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# Did the Container Increase International Trade? Initial Explorations

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# Motivation

*“Born of the need to reduce labor, time and handling, containerization links the manufacturer or producer with the ultimate consumer or customer. By eliminating as many as 12 separate handlings, containers minimize cargo loss or damage; speed delivery; reduce overall expenditure”.*

(Containerisation International, 1970, p. 19)

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# Organization

- Previous research
  - Some background on containerization
  - Empirical framework
  - Data set
  - Preliminary findings
  - Future research
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# Research question

- **Why has world trade grown so much?**
    - Paul Krugman (1995) identifies two world views:
      - Journalists and Commentators emphasize technology-led decline in transportation costs.
      - Trade economists emphasize policy-led multilateral and bilateral trade liberalizations.
    - Additional candidates:
      - Convergence in economic size (Helpman (1987), Hummels and Levinsohn (1995))
      - Vertical specialization/outsourcing (Yi, 2003)
    - How can we disentangle these causes?
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# Some answers

- ❑ Baier and Bergstrand (2001)
    - Addresses Krugman's questions and attributes growth in trade to (16 OECD countries 2 periods 1958/60 and 1986/88:
      - ❑ Income growth (67%), tariff reductions (25%), decline in transport costs (8%), income convergence (0%).
      - ❑ Results are not in favor of the journalists!
      - ❑ A useful benchmark against which to compare our estimates
  - ❑ Egger and Bergstrand (2011): Large literature on the effects of preferential trade agreements (PTAs) on trade flows
  - ❑ Baier and Bergstrand (2007) highlight the econometric (endogeneity) issues that arise
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# Major technological changes in transportation

- Also relates to literature on empirical estimation of changes in transport technology
- 1<sup>st</sup> wave of globalization (1850-1914)
  - Road/River -> Railway
    - Fogel (1964), Hurd (1975), Keller & Shiu (2008).
    - Davidson (2010).
  - Sail -> Steam
    - Slow 19<sup>th</sup> century transition; Harley (1973)
    - In connection with the opening of Suez: Bernhofen, Egger and Wolf (2009), in progress.
- 2<sup>nd</sup> wave of globalization (1945-present)
  - Break-bulk shipping -> Containerization (...)
  - Cheaper air travel (jet engine, etc); Harrigan (2010)

# What is the evidence for transport technologies

- Krugman (2009) on what has changed in the world economy since the 1970s:
  - “The ability to ship things long distances fairly cheaply has been there since the steamship and the railroad. What was the big bottleneck was getting things on and off the ships. A large part of the cost of international trade was taking the cargo off the ship, sorting it out, and dealing with the pilferage that always took place along the way. **So, the first big thing that changed was the introduction of the container.** When we think about technology that changed the world, we think about glamorous things like the internet. **But if you try to figure out what happened to world trade, there is really a strong case that it was the container,** which could be hauled off a ship and put into a truck or a train and moved on.”

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# Literature on the Container

- Marc Levinson (2006): “The Box”.
  - BBC series: “The Box”.
  - Geography and Transportation economics case study literature.
  - Broad Quantitative evidence of the effect of containerization appears to be lacking.
    - Levinson (2006, p.8): “How much the container matters to the world economy is impossible to quantify”.
  - Thin economics literature on containerization
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# Literature (continued)

- Hummels (2007);
  - Found an actual increase in ocean shipping rates during 1974-1984; concludes that gains from containerization must have been eroded by increased fuel costs resulting from the oil crisis.
  - Problematic since it is based on an index which contains rates for break-bulk and container ships.
  - Increasing the share of containerized trade lowers shipping costs between 3 and 13 percent (for US commodity regression ).
- Blonigen and Wilson (2008) estimate the dependence of shipping costs on container usage: increasing the share of trade that is containerized by 1 percent lowers shipping costs by only 0.5 percent.
- Limited to the US and mostly cross-sectional (no time horizon)

# What was the previous technology? (break-bulk)



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# Time line of containerization

- **April 1956:** *Ideal X* sails from Newark to Houston with 58 containers.
    - Converted world War II tanker; used redesigned construction cranes.
    - Loading costs of *Ideal X*: 15.8 cents per ton versus \$ 5.86 for a medium sized break-bulk ship.
  - **1959:** first generation of purpose-built containerships with specialized cranes.
  - **early 1960s:** containerization becomes firmly established on routes between US mainland and Puerto Rico, Hawaii and Alaska.
  - **1966:** containerization adopted in the UK, NL and Germany.
  - **1966-early 1980s:** adoption of container port facilities around the globe
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# Break-bulk => Container

- Elimination of piece-by-piece freight handling.
    - Industry expert: "...a ten thousand mile voyage for a shipment might consume 50% of its costs in covering just the two ten-mile movements through two ports".
  - Container facilitated intermodal-transport (ISO containers).
  - Port efficiency and reduction of theft.
  - Container & computer: enabled global implementation of just-in-time manufacturing .
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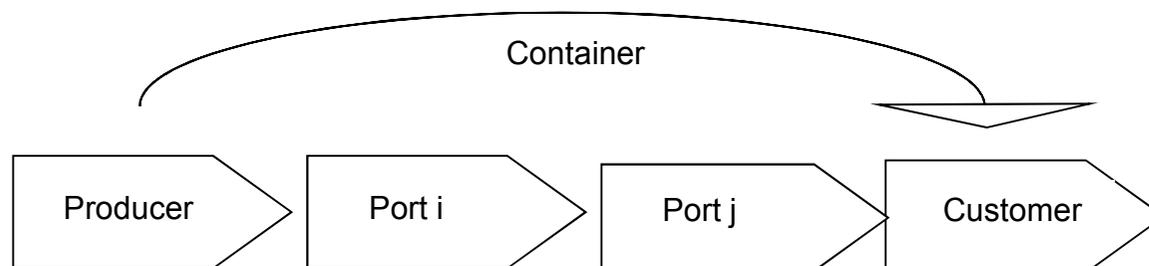
# Effects of Containerization

- **Port efficiency: (1959 versus 1976)**
    - Average time in port: 3 weeks -> 18 hours.
    - Labour productivity: 0.627 tons per man hour -> 4234 tons per man hour.
    - Kim and Sachish (1986): 85% of total factor productivity growth in an Israeli port was due to containerization and only 15% due to economies of scale and output growth.
  - **Break-bulk versus container ship speed/capacity (same time period)**
    - 10,000 tons at 16 knots -> 40,000 tons at 23 knots.
    - Actual reduction in speed after 1970s oil crisis.
  - **Creation of intermodal transport system.**
    - Railways adjust by building railway container terminals.
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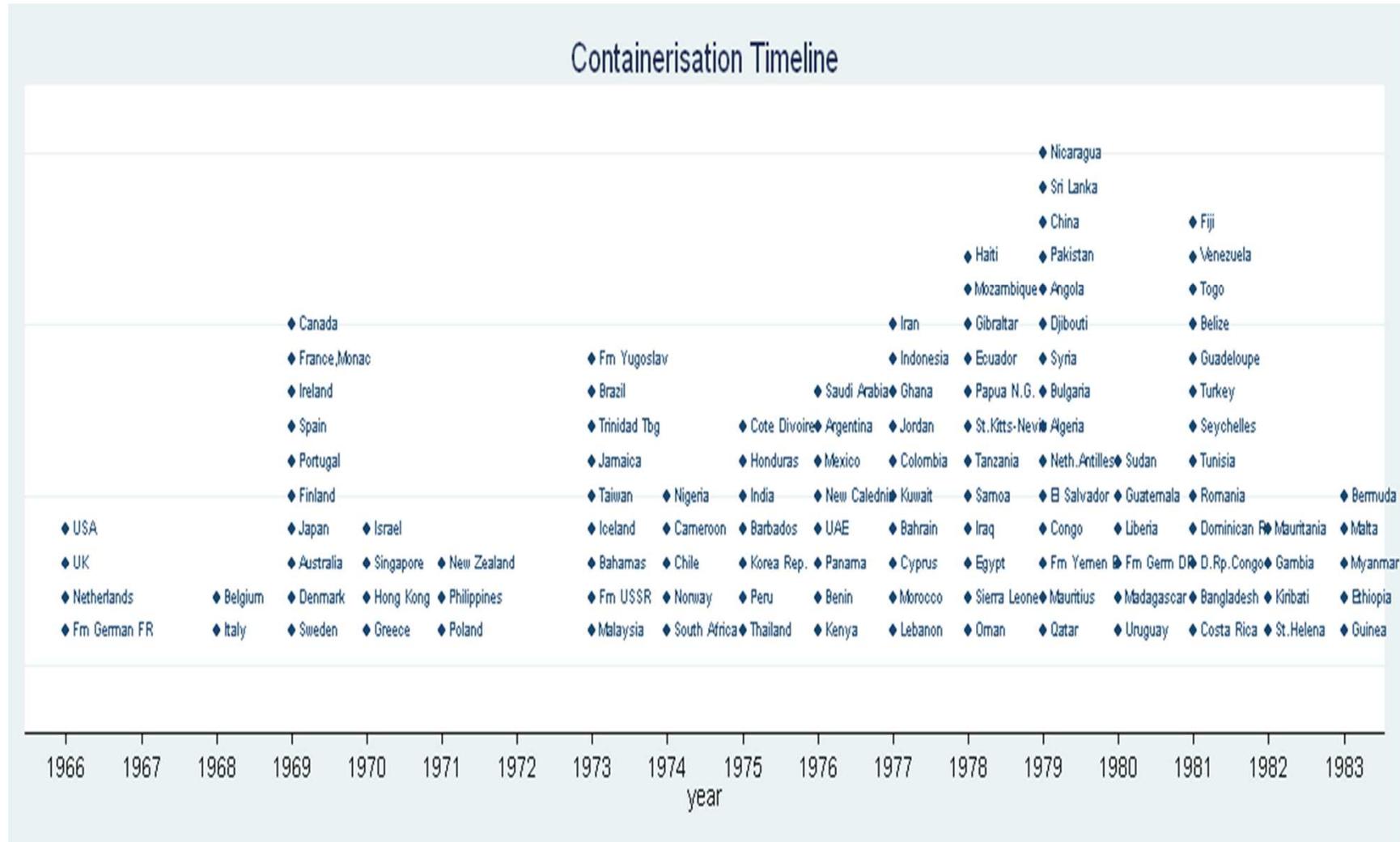
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## Measuring Containerization

- First Container Port in a country identified from *Containerisation International Yearbook* (available 1967 onwards)
- Containerization can be seen as a country  $i$  change, a country  $j$  change or a bilateral change (partial or full containerization)



# Adoption of Containerization (our sample)

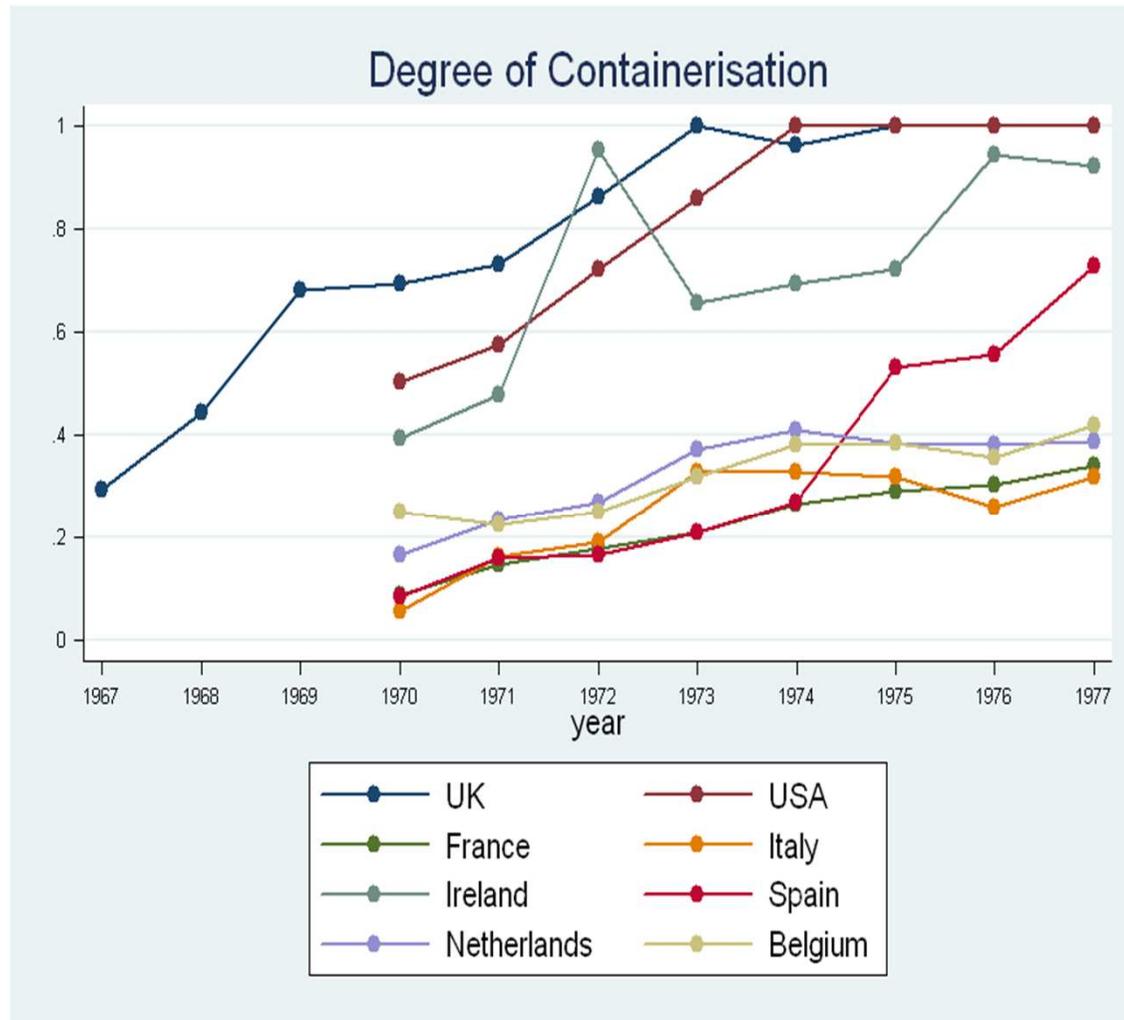


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## Not all products can be containerized

- We anticipate differences in the effects between manufactured trade and total trade
  - Non-containerizable products
    1. **The 5 major bulks:** iron ore, grain, coal, phosphate and bauxite.
    2. **Minor bulks:** steel products, cement, gypsum, non-ferrous metal ores, sugar, salt, sulphur, forest products, wood chips, and chemicals.
    3. **Liquid bulk:** transported in tankers such as oil, oil products, liquid chemicals, vegetable oils, and wines.
    4. **Special bulk:** motor vehicles, steel products, abnormally large installation.
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# Speed of Containerisation Adoption



0/1 variable  
but use data  
from 5-year  
intervals  
(1962, 1967,  
1972, 1977,  
1982, 1987,  
1990)

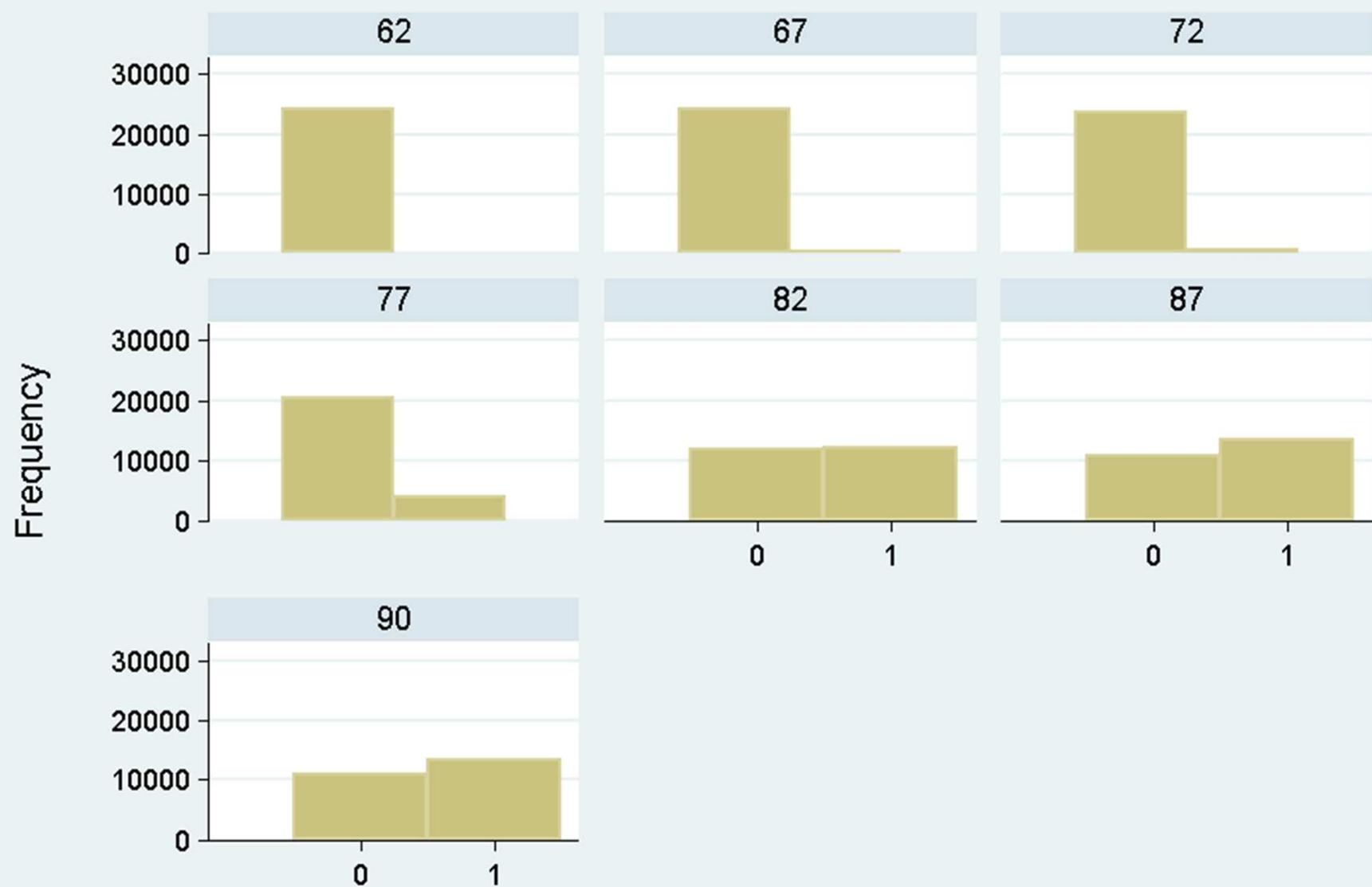
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# Empirical framework

Reduced form Gravity Equation:

$$\ln x_{ijt} = \beta_0 + \beta_1 \ln y_{it} + \beta_2 \ln y_{jt} + \beta_3 D_{ij} + \beta_4 FTA_{ijt} + \beta_5 LANG_{ij} + \beta_6 ADJ_{ij} \\ + \beta_7 \overline{Cont}_{ijt} + u_{ijt}$$

- Standard gravity model
  - The container variables in *cont* vary across i,j,t
  - Concern for endogeneity bias in the effects of containerization
  - Country-time dimension to the bias (include country-time effects)
  - Bilateral dimension to the bias (include country-pair FEs)
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Number of Observations when Both Countries Containerise (per year)

Graphs by year

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# Data

- Period: 1962-1990. (sample of 157 countries, 7 time periods )
    - 1962-1965 pre-adoption period
    - 1966-1983: variation in adoption.
    - 1984-1990: post-adoption period.
  - Indicator variables from *Containerization International*.
  - World trade flows from UN compiled by Feenstra et al.
    - Discard many missing/zero trade values.
  - GDP data from Penn World Tables
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# Empirical Results

Table 1: Base Results: Various Specifications, 5-year Intervals(62,67,72,77,82,87,90)

Dep. Var: ln trade <sub>(ij)</sub>	(1) Manuf	(2) total trade	(3) Manuf	(4) total trade	(5) Manuf (1st Diff)	(6) Manuf
Full Cont <sub>(ij)</sub>	0.466*** (0.0528)	0.218*** (0.0496)	0.089* (0.0498)	-0.037 (0.0461)	0.100** (0.0449)	0.094 (0.0604)
Yrs of part cont						0.000 (0.0046)
FTA	0.404*** (0.0555)	-0.155*** (0.0572)	0.327*** (0.0668)	0.409*** (0.0686)	0.222** (0.0893)	0.326*** (0.0673)
Both GATT	0.403*** (0.0387)	0.111*** (0.0346)	0.019 (0.0516)	-0.026 (0.0453)	0.024 (0.0599)	0.020 (0.0517)
Common Currency	1.330*** (0.0707)	1.127*** (0.0660)	0.406*** (0.1033)	0.526*** (0.0944)	0.209 (0.1250)	0.406*** (0.1033)
ln Dist	-1.195*** (0.0125)	-1.112*** (0.0118)				
Border	0.257*** (0.0488)	0.311*** (0.0495)				
Common Language	0.761*** (0.0251)	0.536*** (0.0233)				
Colony	1.083*** (0.0451)	1.369*** (0.0470)				
Countries	157	157	157	157	157	157
Observations	50413	68508	50413	68508	35415	50413
R <sup>2</sup>	0.7690	0.7304	0.1429	0.0029	0.2382	0.0012
R <sup>2</sup> (within)			0.6601	0.5400		0.6420
Fixed effect	it,jt	it,jt	it,jt,ij	it,jt,ij	it,jt	it,jt,ij



# Containerization in the Comoros Islands



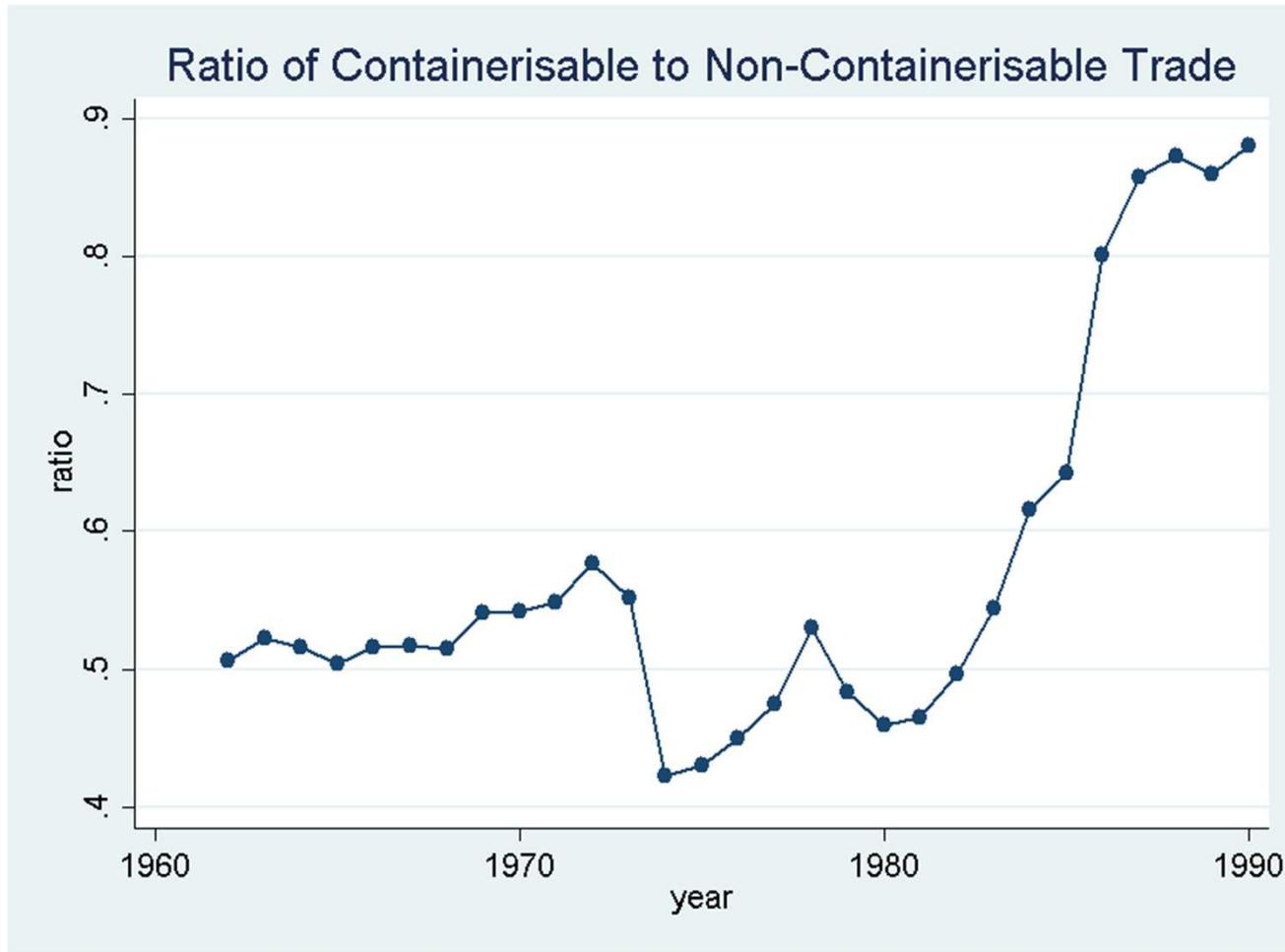
# Empirical Results

Table 3: Testing for Heterogeneity. First Differenced Model: it,jt FE, 5-year Intervals:62,67,72,...

Dep. Var: ln trade(ij)	(13) Manuf	(14) Manuf	(15) Manuf	(16) Manuf	(17) Manuf
dCont(ij)	0.137** (0.0547)	0.091** (0.0457)	0.099** (0.0505)	0.100** (0.0500)	0.099* (0.0510)
dCont*Both High Income	-0.110 (0.0733)				
dCont*Both Mid Income	0.144	(0.1048)			
dCont*Both Low Income			0.097 (0.1008)		
dCont(1st Lag)				-0.004 (0.0515)	
dCont(1st lead)					-0.002 (0.0527)
dFTA	0.221** (0.0891)	0.216** (0.0891)	0.221** (0.0893)	0.202** (0.0904)	0.231** (0.0941)
dFTA(1st Lag)				0.018 (0.0900)	
dFTA(1st lead)					0.152 (0.0970)
dBoth GATT	0.007 (0.0610)	0.008 (0.0610)	0.024 (0.0599)	-0.056 (0.0792)	0.042 (0.0646)
dBoth GATT(1st Lag)				-0.037 (0.0570)	
dBoth GaTT(1st lead)					0.079 (0.0926)
dCommon Currency	0.227* (0.1290)	0.227* (0.1291)	0.209 (0.1250)	0.043 (0.1946)	0.212 (0.1311)
dCommon Currency(1st Lag)				-0.056 (0.1077)	
dCommon Currency(1st lead)					0.052 0.1967
Countries	157	157	157	157	157
Observations	33866	33866	33866	30573	30222
R <sup>2</sup>	0.2391	0.2391	0.2391	0.2428	0.2356
Dummies	it,jt	it,jt	it,jt	it,jt	it,jt



# Containerizable vs. non-containerizable Trade (in values)



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# Future research

- Quantify the contribution to trade
  - Dealing with zeroes.
  - Effect of containerization on the intensive/extensive margin of trade (aggregate and product level).
  - Effect of containerization on reducing fixed costs of exporting.
    - Case study literature argues that manufacturing firms did not have to be located close to ports any more.
    - Requires data for the 1960s-70s
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