most ports import > 2 commodities, and are situated in Gulf.

# Port Throughput, by Ship Type

## Brazil

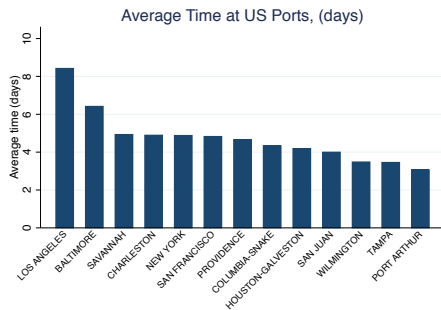
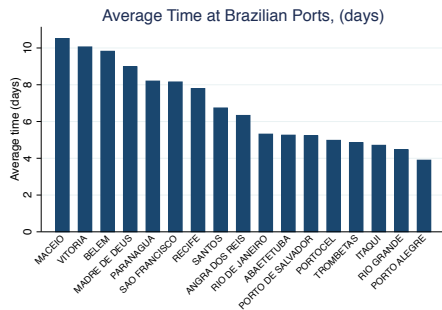


## USA



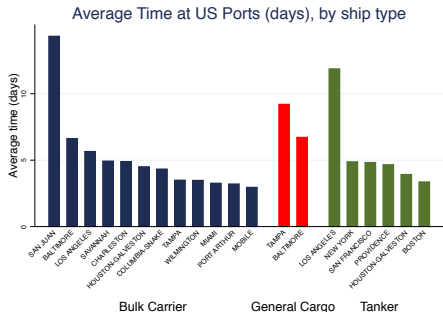
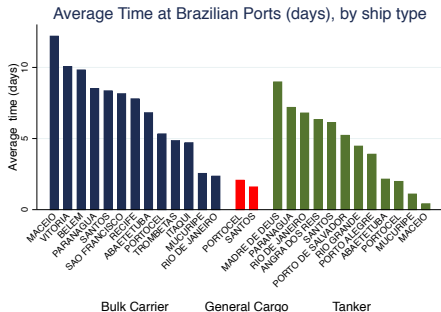
- Fewer ports in Brazil handle more volume than US ports per ship type (at least for trade with the USA).

## Time spent at ports (> 3 days)



- More Brazilian ports have average times > 3 days compared to US. All Brazilian ports are the highest ranking in throughput.
- Average time at Brazilian ports is 6.36 days. In USA 3.82 days.

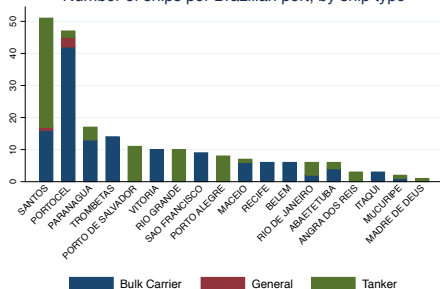
# Time spent at ports, by ship



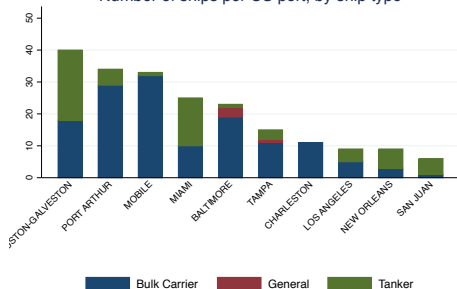
- Bulk Carriers and Tankers wait more in Brazil ports than in USA: 3.51 and 1.37 additional days respectively (USA excludes San Juan).
- General Cargo wait 6.13 days more in USA than in Brazil.

# Number of ships at ports

Number of ships per Brazilian port, by ship type



Number of ships per US port, by ship type



- Except for Santos and Portocel, Brazil ports handle less ships than USA ports.



## Comparison of Brazil and USA top 10 ports by throughput

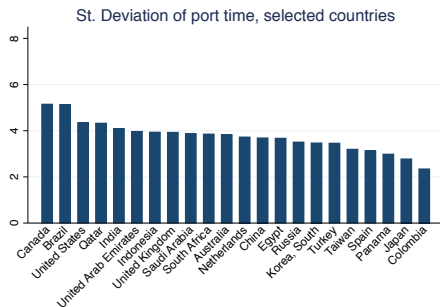
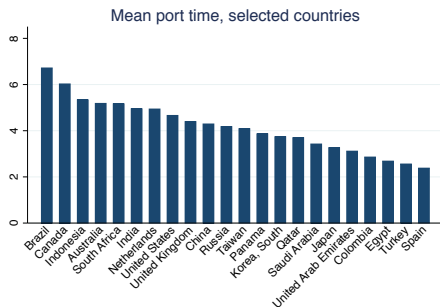
	Brazil	USA	Difference
Port Time (days)	6.96	4.15	2.81
Number of ships	145	149	-4
Volume (Mil. Tonnes)	4095	4069	26

*Top Brazil ports by throughput: Portocel, Santos, Trombetas, Abaetetuba, Vitoria, Angra dos Reis, RJ, Belem, Sao Francisco, Paranagua*

*Top USA ports by throughput: Houston-Galveston, Los Angeles, Mobile, Port Arthur, Baltimore, Miami, Charleston, Wilmington, New Orleans, San Francisco*

- Brazil's top 10 ports handle roughly the same number of ships and volume.
- But Brazil's port time for this volume is 1.67 times the US waiting time.
- Implication for cost of transporting particular goods? Unknown presently.

# Comparison with selected countries



Note: Statistics derived using global vessel tracking information.

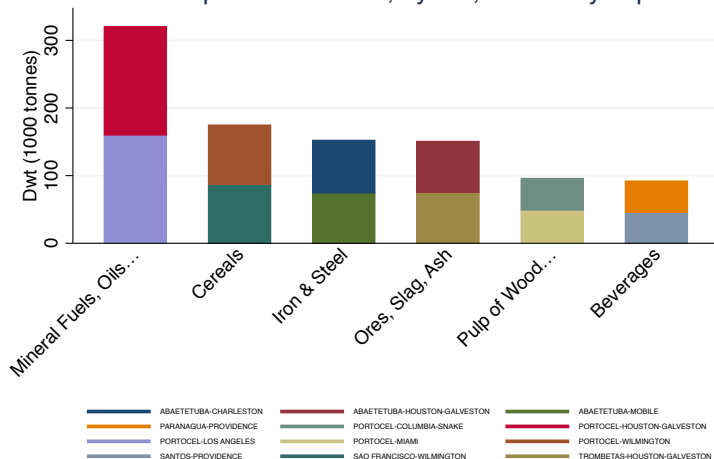
- In addition to mean port time, is it easy to predict port times?

## In depth look at routes in relation to ports

- Focus on commodities.
- Transport costs determinants:
  - Size of ships on a route.
  - Number of ships on a route.
  - Distance (Time of voyage).

## Average size of ships on a route

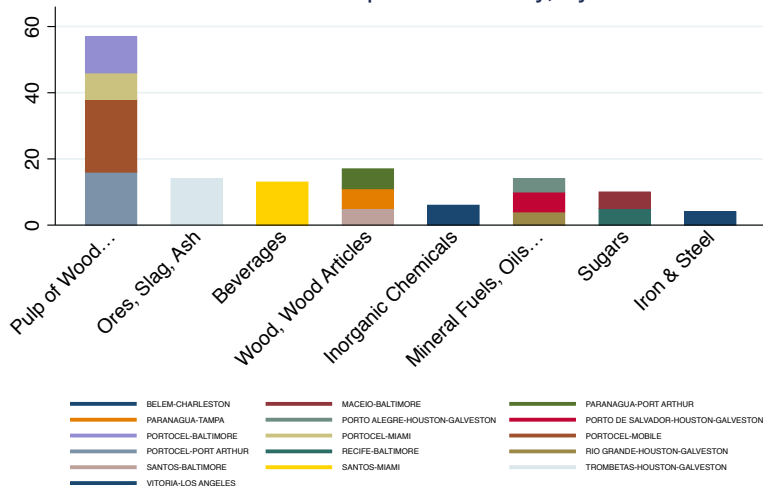
Mean ship size on routes, by HS, ranked by exports



- Biggest ships are Tankers leaving Portocel with average size 160,000 tonnes.
- Bulk Carriers leaving Sao Francisco, Portocel, Trombetas, Abaetetuba (average size 75,000 tonnes).

# Number of ships on a route

## Busiest routes per commodity, by HS

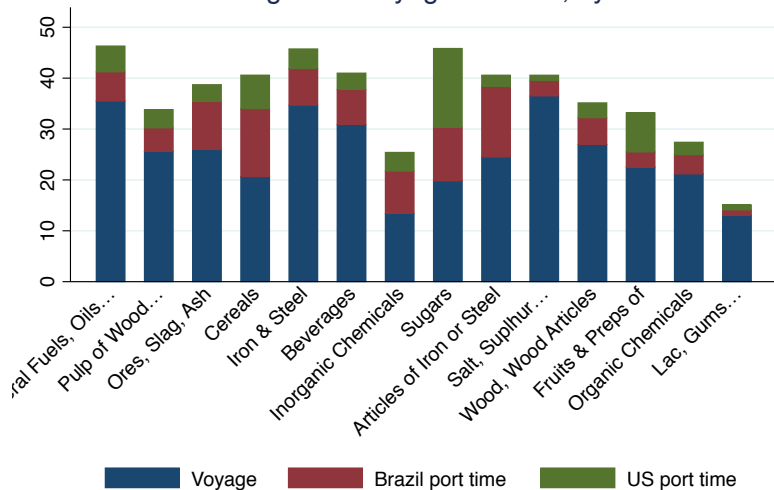


## Number of ships on a route

- Smaller ships  $\Rightarrow$  more ships required (Pulp of wood: 2nd biggest exports).
- Propagates potential port inefficiency: Duration of port operations multiplied by number of ships performing operation.
- Implication for transport costs: Trade off between large number of small ships vs fewer bigger ships?
- Impact on export competitiveness?

# Voyage times

## Average total voyage duration, by HS

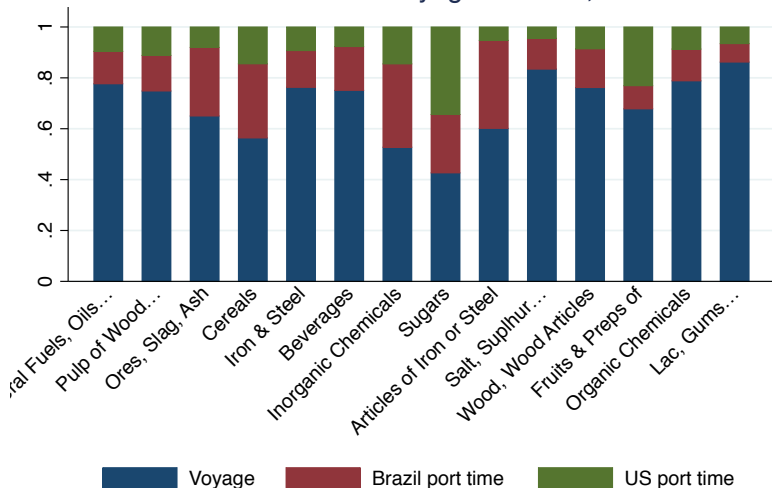


Note: Graphs organised by highest to lowest exports.

- The average journey time is 36.79 days (6.86 at Brazil, 4.45 at USA ports).

# Voyage times

## Share of total voyage duration, %



- Average share of total: 16.7% at Brazil ports, 10.3% at USA ports and 73% sailing.
- Cereals, Articles of Iron or Steel, Inorganic Chemicals, Sugars, Beverages affected more by Brazil port time compared to median good's waiting time.



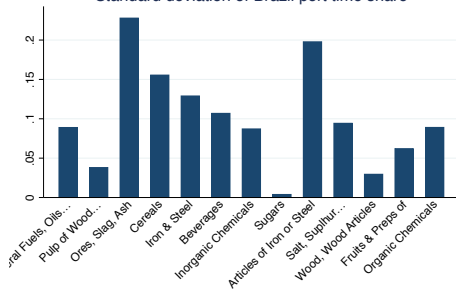
## Voyage times

Commodity	Rank Exports	Br. port time (%)	Rank St. Deviation
Mineral Fuels, Oils...	1	10	8
Pulp of Wood...	2	8	12
Ores, Slag, Ash	3	7	6
Cereals	4	1	1
Iron & Steel	5	9	7
Beverages	6	5	5
Inorganic Chemicals	7	3	2
Sugars	8	4	9
Articles of Iron or Steel	9	2	3
Salt, Sulphur...	10	12	11
Wood, Wood Articles	11	6	10
Fruits & Preps of	12	13	13
Organic Chemicals	13	11	4
Lac, Gums...	14	14	14

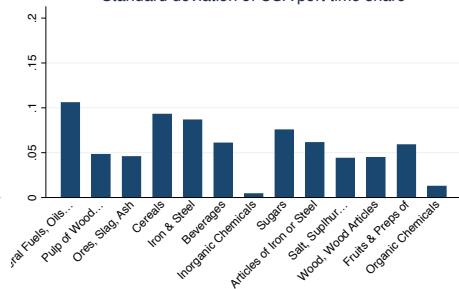
- Commodities with higher than median export volumes have relatively higher Brazil port time (22% vs 17.6% of total voyage time). Port times also less predictable (larger standard deviations - 12% vs 9% of total voyage time).
- Does Brazil port time (and volatility) impact export competitiveness (small market for goods in US)?

# Causes of times in ports

Standard deviation of Brazil port time share



Standard deviation of USA port time share



Note: Graphs organised by highest to lowest exports.

- Brazil's standard deviation of port time (as % of total time) is higher compared to the US.
- Observations around the median exported commodity (by volume) have the highest impact.

## Possible causes of relatively longer times at ports

- Loading sequence (loading procedures).
- Waiting to berth (no space in port).
- Difficult to transfer goods alongside ship.
- Any combination of the three.

## Export Competitiveness, freight, voyage characteristics

	Exports	Rank		Competitive freight	Competitive price
		Brazil Port time	Brazil St. Deviation		
Mineral Fuels, Oils...	1	10	8	N	N
Pulp of Wood...	2	8	12	N	Y
Ores, Slag, Ash	3	7	6	N	N
Cereals	4	1	1	N	Y
Iron & Steel	5	9	7	Y	Y
Beverages	6	5	5	Y	N
Inorganic Chemicals	7				
Sugars	8	4	9	N	Y
Articles of Iron or Steel	9	2	3	N	Y
Salt, Sulphur...	10	12	11	Y	Y
Wood, Wood Articles	11	6	10	N	N
Fruits & Preps of	12	13	13	N	N
Organic Chemicals	13	11	4	Y	Y
Lac, Gums...	14	14	14	N	Y

- Exports with a competitive price may also have competitive freights (the opposite holds only once - Beverages).
- Competitive freights appear to be characterised by lower port times in Brazil and/or standard deviations of port times in Brazil.

## Export Competitiveness, freight, voyage characteristics

- Exports with a competitive price may also have competitive freights (the opposite only holds once - Beverages).
- Competitive freights appear to be characterised by lower port times in Brazil and/or standard deviations of port times in Brazil.
  - Relationship not very clear:
  - Distance, USA port time, number of ships, ship size (e.g. Wood pulp) not controlled for.
  - Identity of exporters/importers may also play a role (intra-firm trade, low markups).

## Emissions policies

- IMO has policies currently in place that aim to achieve 25% emissions intensity improvements in vessel's design efficiency. More policies may follow.
- Concern: Such policies potentially increase maritime transport costs (who pays the increase?), possibly causing reduction in export competitiveness.
- If port times in Brazil (because of port inefficiencies) are found to increase transport costs, then freight competitiveness may fail to arise/disappear (may even impact export competitiveness). Emissions in ports increase.
- Efficient ship size for transport goods lowering congestion, improvements in port infrastructure reduce exposure to such artificial barriers to trade.

# Conclusions

- Brazil appears to have higher and less predictable port times compared to the US (and the rest of the world).
- It is possible that competitive prices (if freights are not competitive) can negate this fact.
- But competitive prices seem to imply competitive freights.
- Competitive freights appear to relate to voyages with lower mean port times and /or st. deviation in Brazil.
- Not necessarily causal, further economic analysis will confirm.

**Thank you**