Chapter 7

Decoupling

7.1 Port-related employment through localization economies

The third argument for subsidizing ports is that they sustain and foster local economic activity. That is, that port activities shape the economic terrain by attracting other economic activites. The argument, borne out by the nineteenth century city, is that the presence of port facilities serves as an anchor for localization economies, i.e., the benefits of locating in the proximity of a specific facility (Henderson 1983; Rodrigue, Comtois, and Slack 2006). As a result of reduced costs generated by ready access to transshipment points, firms are expected to be more efficient, more competitive, and thence more successful, providing employment and revenue for the local community.

In this chapter, the argument in favor of localization economies drawn from Charles Horton Cooley's work is tested against the neo-Marshallian argument that economic activity has decoupled from transportation infrastructure nodes. Having show in Chapter 4 that the U.S.'s transportation infrastructure has shifted geograph-

ically, I now introduce spatial regressions predicting the location of a representative selection of the country's top exporting industries. The results suggest a decoupling of economic activity from transportation nodes, leading to the conclusion that ports no longer serve as anchors for non-port employment.

7.1.1 Industry types and transportation

Glaeser and Kohlhase (2003) have recently called this relationship into question, however. They argue that transportation costs for cargo have dropped so significantly that economists no longer need to treat them as determinants in the location of economic activity. Citing the long-term trend of declining transportation costs in the U.S. over the course of the twentieth century and the nation's shift away from manufacturing and natural resource production toward services, they argue that recent "new economic geography" models like Krugman (1991) and Fujita, Krugman, and Venables (1999) are not relevant for the current socioeconomic situation because they perpetuate the emphasis on immovable natural resources made by early location theorists (e.g., Lösch [1954] and Weber and Friedrich [1965]). Instead, following Marshall's (1890) suggestion that industrial agglomeration is a result of information spillovers and concentrated labor pools, Glaeser and Kohlhase argue that only those transportation costs that enhance or inhibit personal transportation, like subsidies for public transportation or gasoline taxes, are relevant as locational determinants of economic activity.

McCann and Shefer (2004) introduce concepts from economic sociology and economic geography proper to argue for a more subtle approach to transportation costs than Glaeser and Kohlhase's "neo-Marshallian approach." They develop three ideal types of industrial agglomerations based on the distinction made initially by Powell

(1990) that firms can be organized into markets, hierarchies, or networks. Powell breaks down economic organization forms primarily through an analysis of transaction costs (cf. Williamson [1975]). Economic activity can be organized as markets of atomistic actors who communicate and interact through prices. Alternatively, market activities can be organized into a hierarchy that persists over time to coordinate production and exchange. Between these two extremes, Powell places networks consisting of interdependent economic actors that coordinate their activities with multiple collaborators with whom they have developed trustworthy relations through repeated interaction. McCann and Shefer (2004) mirror these three types of organization in categorizing spatial clustering. In the market case, which they call "pure agglomeration," the critical transportation costs are those related to urban commuting as small atomistic firms are dependent on workers' ability to get to the workplace. Spatially, pure agglomerations will be coupled to local urban infrastructure rather than interregional infrastructure. In the case of hierarchical organization of economic activity into large firms that locate in industrial complexes, traditional transportation costs for goods are most relevant due to the high volume of inputs and outputs to the production process. In the case of "social networks," like the industrial districts of Emiglia-Romagna (For example, Brusco 1982), transportation costs have no relevance since the model depends on social infrastructure rather than physical infrastructure, though spatial proximity is assumed to foster the trust necessary for efficient functioning.

Following these authors' lines of thought, we can distinguish at least six sectors whose spatial agglomeration tendencies should be evaluated separately: natural resource extraction, heavy industry, networked light and medium industry, information-oriented work, market-oriented light and medium industry, and retail. McCann and Shefer's (2004) industrial complexes can be divided into two subcategories. The first

is natural resource extraction, in which a few concentrated firms develop industrial complexes to extract natural resources, like mining. The second is heavy industry, which processes raw materials in large quantities at capital-intensive industrial complexes. Similarly, social networks can be broken up into at least two subcategories. The first is networked light and medium manufacturing, which is more likely to display characteristics of industrial districts and consists of a larger number of smaller firms than heavy industry producing more customized goods. The second is information industries, which provide services rather than goods Glaeser and Kohlhase's (2003) and also tends to consist of a larger number of smaller firms. The pure agglomeration category can also be divided into two subcategories. The first is market-oriented light and medium industry, which is distinguished from networked industries by its focus on simpler, more standardized products that are more conducive to market relations since the products and the prices are more readily comparable (Gereffi, Humphrey, and Sturgeon 2005; Sturgeon 2002). The second is retail, which is dependent primarily upon urban agglomeration.

7.1.2 Dialectics of transportation

Due to their reliance on mathematical abstraction, these approaches unfortunately tend to overlook the sociospatial organization of transportation itself as an active force in their discussions. Rather, for these economic approaches, transportation is represented simply by transportation costs over distance and time (Rietveld and Vickerman 2004). Vested interests are overlooked and spatially concrete hindrances like intermodal transfers of cargo are considered simply in terms of costs. For all their spatiality, these approaches conceptualize mathematical fields of agglomeration rather than the concrete mechanics of those agglomerations. Hence, transport theory

tends to treat transportation as a derived demand that responds to and facilitates other agglomerative forces. Except perhaps for the case of road congestion, the role of transportation in shaping the economic terrain by inducing demand is generally disregarded (Rietveld and Vickerman 2004).

It thus seems useful to return to the early theorizations of one of the founders of the Chicago School of Sociology, Charles Horton Cooley. Cooley emphasized the dialectical relation between transportation as a mechanical force and the social forces that developed it. "Precisely because transportation underlies social development it is in turn determined by that development. It is a tool of the economic, the political, the military organizations, and the character of the tool varies with their needs" (Cooley 1894, 41). For Cooley, as this quote implies, though social forces (in addition to natural ones) shape transportation systems, the transportation system underlies and integrates society. He has in mind one simple principle: "*Population and wealth tend to collect wherever there is a break in transportation*" (Cooley 1894, 91, emph. in original).

By 'break' Cooley (1894, 91) means any physical interruption in the movement of goods that is sufficient to result in the transfer of goods and their temporary storage. He then divides breaks into two categories: mechanical and commercial. A *mechanical break* is a purely physical interruption in the flow of goods, while a *commercial break* combines the mechanical break with a change in ownership of the goods. Because commercial breaks involve many other auxiliary services to facilitate economic exchange, they tend to be the sites of greatest agglomeration. This conceptualization accounts for the growth of great port cities like New York, Venice, and Amsterdam, which combined the mechanical break between sea and land with innovative finance and banking to grow into world economic superpowers (Braudel 1992). Note that this view is not incompatible with a transportation costs approach. By locating in prox-

imity to mechanical breaks in transportation, firms are often able to reduce their costs by minimizing the amount of handling involved in transferring cargo from one mode to another, often the largest proportion of transportation costs. Cooley's approach, however, emphasizes how transportation acts as an agglomerative force, rather than focusing on cost reduction.

As Chapter 4 demonstrated, transportation has changed dramatically since Cooley's time. From a port perspective, in the late 1800s the labor-intensive transfer of individually stowed goods from sea to land and vice versa generated a major mechanical break that encouraged agglomeration (Glaeser and Kohlhase 2003). As discussed in the earlier chapter on technological change (Chapter 3), containerization has removed the obligation to break bulk on the docks. Instead, within minutes or hours, goods can continue virtually uninterrupted toward inland destinations where they can be unpacked, repacked, and redistributed. The growth of inland distribution centers (DCs) and warehousing concentrations is well documented (e.g., Notteboom and Rodrigue 2005) and Section 4.3 illustrates this shift. Over the past three decades, warehousing has spread out more evenly across U.S. counties and formed a concentrated band a few hundred kilometers inland and parallel to the coast. Thus, the break point for intermodal cargo transfers has moved from the nation's ports to inland warehousing districts.

So, if Cooley is correct, the tight coupling between breaking bulk and other economic activity implies that agglomeration should be occuring around the new concentrations of warehousing activity and shifting away from ports. If the neo-Marshallians are correct and economic activity has decoupled from its transportation base, economic activity should not follow the restructuring of the transportation network. In the following pages, I explore these two opposing hypotheses in relation to the six industrial sectors (i.e., natural resource extraction, heavy industry, networked light and

medium industry, information industries, market-oriented light and medium manufacturing, and retail[1]).

	Neo-Marshallians	Cooley
Natural resources	Decoupled	Decoupled
Heavy industry	Decoupled	De/coupled
Networked manufacturing	Decoupled	Coupled
Market manufacturing	Decoupled	Coupled
Information industry	Decoupled	Decoupled
Retail	Decoupled	Decoupled

Table 7.1: Relationship of industrial sectors to transportation following Marshall and Cooley

Table 7.1 summarizes how these two approaches would consider the relation of broad industrial classifications to break bulk points in the logistics infrastructure. They thus generate a series of testable hypotheses that will be investigated in the following sections. Natural resources, as a product of the land or sea, are inherently immobile and should thus be decoupled from the transportation infrastructure for both the neo-Marshallians and Cooley. Heavy industry should also be decoupled from the transportation system according to the neo-Marshallian perspective, since transportation costs are no longer important in location decisions. From the Coolean perspective, however, there is an aspect of uncertainty. The enormous sunk costs required of these industries lends a degree of historical inertia to contemporary locations not unlike that of natural resources. This inertia makes it highly unlikely that they would move to new locations to take advantage of changing transportation infrastructure. However, the location of new facilities could still be coupled to break bulk points for those industries that do not significantly reduce the bulk of the raw

[1]Though Cooley does not consider this, retail also serves a break-bulk point. It serves not only as a mechanical break where truckloads of goods are broken up and distributed to customers but also as a commercial break where ownership is transferred from the retailer to the consumer.

materials. Generally, manufacturing will locate near the source of raw materials if the bulk or weight is greatly reduced in processing, but it is otherwise free to locate elsewhere. Cooley would suggest that "elsewhere" should be mechanical break points. Networked manufacturing also should be decoupled in the neo-Marshallian view, but for Cooley there should be a distinct coupling, as manufacturing spatially repositions itself to take advantage of cost savings near new mechanical breaks by reducing the number of modal transfers. Market-oriented manufacturing should follow the same logic as networked manufacturing, though it may be expected to shift more quickly as it is not held in place by organizational interdependencies. Fifth, the information industry, as it does not depend on the movement of goods in any significant way should be decoupled for both neo-Marshallians and Cooley. Finally, retail should remain decoupled from the interregional transportation network from the neo-Marshallian position. Rather, retail should be coupled only to the intraregional transportation network, but this is not the scale addressed in this paper. From Cooley's position, though he does not identify it himself, retail functions as a mechanical and commercial break in the transportation system as goods are transferred from trucks that deliver them to the store and the customers who take ownership of them. Thus, retail should be tightly coupled with concentrations of population but not to the changing transportation network. The primary area of disagreement between the two schools of thought, then, is with regard to manufacturing.

7.2 Sector analyses

In the following sections, sample industries are drawn from each of the six categories described above. They are selected on the basis of four criteria. First, they are believed to be fairly representative of their respective fields with respect to indus-

trial structure. Second, they have consistent definitions under both SIC and NAICS coding across the data employed, making the numbers intertemporally comparable. Third, those sectors that offer tradeable goods (natural resource extraction, heavy industry, and manufacturing) as opposed to generally non-tradeable services (retail and information industries) are amost entirely listed by the International Trade Association (2010) as exporting industries. Industries selected represent a sampling from the export rankings by value, as shown in Table 7.2. At least three of them (semiconductors, pharmaceuticals, and petroleum products) are from the top twenty exporting industries. As exporting industries are more likely to require the services offered by container ships and airlines, they should have initially located proximate to these facilities. Finally, when possible (one case), industries were selected from Table B.1, which represent industries traditionally understood to be directly related to port clusters.

7.2.1 Natural resource extraction

Natural resources behave as one would expect: they are completely indifferent to the location of the wider transportation network. Because they are tied to the physical composition of the planet rather than its social composition and remain immobile, changes in the transportation infrastructure should have no impact on the location of natural resource employment.

The industry selected here is iron ore mining (SIC 1010 and NAICS 212210). Iron ore mining comprises "establishments primarily engaged in (1) developing mine sites, mining, and/or beneficiating (i.e., preparing) iron ores and manganiferous ores valued chiefly for their iron content and/or (2) producing sinter iron ore (except iron ore produced in iron and steel mills) and other iron ore agglomerates" (U.S. Dept. of

Industry	NAICS code	Value (USD millions)	Rank (out of 452)
Natural resources			
Iron ore mining	212210	246	295
Heavy industry			
Flat container manufacturing	327211	816	168
Glass container manufacturing	327213	182	330
Cement, hydraulic	327310	68	391
Ready-mix concrete manufacturing	327320	0	452
Petroleum refineries	324110	8894	16
Retail			
Book, periodical, and music stores	451211–2, 451220	NA	NA
Networked manufacturing			
Pharmaceutical preparations	325412	9425	14
Electroplating, plating, polishing, anodizing, and coloring	332813	NA	NA
Machine tool (metal forming types) manufacturing	333513	1248	126
Automatic environmental control manufacturing for residential, commercial, and appliance use	334512	340	262
Semiconductors and related device manufacturing	334413	59223	1
Market-oriented manufacturing			
Adhesive manufacturing	325520	804	172
Gum and wood chemicals	325191	163	345
Turned product and screw, nut, and bolt manufacturing	332720	NA	NA
Information industries			
Periodical publishers	511120	NA	NA
Data processing services	514210	NA	NA
Motion picture and video production	512110	NA	NA

Source: Table 41. U.S. Total Exports, 1998–2003 from International Trade Association (2010).

Table 7.2: Selected industries ranked by value of exports in 2000

Commerce, Bureau of the Census 2007).

This industry has indeed remained decoupled from transportation nodes. The utter lack of relation to non-physical factors is evident in the lack of signficant estimators in the regression equation below (Table C.4), and the low adjusted R-square values imply that not only is mining not directly related to income or race but also not linked to nodes in the transportation network. The only variable of significance is the slight relation to airports. Iron mining employment is marginally more likely to be located near customs landing airports than away from them; employment drops by a quarter

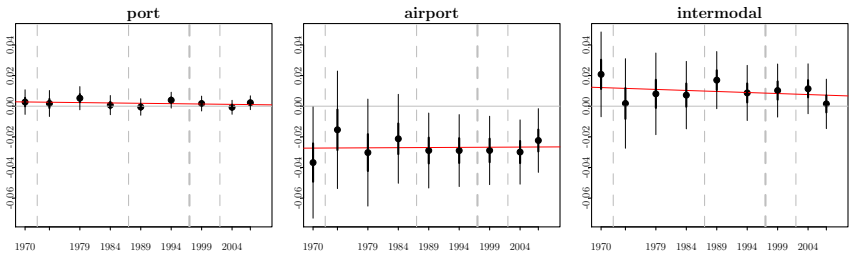

Figure 7.1: Mining, iron ore (SIC 1010 and NAICS 212210): Regression coefficients for distance (in 100km) from closest port, airport, and intermodal terminal by year against the logarithm of employment.
Point represents estimate. Wide line indicates the 50 percent confidence interval, and thin line represents the 95 percent confidence interval for the estimate. Dotted grey lines indicate industrial classification transitions. Red line indicates trend in estimators.

of a percent for every thousand kilometers one gets from such an airport. However, this relation remains unaltered over the time frame considered here and probably has more to do with historical coincidence than deliberate location decisions. No relation to ports is demonstrated.

We can thus conclude that the identical neo-Marshallian and Coolean perspectives are supported here. Natural resources have remained decoupled from the break bulk points of the transportation network.

7.2.2 Heavy industry

Under the broad category of heavy industry, it is necessary to distinguish between two types of products: bulk and general. General commodities can be containerized and shipped. Bulk products are generally not containerized, though there are recent increases in the containerization of bulk cargo (Rodrigue et al. 2006). This is important as the two categories demonstrate different changing relations to ports. Two industries are selected for this section.

The first of these industries is petroleum refining, which de Langen (2007) cites as a core port industry and which is one of the U.S.'s top export industries. A relatively

concentrated industry with 242 establishments and over 65,000 employees in 1997, petroleum refining is defined as those establishments "engaged in producing gasoline, kerosene, distillate fuel oils, residual fuel oils, and lubricants, through fractionation or straight distillation of crude oil, redistillation of unfinished petroleum derivatives, cracking or other processes. Establishments of this industry also produce aliphatic and aromatic chemicals as byproducts" (U.S. Dept. of Commerce, Bureau of the Census 2007). This is a bulk shipping industry that does not lend itself to containerization. Its products are more likely to be transported via pipelines or tanker trucks.

It will be seen from the regression (Table C.5) that despite the fact that refineries are typically considered LULUs (locally undesirable land uses), refineries and urban populations are coming into closer contact. Social variables other than population density have little bearing on the location of refining, suggesting that the deciding factor may be more geographically based. Lending support to this finding is that the estimators for airports show that refinery employment is slightly more likely to be located closer to airports and that it is moving closer to ports. The decline in refinery employment as one moves away from ports has been cut in half from its 1979 level of 0.05 percent for every 100 kilometers. Together this suggests that de Langen's claim has some veracity to it and that bulk commodities are not following the shift toward warehousing centers.

The second industry selected is glass container manufacturing, a concentrated exporting industry with 61 establishments and over 20,000 employees in 1997 that produces "glass containers for commercial packing and bottling, and for home canning" (U.S. Dept. of Commerce, Bureau of the Census 2007) and as a non-bulk good is more likely to use containerized shipping. This concentrated industry is only marginally related to population density and has no statistically significant relation to any of the infrastructural nodes studied. Representative of other container-oriented

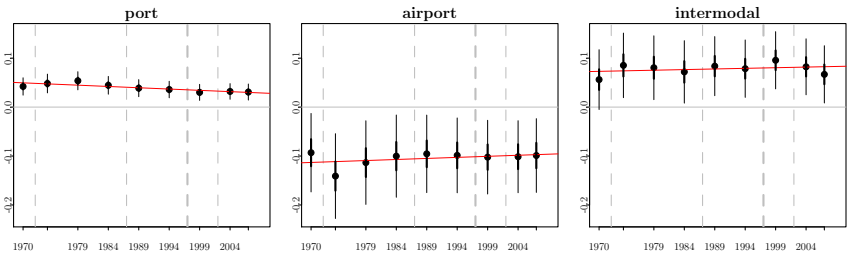

Figure 7.2: Petroleum refineries (SIC 2911 and NAICS 324110): Regression coefficients for distance (in 100km) from closest port, airport, and intermodal terminal by year against the logarithm of employment.
Point represents estimate. Wide line indicates the 50 percent confidence interval, and thin line represents the 95 percent confidence interval for the estimate. Dotted grey lines indicate industrial classification transitions. Red line indicates trend in estimators.

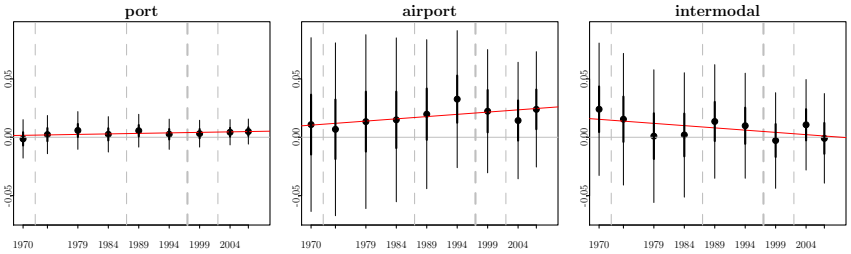

Figure 7.3: Glass container manufacturing (SIC 3221 and NAICS 327213): Regression coefficients for distance (in 100km) from closest port, airport, and intermodal terminal by year against the logarithm of employment.
Point represents estimate. Wide line indicates the 50 percent confidence interval, and thin line represents the 95 percent confidence interval for the estimate. Dotted grey lines indicate industrial classification transitions. Red line indicates trend in estimators.

industries examined, these findings suggest that the sunk investments involved cause these industries to behave like natural resources and remain decoupled from the wider transportation infrastructure.

7.2.3 Manufacturing

Manufacturing covers a wide variety of industrial sectors, each with its own physical requirements and historical trajectory. Thus, generalizing across sectors must only be done with tentative footsteps. Nevertheless, the examples that follow do present a relatively clear pattern of locational behavior.

Networked manufacturing

Networked manufacturing refers to those sectors that are likely to collaborate with providers of related goods or services to collectively produce a final product. Though their small size might simplify relocation, networks fostered through spatial proximity may slow this process. To capture the breadth of industry, an handful of sectors were selected and analyzed. First, under the broad classification of chemical manufacturing falls pharmaceutical preparations (SIC 2834 and NAICS 325412), which refers to "establishments primarily engaged in manufacturing in-vivo diagnostic substances and pharmaceutical preparations (except biological) intended for internal and external consumption in dose forms, such as ampoules, tablets, capsules, vials, ointments, powders, solutions, and suspensions," constitutes a large sector with a moderate number of establishments (838) and well over 100,000 employments in 1997. These establishments produce a mixture of standard and non-standard, property right protected goods and represent one of the largest exporting industries in the U.S. The next two industries are in either primary metal manufacturing (NAICS 332) or fabricated metal product manufacturing (NAICS 333). The first of these is electroplating, plating, polishing, anodizing, and coloring (SIC 3471 and NAICS 332813), which comprises "establishments primarily engaged in electroplating, plating, anodizing, coloring, buffing, polishing, cleaning, and sandblasting metals and metal products for the trade." This sector had a large number of establishments (over 3,400) and almost 75,000 employees in 1997. Though this sector provides a non-tradeable service to other metal working firms and thus does not export, it may still choose to locate near break points to more effectively receive and send goods for electroplating. Machine tool (metal forming types) manufacturing (SIC 3542 and NAICS 333513), on the other hand, which refers to establishments "primarily engaged in manufacturing metal form-

ing machine tools (except handtools), such as punching, sheering, bending, forming, pressing, forging and die-casting machines," constitutes a fairly small but deconcentrated industry, with 225 establishments and over 14,000 employees in 1997. It is also a major exporter producing goods that are highly customized and thus likely to incorporate inputs for interdependent businesses. The final duo examined come from computer and electronic product manufacturing (NAICS 334). The first is automatic environmental control manufacturing for residential, commercial, and appliance use (SIC 3822 and NAICS 334512), which comprises "establishments primarily engaged in manufacturing automatic controls and regulators for applications, such as heating, air-conditioning, refrigeration and appliances" (thermostats, basically). This sector is a significant exporter and is a fairly small but deconcentrated industry, with just over 300 establishments and over 20,000 employees in 1997. The second sector is semiconductors and related device manufacturing (SIC 3674 and NAICS 334413), which comprises "establishments primarily engaged in manufacturing semiconductors and related solid state devices. Examples of products made by these establishments are integrated circuits, memory chips, microprocessors, diodes, transistors, solar cells and other optoelectronic devices," which is a large and moderately concentrated industry with roughly 1,100 establishments and just under 200,000 employees in 1997. Saxenian (1996) and Sturgeon (2003) have shown that this sector can rely very much on networked production, especially in California.

Market-oriented manufacturing

Market-oriented manufacturing tends to produce standardized products that compete in purer markets on the basis of price. These establishments are less tied to other firms and are therefore more capable of picking up and moving to take advantage of changes in transportation costs due to changing spatial organization of the transportation

system.

Three sectors were selected to represent this broad category. The first two sectors represent a variety of pursuits within the broader classification of chemical manufacturing. First, adhesive manufacturing (SIC 2891 and NAICS 325520), which refers to those establishments primarily engaged in manufacturing adhesives, glues, and caulking compounds, is a moderately unconcentrated industry with about 700 establishments and 20,000 employees in 1997 and an export market in 2000 of over $800 million. Second, gum and wood chemicals manufacturing (SIC 2860/2861 and NAICS 325191), which comprises "establishments primarily engaged in (1) distilling wood or gum into products, such as tall oil and wood distillates, and (2) manufacturing wood or gum chemicals, such as naval stores, natural tanning materials, charcoal briquettes, and charcoal (except activated)," is a fairly concentrated industry with 63 establishments and about 2,200 employees in 1997. It is also an exporter, but much smaller by comparison. The third sector chosen is one that perhaps most exemplifies the standardized product: turned product and screw, nut, and bolt manufacturing (SIC 3450 and NAICS 332720). This industry refers to "establishments primarily engaged in (1) machining precision turned products or (2) manufacturing metal bolts, nuts, screws, rivets, and other industrial fasteners. Included in this industry are establishments primarily engaged manufacturing parts for machinery and equipment on a customized basis." This large, deconcentrated sector has many establishments (3,785) and employees (133,399) in 1997 has no export market, perhaps indicative of the ease, low cost, and capital-intensity of producing these items.

Findings

It is not necessary to go into detail for each of these industries, as the patterns are fairly consistent across them. The results can be found in Figures 7.4, 7.5, 7.6, 7.7,

7.8, 7.9, 7.10, and 7.11, and Tables C.10, C.11, C.13, C.14, C.15, C.8, C.9, and C.12.

Consistent with all the other regression analyses, the dominant locational determinant is population density. This predictor is always significant in manufacturing and, for those regressions with some degree of explanatory power (R-square greater than 0.2), impacts employment in the given sector by a quarter to a half a percent increase for every percent density increases. So more urbanized counties have greater levels of manufacturing employment. Income per capita does not have the same relation found in other sectors. While it was often significant prior to the 1980s, it is now no longer so. Only in two of the sectors did it matter: adhesives manufacturing, where it was highly positive, and gum and wood chemicals manufacturing, where it was negative. Tax rates, contrary to many studies, seem relatively unimportant overall. In the few cases where the rates showed significance, it was slight, less than a 0.02 percent increase or decrease in employment per percent of tax. The other social indicators behave generally as one would expect. Education was of some significance in pharmaceutical preparations and semiconductors, which are more knowledge-intensive sectors than the others. In the rare occasions where it was significant, nonwhite population led to a hair's width increase in employment in the given industry. And the percent of the foreign population had a moderately positive correlation with employment in the given sector, ranging from 0.01 to 0.07 percent increase for every percent of the population that was foreign.

Proximity to infrastructure unexpectedly demonstrates little significance in industrial location. Of varying significance, the coefficients for ports range generally from -0.02 to 0.02 percent increase in industry employment for every 100km the county centroid is from the nearest container port. This implies a 0.2 percent increase as one travels from New York City to Detroit (roughly 1,000km). If there is any trend with regard to ports, it is a slight movement away, which would support Cooley's view.

However, concluding thus would be stretching the data very close to its breaking point and is thus unsupportable.

The relation to airports is more interesting. While almost always insignificant due to very large standard errors, the point estimates fairly consistently demonstrate a downward trend. This suggests that manufacturing activities are increasingly locating closer to airports. That said, as the estimates are generally moving from positive values toward zero, the data suggests that manufacturing is losing its relationship to airports, i.e., it is deconcentrating. This would also suggest a decoupling from the infrastructural nodes.

Finally, the relation of manufacturing employment to intermodal terminals is generally insignificant and unchanging. Several sectors (pharmaceutical preparations and environmental controls) may be moving away from a previous attachment to these nodes and gum and wood chemicals manufacturing appears to be deconcentrating relative to them, but the remaining five sectors show an unchanging, insignificant relation to intermodal terminals. Again, we are led to conclude that there is no statistical correlation between intermodal terminals and manufacturing employment.

In sum, the analyses here suggest that manufacturing employment has not been coupled to the infrastructure network during the containerization era. The possibility that change occured between the first containerized shipment in 1956 and 1970 is extremely unlikely. It thus appears that Cooley's view has been untenable for much of the last century if not longer. It also calls the neo-Marshallian perspective into question as well, however. It is generally believed that the shift away from manufacturing toward services occured after 1970. If the regressions completed here accurately reflect industrial location over the past four decades,[2] then the shift to services is not

[2]Future refinements of the data include accounting for spatial correlation through county adjacency matrices, multilevel modeling, incorporating additional sectors and perhaps aggregating as appropriate, and incorporating highway mileage or exits, though the latter would have problematic

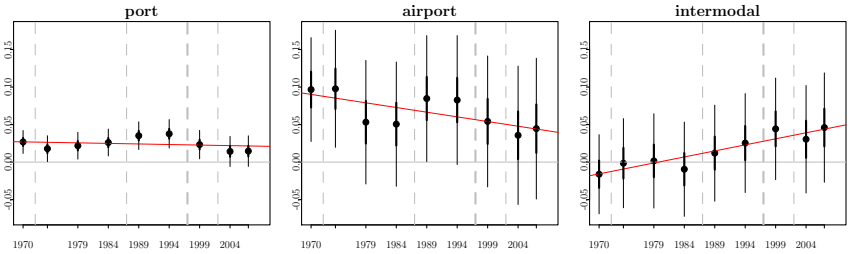

Figure 7.4: Pharmaceutical preparations (SIC 2834 and NAICS 325412): Regression coefficients for distance (in 100km) from closest port, airport, and intermodal terminal by year against the logarithm of employment.
Point represents estimate. Wide line indicates the 50 percent confidence interval, and thin line represents the 95 percent confidence interval for the estimate. Dotted grey lines indicate industrial classification transitions. Red line indicates trend in estimators.

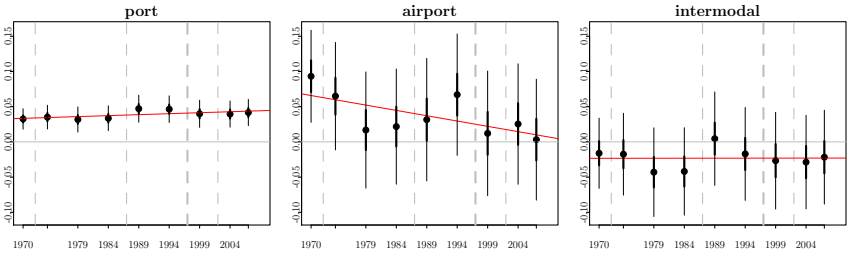

Figure 7.5: Electroplating, plating, polishing, anodizing, and coloring (SIC 3471 and NAICS 332813): Regression coefficients for distance (in 100km) from closest port, airport, and intermodal terminal by year against the logarithm of employment.
Point represents estimate. Wide line indicates the 50 percent confidence interval, and thin line represents the 95 percent confidence interval for the estimate. Dotted grey lines indicate industrial classification transitions. Red line indicates trend in estimators.

responsible for the decoupling.

7.2.4 Retail

For the retail sector, the broad grouping of book, periodical, and music stores was selected. The definitions and hence industrial coding for many other goods that are more likely to be shipped by boat, like televisions, have changed over the period considered here and thus cannot be evaluated. Book, periodical, and music store establishments, which are "primarily engaged in retailing new books, newspapers, magazines, and prerecorded audio and video media" (U.S. Dept. of Commerce, Bureau

correlations with population density.

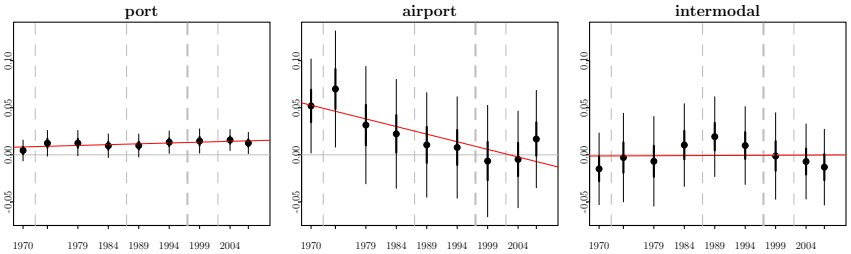

Figure 7.6: Machine tool (metal forming types) manufacturing (SIC 3542 and NAICS 333513): Regression coefficients for distance (in 100km) from closest port, airport, and intermodal terminal by year against the logarithm of employment.
Point represents estimate. Wide line indicates the 50 percent confidence interval, and thin line represents the 95 percent confidence interval for the estimate. Dotted grey lines indicate industrial classification transitions. Red line indicates trend in estimators.

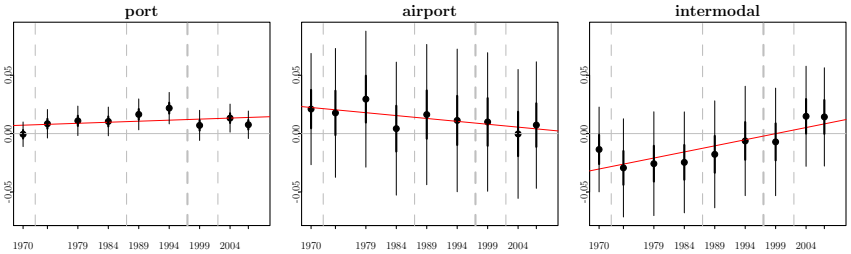

Figure 7.7: Automatic environmental control manufacturing for residential, commercial, and appliance use (SIC 3822 and NAICS 334512): Regression coefficients for distance (in 100km) from closest port, airport, and intermodal terminal by year against the logarithm of employment.
Point represents estimate. Wide line indicates the 50 percent confidence interval, and thin line represents the 95 percent confidence interval for the estimate. Dotted grey lines indicate industrial classification transitions. Red line indicates trend in estimators.

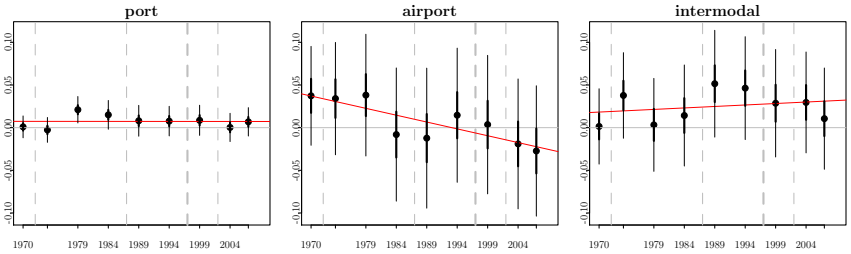

Figure 7.8: Semiconductors and related device manufacturing (SIC 3674 and NAICS 334413): Regression coefficients for distance (in 100km) from closest port, airport, and intermodal terminal by year against the logarithm of employment.
Point represents estimate. Wide line indicates the 50 percent confidence interval, and thin line represents the 95 percent confidence interval for the estimate. Dotted grey lines indicate industrial classification transitions. Red line indicates trend in estimators.

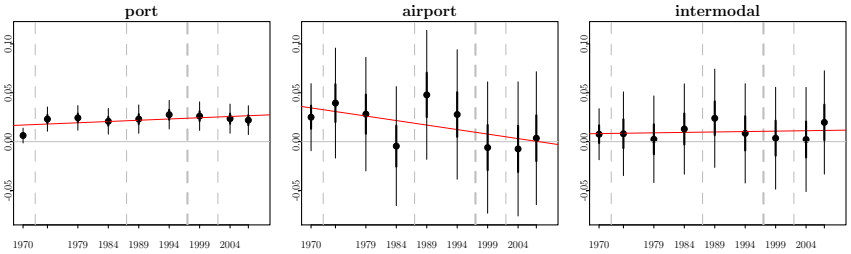

Figure 7.9: Adhesive manufacturing (SIC 2891 and NAICS 325520): Regression coefficients for distance (in 100km) from closest port, airport, and intermodal terminal by year against the logarithm of employment.
Point represents estimate. Wide line indicates the 50 percent confidence interval, and thin line represents the 95 percent confidence interval for the estimate. Dotted grey lines indicate industrial classification transitions. Red line indicates trend in estimators.

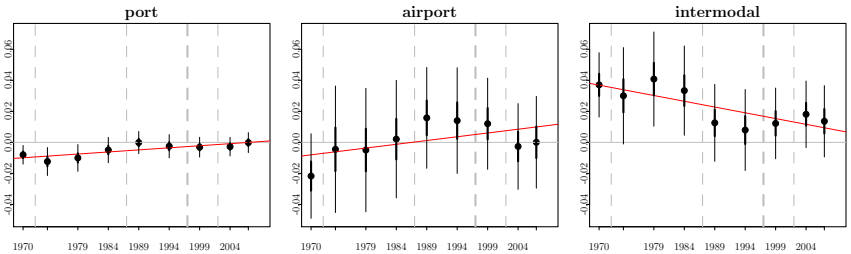

Figure 7.10: Gum and wood chemicals manufacturing (SIC 2860/2861 and NAICS 325191): Regression coefficients for distance (in 100km) from closest port, airport, and intermodal terminal by year against the logarithm of employment.
Point represents estimate. Wide line indicates the 50 percent confidence interval, and thin line represents the 95 percent confidence interval for the estimate. Dotted grey lines indicate industrial classification transitions. Red line indicates trend in estimators.

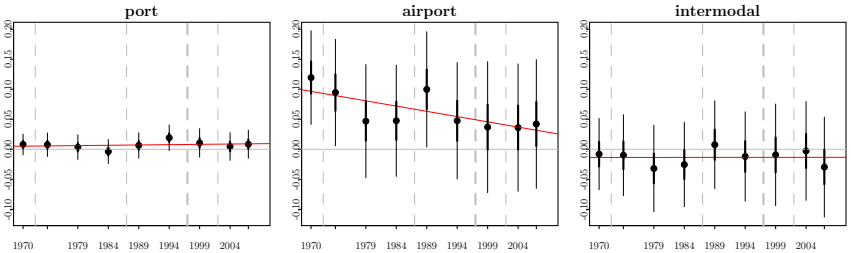

Figure 7.11: Turned products and screw, nut and bolt manufacturing (SIC 3450 and NAICS 33272/): Regression coefficients for distance (in 100km) from closest port, airport, and intermodal terminal by year against the logarithm of employment.
Point represents estimate. Wide line indicates the 50 percent confidence interval, and thin line represents the 95 percent confidence interval for the estimate. Dotted grey lines indicate industrial classification transitions. Red line indicates trend in estimators.

of the Census 2007), are highly deconcentrated with over 12,000 establishments and almost 80,000 employees. The regression results (Table C.7) offer several interesting findings. The overwhelming locational determinant is population density, with a fairly consistent increase of eight percent in retail employment for every ten percent increase in population. There is also an inclination to locate toward more highly educated populations. And there is strong negative trend with regard to income. That is, once we have accounted for the effect of education in increasing the presence of such retail outlets, they have been declining in higher income counties since the late 1980s. While the explanation for this seeming contradiction is not clear, one might posit that the advent of internet services, like Amazon books, may be shifting this commerce away from local retail outlets to facilities located in lower cost areas or accessed electronically. With regard to transportation, these retail establishments demonstrate no relation whatsoever to ports and a consistent bias to locate away from airports and intermodal terminals. We can thus suggest that retailing is also decoupled from the broader, interregional transportation infrastructure but not the intraregional infrastructure associated with high populations. Thus, both Cooley and the neo-Marshallian's conceptions are borne our in this sector for the industry selected.

7.2.5 Information work

The information industries comprise a broad category that comprises "establishments engaged in the following processes: (a) producing and distributing information and cultural products, (b) providing the means to transmit or distribute these products as well as data or communications, and (c) processing data" (U.S. Dept. of Commerce, Bureau of the Census 2007). This category has been dubbed the *creative class* and

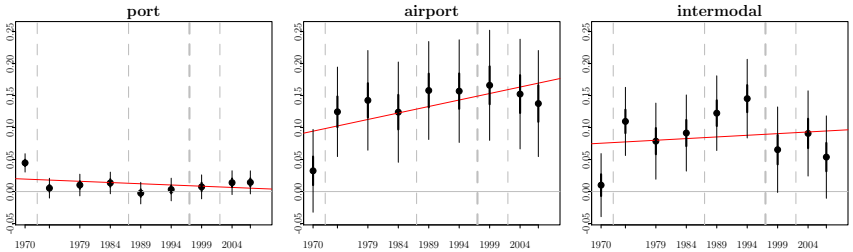

Figure 7.12: Book, periodical, and music stores (SIC 5942, 5994, and 5733/5735 and NAICS 451211, 451212, and 451220): Regression coefficients for distance (in 100km) from closest port, airport, and intermodal terminal by year against the logarithm of employment.
Point represents estimate. Wide line indicates the 50 percent confidence interval, and thin line represents the 95 percent confidence interval for the estimate. Dotted grey lines indicate industrial classification transitions. Red line indicates trend in estimators.

much has been made of its role in driving the contemporary economy (Currid 2006; Florida 2002). While these writers' definition and classification of knowledge work has been criticized as too broad (Peck 2005), some scholars have begun to concentrate on more narrowly defined artistic pursuits (e.g., Markusen 2006; Markusen and Schrock 2006).

In this study I employ two sectors to represent information work. The first is periodical publishing, which comprises "establishments known as magazine or periodical publishers. These establishments carry out the operations necessary for producing and distributing magazines and other periodicals, such as gathering, writing, and editing articles, and selling and preparing advertisements. These establishments may publish magazines and other periodicals in print or electronic form" (U.S. Dept. of Commerce, Bureau of the Census 2007). In 1997, this large, deconcentrated industry employed almost 140,000 people in over 6,000 firms. The second industry, movie and video production, is similarly large and deconcentrated. In 1997 over 80,000 people worked in almost 9,000 firms comprised of "establishments primarily engaged in producing, or producing and distributing motion pictures, videos, television programs, or television and video commercials" (U.S. Dept. of Commerce, Bureau of the Census

2007).

While periodical publishing is most closely tied to population density, it is also correlated with foreign populations and more highly educated populations. Employment rises currently by half a percent for every percent increase in population density, by 0.15 percent for each percentage increase in the proportion of the population with bachelor's degrees, and by 0.07 percent for every percentage increase in the foreign born population. This sector has demonstrated some significant geographical shifts over the past four decades. As the Table C.16 and Figure 7.13 show, periodical publishers are moving away from intermodal terminals and toward ports, while they remain indifferent to airports. Though motion picture and video production is similar (though somewhat weaker) with regard to the social indicators, i.e., attracted to population centers (0.35 percent), foreign populations (0.06 percent), and educated populations (0.11 percent), it differs with regard to transportation. Like periodical publishing, this sector is indifferent to airport location and is moving away from intermodal terminals, but it has remained consistently distant from ports. This is presumably an artifact of the historical evolution of the industry in New York and Los Angeles rather than any particular need for port services.

Curiously, in the one sector that both Cooley and the neo-Marshallians would predict no coupling to infrastructure at all, there appears to be some mild relationship. However, the nature of the relationship remains unclear. There is certainty that these industries are moving away from intermodal terminals, but while neither is moving closer to airports, one is immobile with respect to ports and the other is moving closer to ports. It is tempting to combine these conflicting impulses and argue that they cancel each other out, indicating a decoupling from infrastructure. This would lend support to both the neo-Marshallians and Cooley, but the question bears more inquiry.

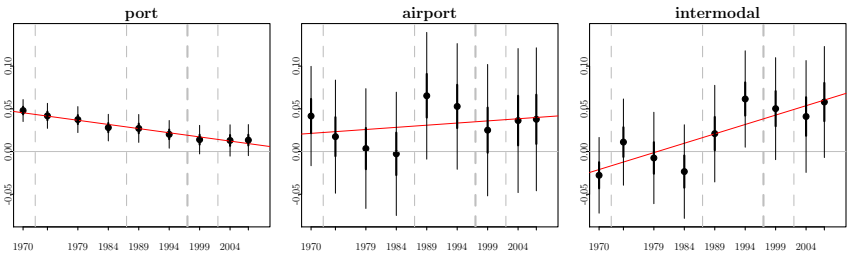

Figure 7.13: Periodical publishers (SIC 2720 and NAICS 511120): Regression coefficients for distance (in 100km) from closest port, airport, and intermodal terminal by year against the logarithm of employment.
Point represents estimate. Wide line indicates the 50 percent confidence interval, and thin line represents the 95 percent confidence interval for the estimate. Dotted grey lines indicate industrial classification transitions. Red line indicates trend in estimators.

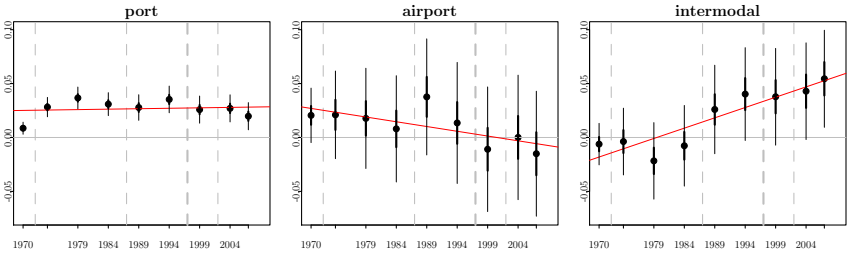

Figure 7.14: Motion picture and video production (SIC 7813 and 7814/7812 and NAICS 512110): Regression coefficients for distance (in 100km) from closest port, airport, and intermodal terminal by year against the logarithm of employment.
Point represents estimate. Wide line indicates the 50 percent confidence interval, and thin line represents the 95 percent confidence interval for the estimate. Dotted grey lines indicate industrial classification transitions. Red line indicates trend in estimators.

7.3 Conclusion

It is apparent that the relation between transportation nodes and economic activity is a complex one that is dependent upon the nature of each type of activity and their interaction. As Table 7.3 summarizes, however, the neo-Marshallian perspective is more right than wrong, and Cooley's ideas no longer seem to hold for the relatively efficient transportation systems of the United States.

Both Cooley and Marshall's ideas about natural resource extraction are accurate. Industries dealing with raw materials have not located with regard to available infrastructure nodes so much as they have determined the extents of the network's branches.

	neo-Marshallians	Cooley	Findings
Natural resources	Decoupled	Decoupled	Decoupled
Heavy industry	Decoupled	De/coupled	Decoupled
Networked manufacturing	Decoupled	Coupled	Decoupled
Market manufacturing	Decoupled	Coupled	Decoupled
Retail	Decoupled	Coupled	De/coupled
Information industry	Decoupled	Decoupled	Uncertain

Table 7.3: Relationship of industrial sectors to transportation following Marshall and Cooley

Heavy industry, presumably as a product of its large sunk costs, behaves in a similar manner, and has not relocated relative to infrastructure over the last four decades. Cooley's strong thoughts on manufacturing location turn out to be inaccurate for our time. Both networked and market-oriented manufacturing demonstrate little change relative to the infrastructural nodes in question, except perhaps for airports. This suggests a decoupling. Retail demonstrates a very high correlation to population density, which suggests that it is coupled to that intraregional infrastructure that supports urban commuting rather than the interregional infrastructure that supports freight movements. This, in essence, supports both the neo-Marshallians and Cooley. Finally, the sector upon which the neo-Marshallian position is originally founded, that of knowledge work, is curiously uncertain. It seems to be demonstrating some attraction toward ports and a movement away from intermodal terminals.

The unexpected finding here is the magnetism of airports for some industries. The role of air freight has likely become a much more important factor in many manufacturing industries' logistical calculations, especially as the value of manufactured goods in the US is increasing, making them more amenable to the costs of air shipping.

Overall, the regression analyses suggest that the location of economic activity is decoupled from the freight transportation network, as the neo-Marshallian approach

suggests. That is, the economic terrain has not shifted to reflect altered freight flow patterns. However, because the relation to infrastructural nodes has shifted very little if at all, the conclusion must be drawn that economic activity has been decoupled from the break points of the infrastructure network for more than half a century. This implies that containerization has not impacted firm location on the broad scale. Instead, it appears more likely that the location of economic activity is a product of unique historical trajectory on an industry by industry basis, though these may find some common foundation in the break points established by the transportation system as it was first built.

Therefore, the analyses in this chapter and the preceding suggest that the main public rationales for subsidizing ports do not hold up. Direct employment is decreasing as mechanization transforms operations, and formerly local activities, like warehousing, move inland for better access to highways and affordable buildings. Meanwhile, so-called port-dependent activities do not seem to have changed their location despite a spatial restructuring of the logistics system. On the whole, economic activity has decoupled from transportation infrastructure's break points, rendering the subsidization of intermodal facilities with the goal of attracting industry to one's territorial jurisdiction ineffective except insofar as the territory supports population density. That is, the product market area for the economic activities examined here is determined by consumption flows rather than freight flows. Subsidy competition, then, results not in the creation of jobs and growth but rather in the transfer of wealth from local users and taxpayers to private companies.