Estimating the effects of containerization on world trade[1]

Daniel M. Bernhofen
University of Nottingham, GEP and CESifo

Zouheir El-Sahli
University of Nottingham and GEP

Richard Kneller
University of Nottingham, GEP and CESifo

October 25, 2011.

PRELIMINARY DRAFT,
PLEASE DO NOT QUOTE (YET).

Abstract

World trade has grown tremendously since World War II. The two main contenders for this growth are policy-led trade liberalizations and reductions in transportation costs. The transportation literature and prominent economic commentators –like Paul Krugman- have attributed a large role to the introduction of the container. However, despite the container's alleged impact on the increase in world trade, quantitative evidence on the effects of the container is still missing. Our paper aims to fill this gap in the literature. We capture technological change via containerization by cross-sectional and time series variation in country's adoption of port and railway container facilities. This allows us to apply a treatment approach to estimate the effects of the container on bilateral trade flows during 1962-1990. Applying a variety of fixed effects specifications, we find containerization to have statistically significant and economically large effects on the volume of bilateral trade at the aggregate product level. We find that containerization led to an average increase of between 75% and 100% in trade flows and that the effects were more than twice as large as the effects of trade policy variables. In addition, we find that containerization had a larger effect on North-South than on North-North trade.

JEL classification: F11

---

[1]Addresses for Correspondence: Daniel M. Bernhofen, School of Economics, University of Nottingham, University Park, Nottingham, NG7 2 RD, UK. Tel: 44 115 846 7055, Fax: 44 115 951 4159, email: daniel.bernhofen@nottingham.ac.uk .

1. Introduction

> *"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)*

This paper examines the effects that containerization has had on the growth on bilateral trade in the world economy. We define containerization as a technological change that arises from shipping goods via containers rather than through the traditional break-bulk method which has characterized international shipping since antiquity. Although there is plenty of qualitative and case study evidence suggesting that containerization stimulated international trade, we are not aware of any direct quantitative evidence of the effects of containerization on world trade.[2]

We exploit time and cross sectional variation in countries' first handling of international cargo via container port facilities as an identification strategy for estimating the effects of containerization on bilateral trade. Informed by the container case study literature, we argue that a country's first handling of international container cargo marked an irreversible transformation from break-bulk to container shipping technology. Based on information scattered in transportation industry journals, we find that the introduction of container ports -outside the innovation country of the US- occurred exclusively between 1966 and 1983. We construct then qualitative variables of containerization for a panel of 157 countries and examine the impacts of containerization on world trade during 1962-1990, which could be viewed as the period of global container adoption.

Our paper is related to two literatures. The first literature pertains to the empirical estimation of changes in transportation technology. Starting with Fogel's (1964) pioneering study on the effects of US railroads on economic growth, a number of studies have investigated the effects of railroad construction on economic performance and market integration. Based on detailed archival data from colonial India, Davidson (2010) provides a comprehensive general equilibrium analysis of the impacts resulting from the expansion of India's railroad network during 1853-1930.[3] Exploiting spatial dispersion of 19^{th} century

[2] See Levinsohn (2006) and Donovan and Booney (2006) for good overviews of containerization and references to case studies on the effects of containerization from a business history perspective.

[3] Davidson (2010) tests several hypotheses of the effects of railroads that he derives from a multi-region, multi-commodity Ricardian trade model. Hurd (1975) follows Fogel (1964) in applying a social savings methodology to estimate the impacts of Indian railroad construction.

grain prices, Keller and Shiu (2008) evaluate the relative impacts of railroad technology versus tariff reductions on market integration in the German Zollverein. While the introduction of rail and steamships were the main changes in transportation technology that underpinned the first wave of globalization (1840s-1914), students of transportation technology and prominent commentators link the post World War II growth of world trade to containerization. For example, Paul Krugman writes (2009, p. 7):

> *"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 costs 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 a really strong case to be made that it was the container, which could be hauled off a ship and put onto a truck or a train and moved on. It used to be the case that ports were places with thousands and thousands of longshoremen milling around loading and unloading ships. Now longshoremen are like something out of those science fiction movies in which people have disappeared and been replaced by machines".*

However despite claims about the significance of containerization in contributing to the growth of world trade, systematic evidence on the effects of the adoption of container technology on world trade appears to be missing.

The second related literature pertains to trade costs and its effects on the volume of trade[4]. Broadly defined, trade costs are all the costs that are incurred in shipping a good from a producer to a final user other than the production cost of the good itself[5]. Traditionally, the literature has focused on protectionist border policies, like tariffs and non-tariff barriers to trade. More recently, the literature has paid more attention to 'natural trade costs', like transportation costs, time or other factors affecting communication (like language, culture).

[4] Anderson and van Wincoop (2004) provide a thorough survey of the literature.

[5] This common definition of trade costs is a bit in contrast to the neoclassical (frictionless) view –often attributed to Arrow and Debreu- which postulates that physically identical goods delivered at different locations and times are different goods.

One strand of the literature examines empirical regularities regarding changes in trade costs over time (Montea (1959) and Hummels (2007)). The other major strand examines the impact of changes in trade costs on trade flows or other performance variables, mostly in the context of an econometric gravity specification (see Bergstrand and Egger, 2010, for a good survey).

Despite claims in the business and transportation literature about the alleged importance of 'containerization' in stimulating world trade, the trade cost literature has been surprisingly silent about the impacts of containerization.[6]Two noteworthy exceptions are Hummels (2007) and Blonigen and Wilson (2008).[7]Exploiting German data on ocean liner shipping rates, Hummels (2007) detected an actual increase in ocean shipping rates during the time period 1974-84 that coincides with the period of major containerization. Using commodity data on US trade flows, Hummels finds that freight cost reductions from increasing an exporter's share of containerized trade have been eroded by the increase in fuel costs resulting from the 1970s hike in oil prices. Hummels (2007, p.144) concludes then that "…the real gains from containerization might come from quality changes in transportation services…To the extent that these quality improvements do not show up in measured price indices, the indices understate the value of the technological change".

Building on Clark et al. (2004) in examining the effects of port efficiency measures on bilateral trade flows, Blonigen and Wilson (2008) also estimate the effects of increased container usage on reducing the import charges for US imports during 1991-2003. They find that increasing the share of trade that is containerized by 1 percent lowers shipping costs by only 0.05 percent.

The few studies that aim to quantify the effects of containerization have primarily focused on the effects of port to port transportation costs after countries' adoption of container technology. However, the transportation literature stresses that the main resource savings from containerization stem from the container-induced overhaul of the transportation system that eliminated as many as a dozen different handlings and linked the producer more directly with the customer. There are qualitative aspects of containerization - like the creation of entirely new container ports- that the above mentioned studies do not capture. In particular, time savings, volume effects and the reduction of pilferage.

[6] Limao and Venables (2001) use actual company quotes for shipping a standard container from Baltimore to various destinations to estimate a transport cost function. But their study does estimate the effects of containerization.

[7] In a non-trade context, Kim and Sachish (1986) show that 85% of total factor productivity growth in an Israeli port during 1966-1983 can be attributed to containerization and only 15% due to economies of scale and output growth.

We argue that capturing the effects of containerization should employ a data domain that includes the period prior to containerization and should exclude periods characterized by other major changes in transportation technologies. Containerization was invented and first commercially implemented in the US during the mid 1950s. Following 10 years of US refinement in port and container ship technologies, containerization started to spread around the globe in 1966 and the adoption period was pretty much completed in 1983. Fortunately, the container adoption period 1966-1983 proceeded the period of international airline deregulations of the early 1990s which –in tandem with aircraft innovations- resulted in dramatic reductions in the costs of air transport[8].

We apply a fixed effect panel approach to estimate the effects of containerization on trade flows during what we call the early years 1962-1990 of the container age. We view containerization as a technological change manifested by countries' investment in container facilities which typically came under government ownership. We make distinction between two modes of transportation: shipping (ports) and railway. We capture containerization as a country specific qualitative variable that switches from 0 to 1 when a country starts containerization. Containerization in a bilateral trading relationship occurs when both the origin and destination countries have containerized. Variations in countries' decisions to containerize allow estimating the average treatments effects of full containerization on bilateral aggregate commodity trade flows during the adoption years of the container.

The panel nature of our data enables us to apply empirical models of treatments effects (Wooldridge, 2002) which have also been recently exploited in estimates of the effects of free trade agreements (FTAs) on bilateral trade flows (Baier and Bergstrand, 2007).
The inclusion of country-and-time effects allows us to capture multi-lateral resistance identified by the structural gravity literature and other time-varying factors that might be correlated with countries' decisions to invest in container ports. Difficult to measure geographic factors, like government desires to act as container port hubs, are captured by country-pair specific fixed effects.

Since the country-time effects are collinear with the opening of container port facilities, we can only estimate the effects of containerization when origin and destination country both containerize. Identification of the effects of containerization therefore comes from the within country-pair change in trade following the adoption of container technology, controlling for any common changes in trade volumes that occurs for the exporting country

[8] Unfortunately, there is limited international data on the value of trade by different modes of transportation.

with all its other importing countries, as well common changes to trade flows for the importing country with all remaining countries from which it receives internally traded goods. We also examine whether the effects of containerization decay or increase over time, or whether they precede the opening of the first container port in that bilateral pair.

Our empirical evidence suggests a strong statistically significant effect from the adoption of containerization on bilateral trade flows in products at the 1- and 4-digit level. Once we control for the possible effects of endogeneity bias on our estimates, we estimate that containerization led to an increase in bilateral trade flows of between 75% and 100% at the product level. The effect of containerization on trade in products at the 1- and 4-digit levels is estimated to be at least two folds of the effect of trade policy liberalization, depending on the measure of trade policy being considered. We also find that the effects of containerization do not differ according to the level of disaggregation or whether the product is containerizable or non-containerizable. We take from this that even though our measure of containerization is based on the first opening of a container port within a country or adoption by railways, it captures at least some of the broader effects that containerization had such as supporting improvements in rail and road infrastructures.

The next section provides a brief historical background on containerization and a discussion of the measurement of technological change which is central to our identification strategy. Section 3 introduces our empirical specifications, describes the data and discusses the results. Section 4 concludes.

2. A brief history on the origins and timing of containerization

Before the advent of containerization, items were wrapped, loaded and stored individually for shipment. Before World War II, US, British and French railway companies experimented with methods of sealing goods in different sizes and shapes of boxes before transporting them. However, the lack of specialized capital equipment like specialized cranes for loading and loading combined with union resistance to changes in work practices at the docks delayed the development of container shipping until the mid 1950s.

The genesis of the container revolution goes back to April 26, 1956 when the first containership, the *Ideal X* travelled from Newark, New Jersey to Houston, Texas with 58 containers. The Ideal X was a converted World War II tanker that was redesigned to carry containers on its deck. As so common in the history of innovation, the breakthrough of containerized shipping came from someone outside the industry, Malcolm McLean a trucking entrepreneur from North Carolina. Concerned about increased US highway congestion in the

1950s when US coastwise shipping was widely seen as an unprofitable business, McLean's central idea was to integrate coastwise shipping with his trucking business in an era where trucking and shipping were segmented industries. His fundamental insight was the creation of an integrated transportation system that moved cargo from the producer to the consumer.

The immediate success of the first US container journey resulted from the large cost savings from the mechanized loading and unloading of containerized cargos. The estimated costs of loading the *Ideal X* were estimated to be 15.8 cents per ton which were in stark contrast to the $ 5.86 per ton for loading loose cargo on a medium sized cargo ship. The large costs of loading and unloading cargo via the break-bulk method resulting from having to move cartons, bags, boxes etc. piece by piece by dockworkers: from truck or railcar to the warehouse, from the warehouse onto the ship, down from the ship at the destination port, to the warehouse and then again on the truck or railcar. Containerization revolutionized this multiple handling of cargo by increasing port labor productivity from 0.627 tons per man hour in 1959 to 4234 tons per man hour in 1976 (Matson research).

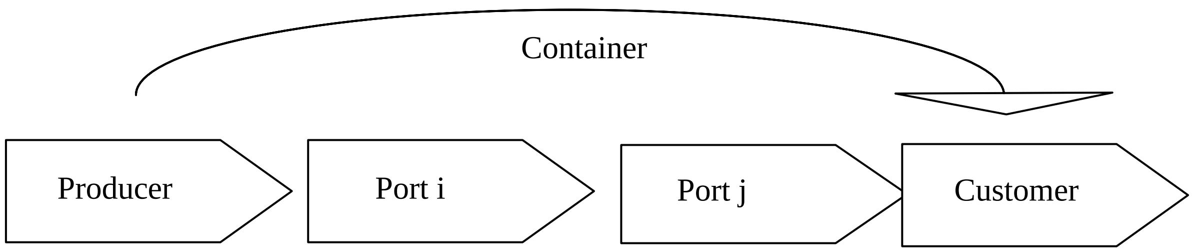
The 1956 container operation by the *Ideal X* involved a ship and cranes that were designed for other purposes. Three years later the industry saw additional savings through the building of purpose-built container cranes followed by the building of large purpose-built containerships. Investment in larger shipping capacity became now profitable since containerization reduced a ship's average time in port from 3 weeks to 18 hours (Matson research)[9]. By the early 1960s, containerization was firmly established on routes between the US mainland and Puerto Rico, Hawaii and Alaska. Containerization required major changes in port facilities, which often led to the creation of new container ports, like Newark and Oakland, which took business from traditional ports like New York and San Francisco. Ten years of advancement in US container technology set the foundation for the world-wide spread of containerization in the mid 1960s.

From a transportation technology perspective, containerization resulted in the introduction of intermodal freight transport, since the shipment of a container can use multiple modes of transportation -ship, rail or truck- without any handling of the freight when changing modes. By eliminating sometimes as many as a dozen separate handlings of the cargo, the container resulted in linking the producer closer to the customer (see Figure 1). Since containerization is about the total resource savings of shipping a good from the

[9] Containerization led to dramatic improvements in shipping capacity and port efficiency, but not so much in journey time. The average speed of a commercial vessel increased from 16 knots in 1950 to 23 knots in 1976 and 25 knots today.

manufacturer to the customer, it is more comprehensive than the standard ice-berg modeling of trade costs which focuses on the resources required to ship goods between two ports.

Figure 1: Intermodal transport: linking the producer closer to the customer



The age of the global use of the container in international shipping started in 1966, when the US, the United Kingdom, the Netherlands and West Germany first started to use container technology in their bilateral trade. Since containers can be shipped through different modes of transport, the speed of the replacement of break-bulk shipping by container technology is in general difficult to capture at the economy level. However, for an island economy like the UK, where all international trade has to go through sea ports, it is possible to measure the speed of container technology adoption using available information on total containerized tonnage handled at ports.[10] Figure 2 depicts the time line of an index of the economy wide degree of containerization that we were able to construct for the UK for the period of 1965-1979. The index is the ratio of container tonnage at all UK ports to the UK's total containerizable trade in a specific year. The construction recognizes that all not all commodities are containerizable. A detailed discussion of how products are classified as containerizable will be discussed below. Figure 2 reveals that the degree of container adoption in the UK was quite rapid. The index grew from around 25% in 1967 (the year after containerization started) to about 80% in 1973, after which it remained relatively flat.

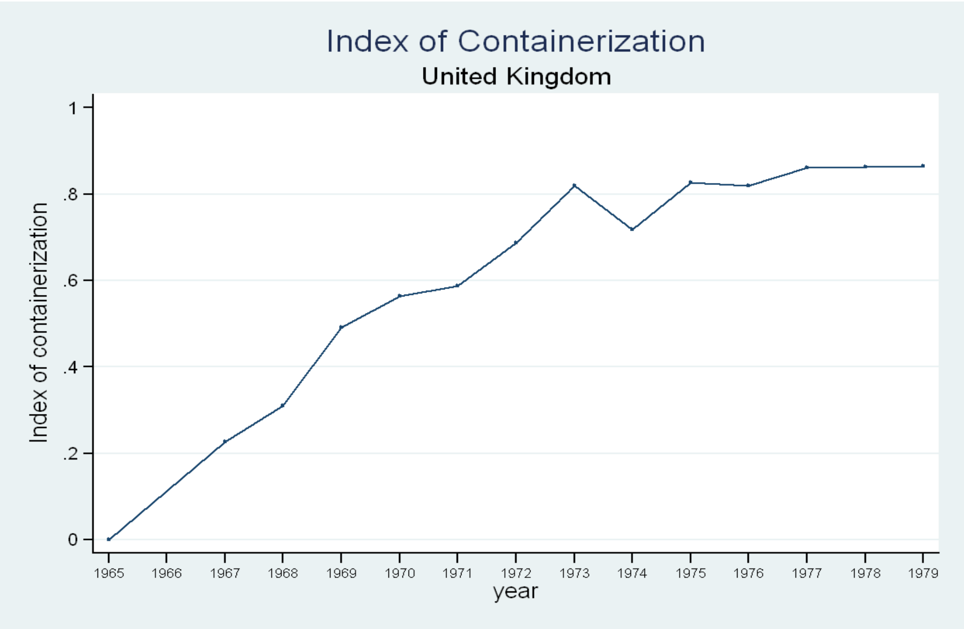
The introduction of container technology started with a country's investment in container port facilities but quickly progressed to engulf other parts of the transportation network of a country to avoid congestion at the port. Figure 3 provides a time line of countries' first processing of international port cargo using container technology. Container adoption in international trade started in 1966 and the last countries in our sample started to containerize in 1983. From an underlying overall sample of 157 countries in a sample period

[10] Comparable data on container tonnage going by railway or trucks is not available.

of 1962-1990, 118 countries containerized between 1966-1983, 18 countries remained uncontainerized and 21 countries did not in port technology since they were landlocked.[11]

A main message of Figure 3 is the considerable cross-sectional and time variation of countries' adoption of container port facilities during the sample period, which we will exploit to estimate the effects of containerization on international trade.

Figure 2: Speed of Container adoption in the UK



Source: Authors' own calculation.

Containerization was quickly picked up by railways in different countries. For example, in response to port containerization, and in an effort to avoid being left out, the railways of Europe came together in 1967 and formed *Intercontainer*, The International Association for Transcontainer Traffic. This company was formed to handle containers on the Continent and compete with traditional shipping lines.[12] Railway containerization allowed landlocked countries like Austria and Switzerland to ship their goods in containers to sea ports in neighboring countries destined to overseas destinations. In many cases, this was cheaper and less laborious than road transportation. In a comprehensive cost study for the UK, McKinsey (1967) calculated that container transport was cheaper by rail than truck for journeys above 100 miles. *Containerisation International* (1972) estimated that the cost of

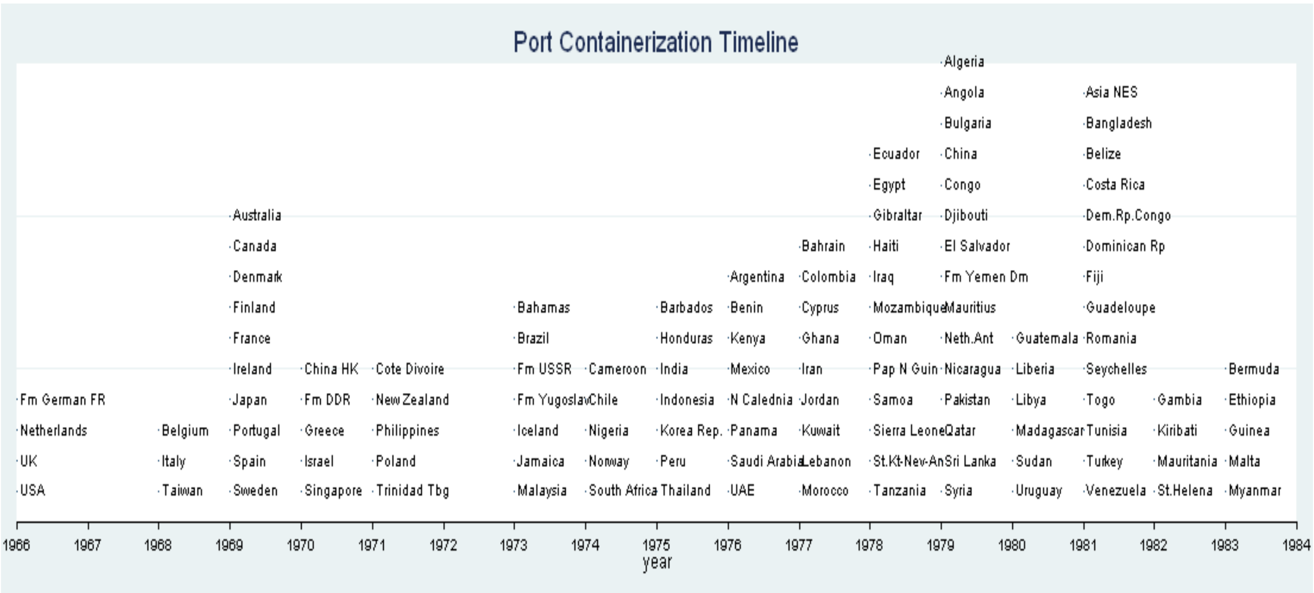
[11] Table 1 in the Appendix lists all countries in our sample with respect to the different countries. Table 2 in the Appendix gives the containerization time line by income category.

[12] At the time, British Rail was already operating a cellular ship service between Harwich, Zeebruegge and Rotterdam and a freightliner service between London and Paris. Initially 11 European countries formed Intercontainer and were later joined by 8 more.

moving 1 TEU (twenty foot equivalent unit container) between Paris and Cologne in 1972 was about FFr 1,025, which was about 75% of the equivalent road costs.

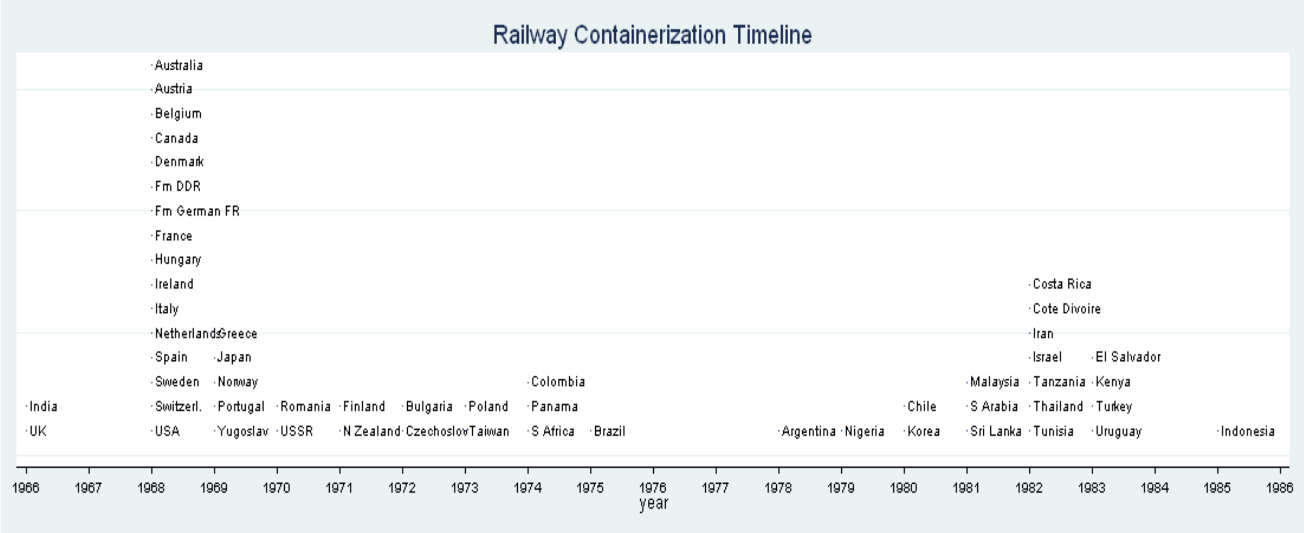
Figure 4 provides the timeline of countries' adoption of containerization through their railways. Figure 4 reveals that most countries adopted railway container technology shortly after the introduction of container ports. The information in Table 4 will be especially useful to identify when landlocked countries adopted container technology. Taken together, Figures 3 and 4 provide a comprehensive picture about the timing of container adoption for transportation by sea and rail.

Figure 3: Time line of Port Containerization



Source: Authors' compilation from various issues of *Containerisation International(1970-1992).*

Figure 4: Time line of Railway Containerization



Source: Authors' compilation from various issues of *Containerisation International(1970-1992).*

3. Empirical implementation

3.1. Capturing containerization

Our objective is to estimate the effect of containerization on international trade. In contrast to earlier studies, which capture containerization by the degree of container usage of ports after the introduction of container technology, our study exploits time variation in countries' adoption of port and railway container technology. Using a treatment approach suggests a sample examination period which includes years prior to the use of containerization in international trade (before 1966), the period of global adoption (1966-1983) and years in the post-adoption period (after 1983).

We capture containerization by a qualitative variable defined on a country pair (i,j). Based on the data in Figures 3, we define a port containerization variable as:

$$PortCont_{ijt} = \begin{cases} 1 & if\ i\ and\ j\ have\ both\ containerized\ ports\ at\ time\ t \\ 0 & otherwise \end{cases} \quad (1)$$

Recognizing that containerization encompasses transportation by sea as well as rail, we use the data in Figures 3 and 4 to define a second containerization variable as:

$$FullCont_{ijt} = \begin{cases} 1 & if\ i\ and\ j\ have\ both\ containerized\ ports\ or\ railways\ at\ time\ t \\ 0 & otherwise \end{cases} \quad (2)$$

The construction of these variables assumes a bilateral trade flow between countries i and j to be 'treated by containerization ' if both countries have adopted the technology at time t.

As Figure 1 makes clear we might view the trade route between two countries as being either partly, only one of the ports has container facilities, or fully containerized when both the origin and destination ports are using the same technology. We concentrate our analysis on the effects on trade of both countries using containers, although we also search for evidence of any effect from the partial containerization of trade. During time periods where only a handful of countries started to containerize, container ships were travelling with specialized onboard cranes which allowed for the unloading of containers at destination ports without container facilities[13]. However, the use of cranes on ships is likely to be less efficient than when both the origin and destination country are using the same technology. In defining the containerization in this way we exploit differences in the adoption of the technology across the many countries that make up our dataset and time.

3.2 Empirical specification

Since the container transportation literature suggests that not all products are containerizable, our dependent variable pertains to the bilateral trade flow from country i to country j in product group k at time t, x_{ijkt}. The advantage of conducting the analysis at the product is that we can exploit information from the container literature which allows us to categorize products according their degree of containerizability at the 1 and 4-digit industry classification. Our core empirical specification is given by:

$$\ln x_{ijkt} = \beta_0 + \beta_1 Cont_{ijt} + \beta_2 Policy_{ijt} + \boldsymbol{\beta_3} \overrightarrow{\boldsymbol{D_{ijkt}}} + u_{ijkt}, \tag{3}$$

where $Cont_{ijt}$ pertains to one of the container variables in (1) and (2), $Policy_{ijt}$ pertains to time-varying changes in bilateral policy variables, $\overrightarrow{\boldsymbol{D_{ijkt}}}$ includes a (large) vector of country, time and product specific fixed effects and u_{ijkt} denotes the error term.

Our time framework has been dictated by availability of bilateral trade data at the product level and the containerization timelines reported in Figures 3 and 4. Fortunately, the world trade data set compiled by Feenstra et al. (2005) goes back to 1962 and covers bilateral

[13] For example, we were surprised to find pictures on the internet that show containers being offloaded on high see on smaller boats to get them onshore in the Comoros Islands which lacked container facilities in the late 1980s.

trade flows from 1962-2000 at the 4-digit industry level.[14] Since the adoption of containerization started in 1966 and ended in 1983, we chose 1962-1987 as our sample period. Following the advice of the panel literature (Woolridge, 2000) we examine changes in trade flows at 5 year intervals. In our context, the advantage of focusing on 5 year variations is that it mitigates the effect of differences in the speed of adoption as well as the allowing time for the build-up of the intermodal transport system. So we have five 5-year periods, with the first period (1962-1967) including a few years of pre-containerization and the last period (1982-1987) includes a few years of post-containerization.

Our panel covers a sample of 157 countries. However, the panel data set is unbalanced since many observations on trade flows are either zeroes or missing. As a result, we only consider observations with positive trade flows.[15] However, the advantage of this data set is that it is the most comprehensive data set on bilateral trade flows which breaks down trade flows to the 4-digit SITC level, allowing us to study the effect of containerization at the product level.

An important concern that arises when trying to identify the effects of containerization on trade flows is their possible correlation with the error term, such that the variable is endogenous and therefore OLS yields biased and inconsistent coefficient estimates. As discussed by Baier and Bergstrand (2007) in the context of the effect of FTAs on trade, of the potential sources of endogeneity bias (omitted variables, simultaneity and measurement error) perhaps most important is the potential omission of other relevant variables. We anticipate that there will be both a country-time and bilateral component to this bias.

Containerization started as a private endeavor by the shipping lines. In the early stages, shipping lines had to bear most of the costs since many ports such as New York and London were reluctant to spend significant funds on 'a new technology' with uncertain returns at the time. Many shipping lines had to operate from small and formerly unknown ports and install their own cranes. The process was extremely expensive. After the container proved to be successful, ports warmed up to containerization and a race started among ports to attract the most shipping lines by building new terminals and providing the infrastructure to handle containers. In many countries, port authorities fall under the administration of the government. Because of the high costs, careful planning and analysis had to be undertaken by governments to study the feasibility of containerization. In the UK, the government

[14] The data set is constructed from the United Nations trade data and is available from NBER.
[15] Also for 1984-2000, the data set covers only bilateral trade involving a subset 72 countries (i.e. bilateral trade among the 72 and of each country of the subset with a 'rest of the world' country).

commissioned McKinsey (1967) to conduct a cost and benefit analysis before spending significant public funds on containerization. The McKinsey report focused on the cost savings and potential economies of scale brought about by the container and how these would benefit UK trade in general.[16]

This suggests that the decision to invest in container facilities is likely to be affected by the government beliefs about the trade potential of a country relative to current levels and may change over time with changes to the ruling party's attitude towards free trade and port inefficiencies. These are also factors that are likely to affect difficult to measure aspects of the broader domestic policy environment which are likely to affect trade flows. We control for such effect though the inclusion of country-time dummies for both country *i* and country *j* in equation (3).

While the decision to invest in container port facilities is potentially affected by omitted country-time factors that also affect trade, there may also be a bilateral component to this investment. The location for container port facilities by a country are likely to be affected by geographic factors, they require deep water channels for example, as well as domestic and foreign demand considerations. For example, the first container port facilities in Italy were located in Genoa, in part because Northern Italy is a major centre of industrial production but also in order to provide easier access to the Western Mediterranean and the Atlantic sea routes and in order that this port would be used to serve Austria and Switzerland with containerized goods.[17]More generally containerization has displayed a hub-and-spoke pattern: large container ports at Rotterdam, Hong Kong and Singapore are used as hubs from which to serve smaller ports. The location of container port facilities in one country may therefore affect the location chosen for container port facilities by later adopters. This may lead to a positive correlation between the location of container port facilities and the error term in the gravity model and therefore a need to control for all observable and unobservable determinants of trade flows between two countries to prevent an upward bias on the containerization variable. We control for this in the regression using a vector $\overrightarrow{\boldsymbol{D_{ijt}}}$ of fixed effects.

---

[16] Nowhere in the report was there a mention of promoting a specific trade route being a reason to containerize.
[17]The investments in capital to allow containerization to occur are large. There is evidence that suggests containerization led to the rise and fall of ports (Levinson (2006), p. 76ff). Certainly in the beginning, the decision to containerize by a port was a strategic decision. Many ports in Europe and the United States raced to containerize to attract business from shipping lines. In New York, the decision of the port not to containerize led to its demise. Ports Elizabeth and Newark in New Jersey became successful because of their decisions to invest in container facilities. In the UK the ports in London and Liverpool declined at the expense of Felixstowe. In Europe, the ports of Rotterdam and Bremen were fast to adopt the new technology and accommodated the first transatlantic trip.

The effects of containerization are therefore identified in our empirical framework using the within country-pair variation in trade following the start of containerized trade by both countries, conditional on common changes to trade with other countries in that time period for the importer and exporter. We also note that fixed effect specifications have also been used to avoid omitted variable biases associated with multilateral resistance terms identified from the structural approach to gravity (see Bergstrand and Egger (2010) and Feenstra (2004) for good surveys of the gravity literature). The inclusion of country-time as well as country-pair fixed effects in the gravity model removes the need to include all time varying country specific factors such as GDP and GDP per capita, as well as time invariant country-pair specific factors such as distance, border dummies, common language etc in equation (1). A disadvantage of this approach is that the effects of containerization are determined only when the two countries containerize in different time periods (where they occur in the same time period the effect is captured by the country-time effects). If both countries adopting the technology in the same time periods has a different effect to trade volumes compared to when they differ this will affect our estimated effect of containerization. The use of fixed-effects also suggests that countries that never containerize could be excluded from the sample. We include them in order to improve the efficiency with which the country-time effects are estimated.

We opted for first differencing the data across 5-year time periods such that our dependent variable becomes $\text{dln}\boldsymbol{x}_{\boldsymbol{ijk},\boldsymbol{t}-(\boldsymbol{t}-\boldsymbol{1})}$. Woolridge (2002, chapter 10) suggests that first-differencing a panel data set yields advantages if unobserved heterogeneity in trade flows is correlated over time. In our context, by differencing the data we remove the need to include *ijk* fixed effects and has also the advantage of not assuming that *ijk* effects are time invariant.[18] In all of our specifications, we include country-time effects *it*, *jt* to account for multi-lateral resistance and product time-effects *kt*. So we regress $\text{dln}\boldsymbol{x}_{\boldsymbol{ij},\boldsymbol{t}-(\boldsymbol{t}-\boldsymbol{1})}$ on $\boldsymbol{Cont}_{\boldsymbol{ij},\boldsymbol{t}-(\boldsymbol{t}-\boldsymbol{1})}$ and the other first differenced country-pair time-variant policy variables like being in a free trade agreement (FTA), being a member in the GATT or having a common currency (Common Cur) at time *t*.

[18] Also given the limits of available computer power available to us first differencing is a necessary transformation of the data.

3.3. Measuring product containerizability

We identify the containerization at the product using the 1971 classification provided by *Containerisation International*[19]. The publication classifies products at the 3- or 4-digit level as suitable for containerization, those that have limited suitability, and those that are unsuitable. The classification is made based on the physical nature of the product and its properties. For instance, some commodities are shipped in 'bulk' and not in containers. 'Bulk' in shipping refers to cargoes that are shipped in complete shiploads (in the holds of ships). Such cargoes include coal, grain, timber, ores, fertilizers, copra etc. These are commodities that are either traded in such big amounts and are therefore unfeasible to containerize or their nature does not allow their transport in containers (wheat)[20]. We use this information to classify a 4-digit product category as either containerizable or not. Containerizability is viewed as a binary variable.

Since the 4-digit is quite disaggregated for examining bilateral, we also construct a 1-digit measure of containerizability from the 4-digit binary variable. Specifically, we construct a 1-digit variable as a weighted average of the 4-digit variables, using 1962 US trade (imports and exports) as the weight. We chose the US since it is the country with the longest history of using the container. Since the aggregate measure turns out to be clustered around 3 values, we categorize 1-digit industries either as highly containerizable, medium containerizable or not containerizable. A list of the 1-digit industries and their classification is given in Table 3 of the Appendix.

3.4 Baseline estimates

Table 1 contains the estimates of our baseline specification. The upper panel gives the estimates of the full containerization variable (2) and the lower panel of the port containerization variable (1). The first three columns give the regression results at the 1-digit level for different samples: high containerizable products, high and medium containerizable, all products. The last two columns give the results for containerizable and all products at the 4-digit level. Overall, we find containerization to have statistically significant and

[19]Containerisation International Yearbook 1971

[20]Martin Stopford in his book, *Maritime Economics* lists four main categories of bulk cargo that are not shipped in containers. 1) Liquid bulk: transported in tankers such as oil, oil products, liquid chemicals, vegetable oils, and wine. 2) The five major bulks: iron ore, grain, coal, phosphates and bauxite. These are transported in shiploads in the holds of ships. 3) Minor bulks: This category covers the many other commodities that travel in shiploads. Most important are steel products, cement, gypsum, non-ferrous metal ores, sugar, salt, sulphur, forest products, wood chips and chemicals. 4) Specialist bulk cargoes: Motor vehicles, steel products, refrigerated cargo, and abnormally large structures such as offshore installations.

economically large effects on changes in the volume of bilateral trade. A comparison between the 1-digit and 4-digit estimates suggests that the level of aggregation does not appear to matter. Consider the whole product samples, the coefficient estimate of 0.679 suggests an average treatment effect of full containerization of 97% (=1-$e^{0.68}$) at the 1-digit level and of 93% (=1-$e^{0.66}$) at the 4-digit. As expected, the corresponding coefficients on port containerizations are 87% and 72%. An interesting finding is that the estimates are not much different if the sample is reduced to containerizable products. This could be explained by increased overall efficiencies resulting from containerization or by complementary relationships. For example, technological change reducing the trade costs of international trade in (containerizable) car parts is expected to increase overall demand and trade in (noncontainerizable) automobiles.

Table 1: Baseline estimates at 1 and 4-digit industry levels

	Dep.Var: ln trade(ijk)	1-digit industry level			4-digit product Level	
		1st Diff (by ijk)	1st Diff (by ijk)	1st Diff (by ij)	1st Diff (by ijk)	1st Diff (by ijk)
		Highly Containerizable	High and Medium Containerizability	All products	Containerizable	All products
Port and Railway	Full Cont(ij)	0.650***	0.642***	0.679***	0.622***	0.656***
		(0.0270)	(0.0182)	(0.0176)	(0.0065)	(0.0057)
	FTA	0.358***	0.267***	0.303***	0.336***	0.343***
		(0.0535)	(0.0380)	(0.0366)	(0.0093)	(0.0082)
	Both GATT	0.183***	0.239***	0.275***	0.343***	0.349***
		(0.0365)	(0.0247)	(0.0242)	(0.0098)	(0.0088)
	Common Curr	0.181**	0.088	0.088*	0.133**	0.128***
		(0.0765)	(0.0528)	(0.0513)	(0.0167)	(0.0149)
	No. Countries	157	157	157	157	157
	No. Observations	90306	209420	237106	1727832	2237820
	overall R^2	0.1553	0.1194	0.1078	0.1054	0.0967
	Fixed effect	it,jt,kt	it,jt,kt	it,jt,kt	it,jt,kt	it,jt,kt
Port Containerization	Port Cont(ij)	0.569***	0.565***	0.625***	0.506***	0.545***
		(0.0259)	(0.0176)	(0.0171)	(0.0060)	(0.0053)
	FTA	0.327***	0.237***	0.277***	0.324***	0.331***
		(0.0535)	(0.0380)	(0.0365)	(0.0093)	(0.0082)
	Both GATT	0.195***	0.247***	0.286***	0.376***	0.386***
		(0.0365)	(0.0247)	(0.0242)	(0.0098)	(0.0088)
	Common Curr	0.181**	0.090*	0.089*	0.134***	0.129***
		(0.0765)	(0.0528)	(0.0513)	(0.0167)	(0.0149)
	No. Countries	157	157	157	157	157
	No. Observations	90306	209420	237106	1727832	2237820
	overall R^2	0.1543	0.1184	0.1072	0.1045	0.0957
	Fixed effect	it,jt,kt	it,jt,kt	it,jt,kt	it,jt,kt	it,jt,kt

Coefficients marked with *,**,*** denote significance at the 10%, 5% and 1% levels respectively.

How does this compare to the trade policy variables that we include in the regression? We include three sets of policy variables. The FTA dummy indicates whether a country pair i,j belonged either to the same regional free trade block or had a free trade agreement in a specific year. The common currency control switches to 1 to indicate whether countries i and j share a common currency. In addition, we control for membership of the GATT, the precursor of the WTO, according to whether both the originator and the destination are GATT members.

We find that the estimated effects of containerization are generally much bigger than the of trade policy variables. For example, in column (3), the coefficient of the FTA variable is 0.303, which corresponds to an average treatment effect of 34% ($=1\text{-}e^{0.30}$), which is about a third of the effect of full containerization. It is reassuring that our estimated FTA coefficient is roughly the same as the estimate provided by Baier and Bergstrand (2007, p.91), whose consider a panel data that goes to 2000. While the GATT coefficient is quite similar in magnitude to the FTA coefficient, the coefficient on the common currency is only about a tenth of the container coefficient and also only significant at the 10% level. Overall, the results in Table 1 reveal that the inclusion of railway containerization increases the overall average treatment effect by between 10 and 20% and that effect of containerization are between two to three times as large as the trade policy variables. Given the similarities between the 1 and 4-digit results, the remaining regressions pertain to the sample of all 1-digit industries.

3.5 Lagged effects

Thus far we have assumed that containerization is correctly modeled as a one-off shift to the level of trade that occurs when both countries adopt the container, where in the first-differenced model this occurs only in the 5-year period in which the technology was adopted. This assumption was adopted firstly given the case study evidence that much of the experimentation with containerization technology occurred in the US in the decade prior to the internationalization of container technology and secondly from the evidence that the development of new products and the fragmentation of the production chain also attributed to containerization required complementary physical and managerial technological change, in particular in ICT and just-in-time inventory management, and occurred some time after our sample window.

Table 2: Estimates including lagged effects

Dep. Var: ln trade(ijk)	1st Diff(by ijk)	1st Diff(by ijk)
Full Cont(ij)	1.462***	1.625***
	(0.0301)	(0.0363)
1st lag Cont(ij)	0.558***	0.946***
	(0.0265)	(0.0371)
2nd lag Cont(ij)	0.124***	0.380***
	(0.0235)	(0.0339)
3rd lag Cont(ij)		0.161***
		(0.0318)
1st lead Cont(ij)	0.161***	0.079***
	(0.0224)	(0.0236)
Partial Cont	0.893***	1.299***
	(0.0212)	(0.0258)
1st lag PartCont		0.678***
		(0.0221)
FTA	0.222***	0.216***
	(0.0386)	(0.0452)
1st lag FTA	0.100***	0.059
	(0.0383)	(0.0395)
2nd lag FTA	0.083*	0.076
	(0.0487)	(0.0489)
3rd lag FTA		-0.049
		(0.0549)
1st lead FTA	0.135***	0.119**
	(0.0467)	(0.0497)
Both GATT	0.118***	0.084***
	(0.0278)	(0.0289)
1st lag Both GATT	0.055**	0.013
	(0.0260)	(0.0271)
2nd lag Both GATT	0.009	0.014
	(0.0255)	(0.0290)
3rd lag Both GATT		0.082***
		(0.0298)
1st lead Both GATT	-0.069**	-0.079**
	(0.0330)	(0.0338)
Common Currency	0.405***	0.033
	(0.1168)	(0.1339)
1st lag Com Cur	0.123	-0.028
	(0,0843)	(0.1208)
2nd lag Com Cur	0.029	0.130
	(0.0582)	(0.0948)
3rd lag Com Cur		(0.067)
		(0.0640)
1st lead Com Cur	0.212	-0.190
	(0.1715)	(0.2155)
No. Countries	157	157
No. Observations	197611	176927
Total ATE	3.198	5.168
overall R^2	0.1240	0.1311
Fixed effect	it,jt,kt	it,jt,kt

Coefficients marked with *,**,*** denote significance at the 10%, 5% and 1% levels respectively.
Total ATE is the sum of statistically significant container coefficient estimates.

In Table 2 we search for evidence of lagged effects from containerization, as well as whether trade was affected from partial containerization, which we define as when only one country in a given country-pair has the container technology. Finally we also conduct a falsification test by exploring whether the container variable captures the effect of the introduction of this new transportation technology rather than any trend to bilateral trade that was also present prior to the adoption of containerization. If the effect captured by the container dummy were simply related to trends already present in trade between that country-pair, we would expect the coefficient on years prior to the adoption of the container to be as large and significant as the coefficient on our variable of interest.

Focusing first on the results for lags of the container variable we find evidence in column 1 that the effects of containerization did decay across time, although still had a positive influence on trade some 20 years after the first adoption of the technology. According to the estimates in this regression the contemporaneous effect of containerization was 316%, followed by 75% and 13% over the next two 5-year periods. In column 2 of Table 2 we find that trade was still 17% above the level expected without containerization up to 20 years after containerization started. [The total average treatment effect is a staggering 565% in column 1 and a 1000%. in column 2...]

In the early years of containerization, ships reduced the need for large investments in port infrastructure to load and un-load containers by having cranes attached to the ship. This raises the possibility that partial containerization of a bilateral trade route may also positively affect trade, although we might anticipate that the effect would be smaller compared to when both countries have completed the construction of dedicated container ports and railway facilities. We capture this partial containerization effect in column 1 using a variable constructed according to whether either country in each country-pair has containerized, while in column 2 we test for possible lagged effects.

We find support for our hypothesis that partial containerization was had an important effect on trade, although to a lesser extent compared to when both countries containerize. In column 1 we estimate that partial containerization of a country-pair was associated with a 144% increase in trade volumes, while the lagged effect is estimated to be 90%.

Finally, in Table 2 we reject the possibility that the container variable captures some previous trend in trade. We find that the first-lead container variable is also associated with increased trade, trade volumes are estimated to have risen by 7% (column 2), but this is clearly much smaller than the contemporaneous container effect. More formally we can reject the hypothesis that these two coefficients are equal [we should test for this and report the result].

3.6 Robustness regarding the sample size

Finally, Table 3 considers the effects of containerization using different sample sizes. Given that developing economies containerized late, column (1) reduces the sample to North-North and North-South trade, (i.e. trade flows for which either i or j is an OECD country). Compared to column (3) in Table 1, restricting the sample to OECD trade increases the average treatment effect of full containerization from 97 to 173%, while the average treatment effect of port containerization dropped slightly from 87 to 83%. Column (2) restricts the sample just to trade within the OCED countries. A drop of the average treatments of full and port containerization to 61 and 45% suggest that containerization had the biggest effect on North-South trade. Columns (3) and (4) include only trade flows above and below 1m, while column 5 reduces the sample period to 1982...[more discussion needed here].

Table 3: Using different sample sizes

	Dep.Var: ln trade(ijk)	1-digit Industry Level Flows				
		1st Diff (by ijk) OECD Trade	1st Diff (by ijk) within-OECD Trade	1st Diff (by ijk) Flows $>$ 1m	1st Diff (by ijk) Flows $<$ 1m	1st Diff (by ijk) Dataset 1962-1982
Port and Railway	Full Cont(ij)	1.004***	0.475***	1.149***	0.577***	0.245***
		(0.0308)	(0.0642)	(0.0256)	(0.0251)	(0.0208)
	FTA	0.211***	0.298***	0.329***	0.297***	0.225***
		(0.0384)	(0.0373)	(0.0381)	(0.0707)	(0.0443)
	Both GATT	0.285***	0.169	0.571***	0.221***	0.066**
		(0.0396)	(0.1081)	(0.0372)	(0.0324)	(0.0284)
	Common Curr	0.214***	0.351**	0.366***	0.013	0.120**
		(0.0623)	(0.1627)	(0.0781)	(0.0682)	(0.0534)
	No. Countries	157	23	157	157	157
	No. Observations	172676	26105	111070	125998	165155
	overall R^2	0.1093	0.1118	0.2168	0.0991	0.0922
	Fixed effect	it,jt,kt	it,jt,kt	it,jt,kt	it,jt,kt	it,jt,kt
Port Containerization	Full Cont(ij)	0.604***	0.373***			0.200***
		(0.0239)	(0.0519)			(0.0200)
	FTA	0.190***	0.280***			0.207***
		(0.0384)	(0.0375)			(0.0442)
	Both GATT	0.331***	0.201*			0.069**
		(0.0396)	(0.1079)			(0.0284)
	Common Curr	0.210***	0.352**			0.121**
		(0.0624)	(0.1627)			(0.0534)
	No. Countries	157	23			157
	No. Observations	172676	26105			165155
	overall R^2	0.1211	0.1117			0.0988
	Fixed effect	it,jt,kt	it,jt,kt			it,jt,kt

Coefficients marked with *,**,*** denote significance at the 10%, 5% and 1% levels respectively.

4. Conclusion

In this paper we have explored the effects of containerization on world trade during what we have called 'the early years' of the containerization age. Business and industry analysts have conjectured that containerization had a tremendous impact on the entire transportation industry and on the growth of world trade. However, quantitative estimates of the effects of the container are still missing. The empirical challenge is how to disentangle the effects of the container from other changes that have affected trade.

The key idea of this paper is to exploit cross-sectional and time-series variations in country' first adoption of port and railway container facilities to estimate the treatment effects of the container on bilateral trade flows at the country and industry level. The richness of the data allow to use country-time, country-pair and industry-time fixed effects as well as time-varying trade policy variables to control for other factors affecting bilateral trade. Our most preferred specifications suggest that containerization had a considerable effect on bilateral trade flows at the industry level and the effects of container technology are stronger than the effects of trade policy variables. [add more text here]

References

Anderson, James and Eric van Wincoop, 2004. Trade costs. *Journal of Economic Literature* 42, 691-751.

Annual digest of port statistics (1968-1979). London: National Ports Council.

Baier, Scott and Jeffrey Bergstrand, 2001. The growth of world trade: tariffs, transport costs, and income similarity. *Journal of International Economics* 53(1), 1-27.

Baier, Scott and Jeffrey Bergstrand, 2007. Do Free Trade Agreements Actually Increase Members' international Trade? *Journal of International Economics* 71, 72-95.

Bergstrand, Jeffrey and Peter Egger, 2010. Gravity equations and economic frictions in the world economy, in Bernhofen, Falvey, Greenaway and Kreickemier (editors): *Palgrave Handbook of International Trade*, forthcoming.

Blonigen, Bruce and Wesley Wilson, 2008. Port efficiency and trade flows. *Review of International Economics* 16(1), 21-36.

Clark, Ximena, Dollar David and Alejandro Micco, 2004. "Port efficiency, maritime transport costs and bilateral trade", *Journal of Development Economics* 75(2), 417-450.

Containerisation International(1970-1992). Various issues. London: National Magazine Co. Ltd.

Davidson, Donald, 2010. Railroads and the Raj: Estimating the impact of transportation infrastructure. MIT mimeo.

Donovan and J. Bonney, 2006. *The Box That Changed the World: Fifty Years of Container Shipping - An Illustrated History*. Commonwealth Business Media Inc .

Feenstra, Robert, Robert E. Lipsey, Haiyan Deng, Alyson C. Ma and Hengyong Mo, 2005, "World Trade Flows: 1962-2000", NBER Working Paper No. 11040.

Feyrer, James, 2009. Distance, Trade, and Income - the 1967 to 1975 Closing of the Suez Canal as a Natural Experiment. *NBER Working Paper Series*, Vol. w15557, pp. -.

Fogel, Robert, 1964.*Railways and American Growth*, Johns Hopkins Press.

Glick R., Rose, A., 2002. Does a currency union affect trade? The time-series evidence. *European Economic Review* 46(6), 1125-1151.

Head, Keith, Thierry Mayer and John Ries, 2010. The erosion of colonial trade linkages after independence, *Journal of International Economics*, Volume 81, Issue 1.

Hummels, David 2007. Transportation costs and international trade in the second era of globalization, *Journal of Economic Perspectives* 21, 3:131-154.

Hurd, J., 1975. Railways and the expansion of markets in India, 1861-1921. *Explorations in Economic History* 12, 263-288.

Keller, Wolfgang and Carol Shue, 2008. Institutions, technology and trade. University of Colorado, mimeo.

Krugman, Paul, 2009, Citigroup Foundation Special Lecture, Festschrift paper in Honor of Alan V. Deardorff, University of Michigan IPC working paper 91.

Krugman, Paul, 1995. Growing World Trade: Causes and Consequences. *Brookings Papers on Economic Activity,* 1995(1):327-377.

Levinson, M. 2006. *The Box: How the Shipping Container Made the World Smaller and the World Economy Bigger.* Princeton University Press.

Limao, Nuno and Anthony Venables, 2001. Infrastructure, geographical disadvantage, transport costs and trade. *The World Bank Economic Review* 15(3), 451-479.

McKinsey Co, 1967. Containerization: the key to low-cost transport", A report for the British Transport Docks Board.

Mokyrl, Joe, 1992, *The Lever of Riches: Technological Creativity and Economic Progress*. Oxford University Press.

Montea, Carmellah. 1959. The estimation of transportation costs in international trade. *Journal of Political Economy* 67: 41-58.

National Ports Council. (1968-1979). *Annual digest of port statistics*. London: National Ports Council.

Raine, George, 2006, “A sea change in shipping: 50 years ago, container ships altered the world”, San Francisco Chronicle, February 5.

Rose, Andrew, 2004. Does the WTO Really Increase Trade? *American Economic Review* 94(1), 98-114.

Wooldridge, Jeffrey, 2002. Econometric Analysis of Cross-Section and Panel Data. MIT Press, Cambridge, MA.

Appendix

Appendix Table 1: List of Countries in Sample

Panel A: Countries Containerized between 1966 and 1983 (118 countries)

Algeria	Djibouti	Ireland	Nigeria	Thailand
Angola	Dominican Republic	Israel	Norway	Togo
Argentina	Ecuador	Italy	Oman	Trinidad Tobago
Australia	Egypt	Jamaica	Pakistan	Tunisia
Bahamas	El Salvador	Japan	Panama	Turkey
Bahrain	Ethiopia	Jordan	Papua N.Guinea	UK
Bangladesh	Fiji	Kenya	Peru	USA
Barbados	Finland	Kiribati	Philippines	United Arab Emirates
Belgium-Luxembourg	East Germany	Korea Republic	Poland	Uruguay
Belize	West Germany	Kuwait	Portugal	Venezuela
Benin	Fm USSR	Lebanon	Qatar	
Bermuda	Fm Yugoslavia	Liberia	Romania	
Brazil	France, Monaco	Libya	Samoa	
Asia NES (Bhutan, Brunei)	Gambia	Madagascar	Saudi Arabia	
Bulgaria	Ghana	Malaysia	Seychelles	
Cameroon	Gibraltar	Malta	Sierra Leone	
Canada	Greece	Mauritania	Singapore	
Chile	Guadeloupe	Mauritius	South Africa	
China	Guatemala	Mexico	Spain	
Hong Kong	Guinea	Morocco	Sri Lanka	
Colombia	Haiti	Mozambique	St. Helena	
Congo	Honduras	Myanmar	St. Kitts & Nevis - Anguilla	
Costa Rica	Iceland	Netherlands Antilles & Aruba	Sudan	
Cote Divoire	India	Netherlands	Sweden	
Cyprus	Indonesia	New Caledonia	Syria	
Democratic Republic Congo	Iran	New Zealand	Taiwan	
Denmark	Iraq	Nicaragua	Tanzania	

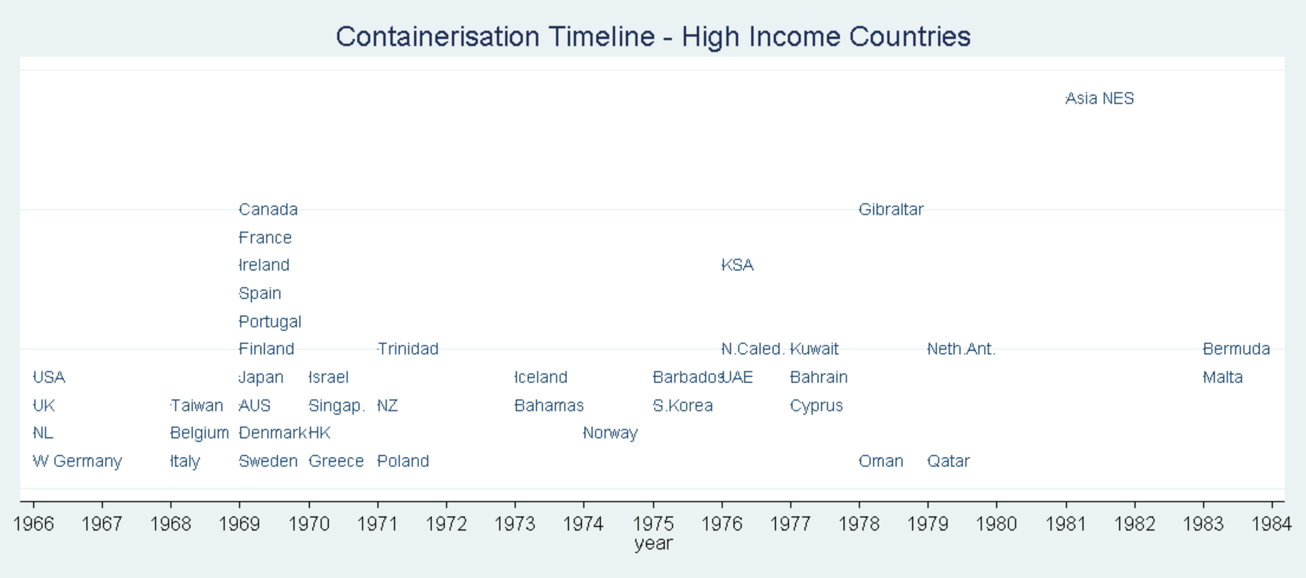
Panel B: Countries remaining largely uncontainerized until 1990 (18 countries)

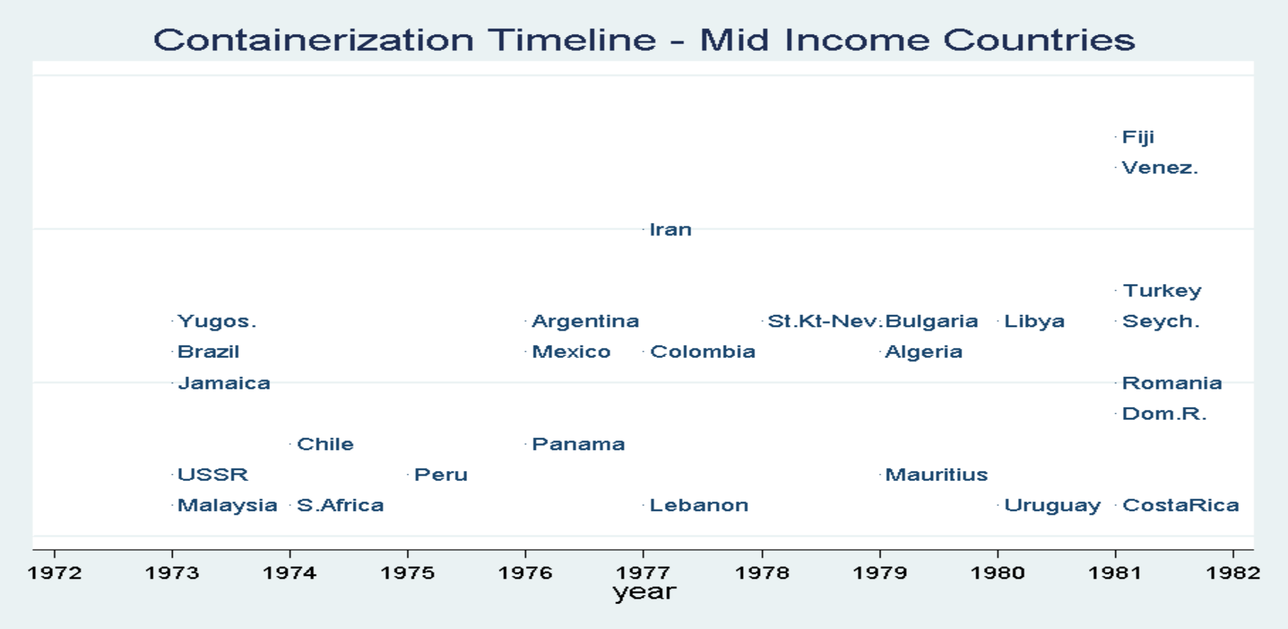
Albania
Cambodia
Macao
Cuba
Equatorial Guinea
Falkland Islands
French Overseas Departments
French Guiana
Gabon
Greenland
Guinea Bissau
Guyana
Korea Democratic People's Republic
Senegal
Somalia
Saint Pierre and Miquelon
Suriname
Viet Nam

Panel C: Landlocked Countries (21 countries)

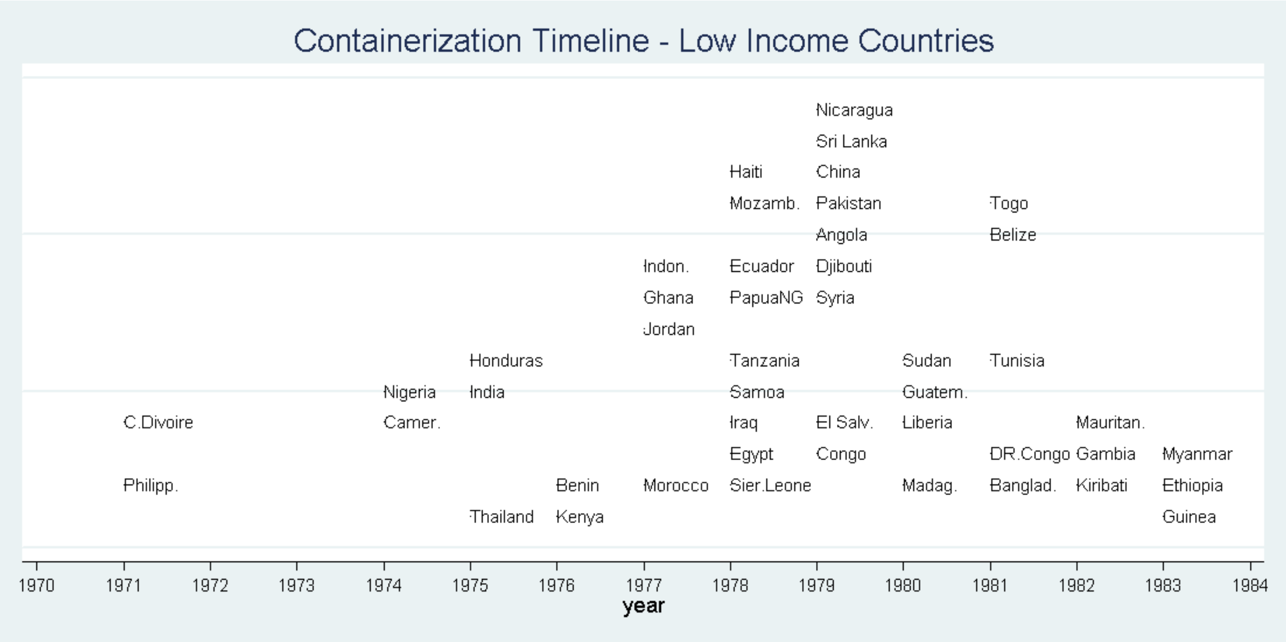
Afghanistan
Austria
Bolivia
Burkina Faso
Burundi
Central African Republic
Chad
Czechoslovak
Hungary
Laos
Malawi
Mali
Mongolia
Nepal
Niger
Paraguay
Rwanda
Switzerland-Liechtenstein
Uganda
Zambia
Zimbabwe

Appendix Table 2: Containerization Timeline by Income Category[21]





[21]The classifications are according to the World Bank (2009).


Containerization Timeline - Low Income Countries
Nicaragua
Sri Lanka
Haiti
China
Mozamb.
Pakistan
Togo
Angola
Belize
Indon.
Ecuador
Djibouti
Ghana
PapuaNG
Syria
Jordan
Honduras
Tanzania
Sudan
Tunisia
Nigeria
India
Samoa
Guatem.
C.Divoire
Camer.
Iraq
El Salv.
Liberia
Mauritan.
Egypt
Congo
DR.Congo
Gambia
Myanmar
Philipp.
Benin
Morocco
Sier.Leone
Madag.
Banglad.
Kiribati
Ethiopia
Thailand
Kenya
Guinea
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
year

Appendix Table 3: Containerizability at 1-digit SITC Industry Level
(constructed by using 1962 US 4 digit import and export shares as weights to calculate aggregates at the 1-digit level)

SITC	Product Description	% Containerizability (aggregated from 4-digit, using US weights)	Containerizability (defined from numbers to the left)
0	Food and Live Animals	46%	Medium
1	Beverages and tobacco	100%	High
2	Crude materials, inedible, except fuels	56%	Medium
3	Mineral fuels, lubricants and related materials	0%	No
4	Animal and vegetable oils, fats and waxes	100%	High
5	Chemicals and related products, n.e.s.	60%	Medium
6	Manufactured goods classified chiefly by material	95%	High
7	Machinery and transport equipment	50%	Medium
8	Miscellaneous manufactured articles	100%	High
9	Commodities and transactions not elsewhere classified	0%	No