Transportation quality indices for economic analysis of non-metropolitan cities

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It is generally agreed that transportation plays a role in economic development, but it often is assumed away in empirical work due to data voids or under implicit assumptions that it is largely an inert factor. This paper seeks to add to the quantitative material by offering estimates of the relative quality of surface freight transportation service resources available to non-metropolitan cities across the US. Indicators suggest that cities located in the Midwest have relatively higher freight transport service quality, and that a cluster of north-eastern states are at a disadvantage, considering the quality of freight service for non-metropolitan areas. Transportation quality indicators developed in this research offer a new opportunity to consider transportation in analysis of economic development policies and strategies.

1. Introduction

Economics offers a powerful portfolio of tools for examining a wide range of phenomena. Despite an abundance of theories, however, economists are not good at explaining either macroeconomic growth or spatial variations in economic performance. Predictions of which country will prosper in the future and which will languish in the vanguard have never been good, and this extends down the level of aggregation to regions and cities. Access to markets is, however, generally seen as an important consideration in the ability of many regions or urban areas to function successfully in modern, integrated national and global trade networks. This paper focuses, with a primary emphasis on the main surface freight modes, on the quality of transportation services available to city centers in non-metropolitan US regions as a factor in this accessibility. It is very much an applied contribution that seeks to develop and quantify indicators making use of readily available data.

In part because of data availability, and the complexities and diversities of their internal structures, together with their overall economic importance, the largest metropolitan areas in the US have attracted considerable academic attention, but smaller and medium sized cities often play a pivotal role in economies of their surrounding regions and on occasions can act as either growth poles when there is regional economic expansion, or as stabilizing factors where there is wider spatial economic decline.

There are often differences in the nature of smaller and medium sized cities compared to the metropolitan areas. In the transportation context, for example, unlike larger metropolitan centers, commerce and trade generated by non-metropolitan regions may not be sufficient to create a competitive environment for freight or business travel. There is simply not enough demand to justify multiple suppliers serving the market. This has raised long-standing issues regarding captivity of markets. This, and other factors, sets them in a somewhat different context in terms of the local transportation market.

One of the generic problems in developing and subsequently calibrating analytical models of non-national economic growth, and a particular challenge faced in integrating transportation into discussions of economic development, particularly in small- to medium-sized cities, is a lack of apposite data. There are few consistent time-series at an appropriate level of aggregation and much prior work at the sub-metropolitan level has had to used case studies.

The objective of this paper is to create indices that offer insight into the quality of transportation available for businesses located in non-metropolitan areas.[1] Transportation indices (or, more accurately, sets of indices) are developed for the main surface modes of freight transportation. The treatment of inland waterborne transport is less complete than either trucking or rail freight because of data limitations.

Air cargo transportation is not included although it is taking an increasingly large share of longer distance freight by value, although not be weight or ton-miles; some estimates suggest that it carries 40% of world trade by value. One of the problems with analyzing air cargo is the commonality of much of the system used by freight and passenger carriers; even aircraft often have significant belly-hold loads. Isolating these is difficult and adequate data is not readily available. What should be added to this is that there are strong and complex links between freight transportation, person transportation, and location and a full economic model

[1] The issue of inadequate data and measurement regarding freight transportation quality was one of the challenges highlighted in a recent Transportation Research Board Report (2003)

of city development would need to take these into account. We are not trying to be that ambitious.

The indices developed here provide a measure of the relative quality of freight transportation services. The indices can be incorporated into future endeavors directed at looking into developing and growing non-metropolitan economies.

2. Background

The contemporary role of the importance of freight transportation in economic development has in many ways been neglected, or at least until recently. Certainly, historians see it as important in the UK's Industrial Revolution – indeed there is a literature on the accompanying "Transport Revolution" and in the opening up of the US economy, as well as in the creation of empires by the European powers, but much of the preoccupation in the latter part of the twentieth century was with passengers transportation and individual mobility.

The earlier periods were marked by major shifts in technology; paved roads, dredged ports, railways, and steam ships that allowed for faster, more secure, and reliable cargo movements, but they were also accompanied by institutional changes that allowed for the roads and railways to be constructed and to be financed. The most significant recent change in freight transportation technology came in the 1960s with the advent of the contained. The advent of unitization significantly reduced the cost of moving many types of freight, and brought about changes in the entire notion of logistics and supply-chain management.

The intellectual focus regarding transportation, however, changed somewhat in the 1960s and 1970s. The so-called 'Transportation Problem" largely came to be seen as an urban problem and one to do with person movements and the congestion that that can result form it. Deregulation of freight markets was certainly at the forefront of debates in the early 1980s but was less to do with economic development than with ideas of enhanced market efficiency; in the case of the railways it was also, in some ways, a knee-jerk reaction to the poor financial state of the industry. In managerial terms, there was a tendency to treat transportation costs as a small, fixed component of overall costs of production. This has, however, changed once again, with the recognition that these costs can be increased with congestion, and that financial costs are not a complete measure of the input that freight transportation makes to such things as inventory holdings. There has, as a consequence, been a considerable upsurge of interest in logistics and, for planning purposes, freight transportation demand modeling (Button, 2005). These changes have inevitably interacted and affected the way in which freight transportation and economic development are viewed.

2.1 Economic development and transportation

Freight transportation in regional economic development debates is often treated as a passive factor being reactive to the demands of other industries rather than a driver; following the traditional economic notion of it being a derived demand. In theoretical work, however, transportation is generally treated as fundamental in the growth and development of local economies. Weber (1899) and von Thunen (1966) posit that transportation is a critical underlying facet in discussing spatial organization of an economy and the subsequent rates of economic growth that comprise it. In the standard regional development literature, a rather limited amount of transportation research has been concentrated on investment in, and availability of, physical assets. A large part of this empirical work being stimulated by public policy debates in the late 1980s concerning the macro-economic role of publicly provided infrastructure investment in general (Aschauer, 1989; Munnell, 1992; Fox and Porca, 2001; Chandra and Thompson, 2000). Results broadly agree that once a core transportation network is established, little causal evidence is found to substantiate additional transport infrastructure investment being a contributing factor in further national or regional economic growth.[2]

Other literature has concentrated on the spatial aspects of transportation developing theories of accessibility and mobility. Although the terms often are considered interchangeable in planning, distinction can be made in definition and measurement (Ross, 2000; Lithman, 1999; Handy and Neimeier, 1997). Mobility is the quantity of movement that is rather easily measured by quantitative items such as vehicle ton-miles or revenue ton-miles. Accessibility has an array of definitions that generally refer to a degree of spatial separation between a location and an opportunity. However, a uniform, standard measure has neither clearly been defined nor generally accepted; for example there have been long standing debates in the planning field over the relative roles of absolute and relative accessibility.

Although little consistency is offered across accessibility measures, the basic properties of acceptable measures typically are based in axioms presented by Weibull (1976). The theoretical underpinnings are established so that opportunity sequencing is insignificant, individual behavior is rational, and the influence of measure is consistent across observations. Five functional forms of accessibility, each based in the spatial separation ideas, are travel-cost, cumulative opportunity, gravity, utility, and time-space (Handy, 1997; Bhat, 2000, 2001; Baradran and Ramjerdi, 2001). Consideration of accessibility measures in regional economic development is, however, given limited space in much of the existing literature (Keeble, et al., 1982; Vickerman, et al., 1999; Harris, 2001). Findings suggest that if accessibility – in terms of access to economic activity – is important to economic growth, the peripheral regions are becoming increasingly disadvantaged in many countries; or in the context of an international grouping such as the European Union, the peripheral countries are suffering relative to the core.

A region’s transportation resources are an important factor for understanding the relative position a region holds as it seeks to integrate its goods and labor force in an increasingly flexible and global marketplace. Although distance is often a critical factor in this relationship, it may not provide the best representation of the competitive position of a location in terms of its transportation resources. Previous studies also suggest that those regions lagging in terms of accessibility often continue to do so at an increasing rate. Transportation may thus be seen as a critical yet opaque factor in this concern over accessibility.

2.2 Non-metropolitan regions

The past century has seen a significant urbanization of the US; in 1900 about 40 percent of the population lived in urban areas by 2000 it was about 80 percent. The underlying interest in links between transportation and sub-national spatial variations in economic performance has largely been stimulated by either the particular growth in large cities or, conversely, with the decline in some rural populations.. This is not surprising since in 2000, over half of the US’s population of

[2] There is, however, a very extensive literature on the more micro impacts of transportation investment that forms part of project appraisal. This work though tends to be purely locally oriented and not to take account of wider spread and backwash effects, or any crowding out that may occur. The emphasis here is more at the meso level looking at transportation network service availability.

268 million lived in the largest cities – what Vachal (2005) calls the "megapolitans." The larger spatial units are also in a much stronger position to articulate their policy concerns through the exercise of "voice" as well as their market power; they are each unified political and economic units.

What may be thought of as the meso-spatial unit, the non-metropolitan or megapolitan city, has received less attention. In physical terms, however, these type of city are important in the US and elsewhere. In the case of the US, non-metropolitan communities with populations of between 25,000 and 249,999 account for about 75 percent of the country's non-metropolitan population; the percentage is higher in the west.

While, in relative terms, the smaller US cities are expanding more slowly than the larger spatial concentrations, there are many mesopolitan and micropolitan cities that are growing in income (table 1). Looking at rural areas more generally, between 1989 and 1991 the US's rural population grew by about 1.75 million, and between 1990 and 1994 the US Census revealed 75 percent of rural areas grew in population, a marked change of the previous post-1975 trend that saw 55 percent of the rural regions lose population. But the populations of the non-metropolitan regions are also changing (Kotkin, 2000) with skilled professionals moving to them from urban regions.

Clearly there are definitional issues involved as to what constitutes a non-metropolitan region, and the economic role of each small city is dependent on local circumstances. Economically these smaller cities can, in general, serve important functions for surrounding rural communities in terms of providing sufficient scale to attract key service industries (banking, insurance, health care, etc.) upon which the hinterland relies. They also generally support the regional inter-urban transportation nodes for road and rail, and often air transportation, being themselves hubs in the secondary system of hub-and-spoke networks, as well as for more local transportation demands.

Table 1. Population change by city classification

City Group	1980 to 1990	1990 to 2000	1980 to 2000
Micropolitan	0.16	0.71	0.39
Mesopolitan	0.61	1.03	0.79
Metropolitan	0.87	0.93	0.89
Megapolitan	1.33	1.04	1.21
All cities	1.00	1.00	1.00

Source: Vachal (2005)
Note: megapolitans have populations of over 1,097,315; metropolitans between 482,854 and 1,097,314; mesopolitans, 68,639 to 482,853; and micropolitans, under 68,639.

3. Data Sources and Index Composition

Transportation resources are often a fundamental consideration as cities and their hinterlands seek to attract and grow businesses for economic development. In some cases the challenge involves the "last-mile problem" – the initial collection and final distribution of goods – when there is network congestion. In other cases it centers on the trunk haul and the ability to get goods and services to the urban area from other areas. Data on freight transportation are seldom, however, suitable for studying the important linkages; often they collected on a one off basis for what are in effect case studies (e.g. investments in links in the network). Three primary surface freight modes, trucking, rail, and water – with an emphasis on the first two – are considered in the development of freight transportation indicators. Other sectors such as air transportation and pipelines do serve small segments of the freight market, but, although important for some items (e.g. pipelines for oil) and for some regions, the physical share for these modes within the US as a whole are estimated to be less than 1percent and 3percent respectively (Bureau of Transportation Statistics, 2000). Due to the limited representation of these modes in overall freight flows, they are not considered.

Regarding proxies for the relative quality of freight transportation available for a non-metropolitan city, statistics that characterize freight movements in terms of volume, capacity, and service rates are considered. Which is the more useful depends to some extent on the purpose any index is to serve. Volumes provide information about the level of economic activity, and in the context of the New (or “Endogenous”) Economic Growth Theory[3], and indeed even more so in the more traditional models of circular and cumulative causation, higher levels of activity allow for agglomeration economies as business and consumers benefit from the efficiencies of size and convenience.

Capacity may be a consideration in the quality of freight transportation, in terms of reliability and pricing competition. Carriers’ freight service rates offer another source of information about the effectiveness of competition in transportation pricing and the willingness of users to pay for freight movement per se. Although overall capacity and utilization may be factors in transportation pricing, service rates offer a more comprehensive indicator because they encompass other market parameters, such as the effects of intramodal, intermodal, geographic and product competition

3.1 Non-metropolitan city delineation

The US population has become highly urbanized during latter part of the 20th century, with approximately 79 percent of people living in urban areas in 2000 (US Census, 2002). The concern here is with the non-metropolitan segment of US cities. These cities were selected using a combination of the Office of Management and Budget (OMB) city definitions and US Department of Agriculture’s Economic Research Service (ERS) RuralUrban Continuum Codes. Cities, and their respective counties, selected from this group are those with a city population of 25,000 to 250,000 in counties that are not adjacent to major metropolitan counties.[4] City population data for 2000 was obtained from the US Census Bureau (2003) for making the selection. These cities and their associated counties can conveniently be termed “mesopolitans”. The locations of these cities are illustrated in figure 1.

3.2 Freight transport data for non-metropolitan cities

Three primary data sources are used in the description of freight transport service quality.

The first is the 1997 Commodity Flow Survey – CFS (Bureau of Transportation Statistics, 2000). This survey is a continuation of the Commodity Transportation Survey conducted from 1963 to 1997. It estimates modal distribution and shipment characteristics, such as distance, weight, and value, of freight originated by a universe of about 800,000 domestic businesses. An important

[3] Temple (1999) offers a survey of developments in economic growth theory. Essentially, the new (or endogenous) growth theory often associated with economists such as Romer and Lucas, emphasizes the ability of regions that are already growing fast to develop self-sustaining momentum due to their ability to process and created knowledge more effectively. This extends an older view of cumulative causation that focused more on the benefits fast growing regions enjoy from being able to exploit traditional economies of scale.

[4] These major metro counties are defined as those counties having populations of 1 million or greater.

source of rail industry data is the US Public Use Waybill Sample (Surface Transportation Board, 1999-2001). Information regarding commodity, equipment, origin, destination, rate and volume for rail shipments is included in this data set.
The US Department of Commerce (2000) *Vehicle Inventory and Use Survey* (VIUS) also is accessed as a data source. The VIUS includes a profile of the nation's truck population based on state commercial truck registration data. The National Transportation Atlas Database (NTAD) is a primary information source for consideration of water transport quality among the mesopolitans; energy, agriculture, and chemical are dominant industries in the use of water for goods transport (Bureau of Transportation Statistics, 2000). The NTAD database was enlisted to identify water terminals that reported food products, coal, grain, or chemicals as the primary cargo. The locations of the 430 water terminals included in the dominant-water-user industry terminal geography are identified. Proximity to these terminals is considered as a water service quality factor.

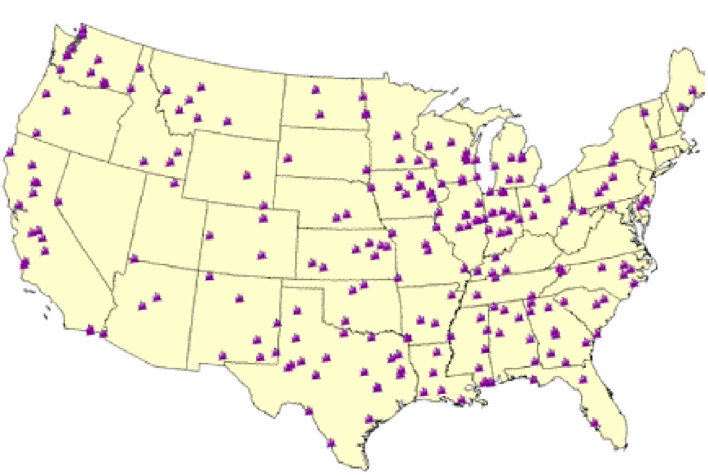

Figure 1. U.S. Mesopolitan locations

4. Results

The freight and business transport quality indices are comprised of a number of components that indicate relative quality in the mesopolitan population. The freight measure is a composite quartile indicator with rail rate, truck capacity, and water access components. The individual modal service measures are combined in the overall composite freight service indicator by weighing the influence of individual modal services in accordance with the CFS modal share information.

4.1 Freight service diversity

Initially, an overall indicator of freight modal diversity is presented. Modal diversity offers an indicator for the level of modal competition influencing the current distribution and use of freight transportation resources. With the transportation industries largely deregulated over two decades ago (e.g., the railways under the Staggers Act, 1980 and trucking under the Motor Carriers reform Act, 1980), market competition is a primary factor in determining transportation quality as it brings in consideration of rates and reliability. The modal diversity index is estimated as a Herfindahl-Hirschman Index of modal concentration of the form:[5]

$$H = \sum_{i=1}^{m} X_i^2 \qquad (1)$$

where; m is mode share i, for modes truck, rail and water, and X is modal share in state.
The modal diversity scale ranges from 0 to 1, with unity indicating modal monopoly. The overall US freight modal diversity index is 0.52 considering the three primary surface modes; trucking, railroad and water. The lower, mid, and upper quartiles of diversification for distribution of the modal diversity indicators across the 48-contiguous states are at the index levels of 0.48, 0.58, and 0.75, respectively. The state-level modal diversity categorizations are listed in table 1.
The high concentration of truck use in the Northeast is evidenced by the cluster of states in that region with a diversity index in the upper quartile. Trucks handle more than 93 percent of the tons of freight by the three primary modes that originate from Massachusetts, New Hampshire, New York, Pennsylvania, Rhode Island, and Vermont State clusters in the northern and southern plains, along with Utah, Illinois, Kentucky, and West Virginia have the most diversity in modal usage for freight originations. The range of diversity may be a function of factors including freight characteristics, customer demands, institutional differences, and the base of natural and man-made transport resources.

4.2 Freight Service

The freight quality indicator includes truck capacity, rail rate, and water distance as proxies for service quality among the primary modes. The quartile-based assessment of the indicators among states is weighted by the state modal origination shares. The state-level quartile delineations offer mesopolitans some insight into transportation resources by providing a measure of the relative position of individual state transportation resources, compared to other states (table 2). These state-based indicators may be useful in assessing future policy and investment strategies for economic development of mesopolitans and their regional economies.
The composite freight quality indicators, based on quartile distribution, are also presented in table 2. Mesopolitans located in several plains and western states, including Idaho, Iowa, Montana, Kansas, Nebraska, North Dakota, South Dakota, Oklahoma, and Wyoming, have the highest quality freight based on the composition index. A cluster of freight disadvantaged mesopolitans is found in the northeast region, along with mesopolitans in Florida, Tennessee, and Texas. The freight quality indicator for mesopolitans in these states is in the lower quartile (or 25th percentile). The quality indicators for the individual modes used in the composite freight quality measure are included in the table.

[5] The Herfindahl-Hirschman Index is a commonly accepted measure of market concentration. It is calculated by squaring the market share of each firm competing in the market and then summing the resulting numbers. The index thus takes into account the relative size and distribution of the firms in a market and approaches zero when a market consists of a large number of firms of relatively equal size. It increases both as the number of firms in the market decreases and as the disparity in size between those firms increases.

Table 2. Freight transportation diversity and quality indicators (Quality Quartile: 1 = more positive to 4 = more negative for overall quality)

State	Freight, Modal Diversity Index[1, 2]	Individual Modal Quality Indicators			Composite Freight Transportation Quality Indicator
		Rail	Truck	Water	
Alabama	3	2	2	1	2
Arizona	2	4	3	4	3
Arkansas	3	3	2	2	2
California	3	2	3	3	3
Colorado	2	1	2	4	2
Connecticut	4	4	4	1	4
Delaware	2	3	3	2	3
Florida	2	4	4	1	4
Georgia	3	3	2	2	2
Idaho	2	2	1	4	1
Illinois	1	3	3	1	3
Indiana	3	3	2	2	2
Iowa	3	1	1	2	1
Kansas	2	1	1	4	1
Kentucky	1	1	2	1	2
Louisiana	1	3	3	1	3
Maine	4	*	2	1	1
Maryland	3	4	4	2	4
Massachusetts	4	4	4	3	4
Michigan	3	4	3	1	3
Minnesota	1	1	2	2	2
Mississippi	2	3	3	1	3
Missouri	3	3	2	1	2
Montana	1	1	1	4	1
Nebraska	2	1	1	3	1
Nevada	4	1	3	3	3
New Mexico[2]	4	2	2	1	2
New Jersey	3	4	4	1	4
New York	1	4	2	4	2
New Hampshire	4	4	4	3	4
North Carolina	4	3	3	3	3
North Dakota[2]	1	1	1	4	1
Ohio	3	4	3	2	3
Oklahoma	1	2	1	3	1
Oregon	3	2	2	3	2
Pennsylvania	2	2	4	3	4
Rhode Island	4	3	4	2	4
South Dakota	4	4	2	3	2
South Carolina	3	1	1	4	1
Tennessee	4	2	4	2	4
Texas	1	2	4	4	4
Utah[2]	1	1	3	4	3
Vermont	4	3	2	3	2
Virginia	2	4	2	1	2
Washington	2	2	2	1	2
West Virginia	1	2	3	1	3
Wisconsin	4	3	2	2	2
Wyoming	3	1	1	4	1

[1] Diversification of single mode traffic volumes (Commodity Flow Survey, 1997).
[2] On average, 94 percent of the freight originated in states was shipped via single mode. States in the 25th quartile include ND, NM, and UT that report only 70, 68, and 58 percent of freight via single mode. “Unknown” is the most common mode category for freight not reported under single mode.

4.2.1 Truck indicator

Tucking, is the dominate freight mode in the US with demand for its services increasing over recent decades in response to changing consumer product demands and enhanced business inventory management practices (e.g., “just-in-time management”). The truck industry offers few data sources for assessing competition and associated service quality. As truck capacity has often been found in business response surveys to bean important factor in attracting freight-based economic development, a ratio of for-hire trucks to state population is used as a proxy for truck quality in terms of capacity.

The US ratio of population to freight truck capacity is 15.1. Trucks that are categorized in the VIUS as business-use, for-hire, and daily-rental are included in the available fleet for the total trucks estimate (table 2). The geographic distribution of population and freight truck capacity is highly correlated at the state level (r= 0.95, p= 0.000). State-level truck capacities range from a high of 30.5 to a low of 5.1. Trucks are manifestly a highly mobile and flexible freight transportation resource so regional information may offer another benchmark for assessing truck freight.

The population-freight truck ratio varies across the four US Census Divisions (table 3). The midwest and west have the lowest population-freight truck ratios of 13.2 and 13.5, respectively. The northeast has the least attractive ratio among the four regions at 22.3 residents to each truck. The south is at the national average with a ratio of 15.1. These ratios suggest that relative truck capacity is nearly 40 percent less in the northeast region than in the west of the country.

Table 3. US Population-to-truck ratios

	Population	Total Trucks	Total Freight Trucks	Population-to-Truck Ratio
Northeast	53,594,378	9,702,005	2,403,275	22.3
	19%	14%	25%	
Midwest	64,392,776	17,085,976	4,886,900	13.2
	23%	25%	29%	
South	100,236,820	24,239,298	6,634,210	15.1
	36%	35%	27%	
West	61,359,463	17,313,760	4,557,440	13.5
	22%	25%	26%	
U.S. Total	279,583,437	68,341,039	18,481,825	15.1

Source: US Census Bureau, 2000 and 2003

4.2.2 Rail indicator

Rail quality indicators are based on the freight rate data reported in the Waybill Sample between 1999 and 2001. As with trucking, deregulation of the rail industry has encouraged more market based pricing with differentiation based on commodity characteristics and the competitive environment. The growth in rail use has been considerable since the 1980s and as consolidation and rationalization of the network has taken place. A wide variation in both uses of rail in shipping and rail rates paid is illustrated by the average rate paid among two-digit SCTG commodity classes (table 4).

Table 4. Modal shares, rail rates, and rail distances, by SCTG commodity class

Commodity Class	Million Tons	Modal Shares[1]				Average Rail Revenue per Ton Mile	Average Rail Distance
		Truck (%)	Rail (%)	Water (%)	Multi and Unknown (%)		
Live Animals	6	100	0	0	0	n.a.	n.a.
Cereal Grains	490	45	29	18	8	3.30	832
Other Agricultural Products	202	72	9	16	2	4.65	925
Animal Feed & Products	220	90	8	2	0	4.58	802
Meat, Fish, Seafood	79	98	1	1	0	5.54	1,534
Milled Grain Products	103	82	17	0	1	5.26	772
Other Prepared Foodstuffs	397	90	8	1	1	5.17	950
Alcoholic Beverages	81	89	10	0	0	4.51	1,089
Tobacco Products	4	100	0	0	0	3.37	1,640
Monument & Building Stone	16	100	0	0	0	2.78	961
Natural Sands	443	95	2	2	0	5.05	416
Gravel and Crushed Stone	1,815	94	3	3	0	5.08	221
Nonmetallic Minerals N.E.C.	236	74	15	7	7	4.48	388
Metallic Ores & Concentrates	91	20	47	7	28	4.47	221
Coal	1,217	22	56	6	16	2.87	630
Gasoline & Aviation Turbine	963	54	1	8	75	6.40	258
Fuel Oils	482	52	1	11	69	4.86	834
Coal & Petroleum Products	475	62	13	15	20	5.43	653
Basic Chemicals	296	44	28	16	22	5.76	863
Pharmaceutical Products	10	97	0	0	4	5.94	1,443
Fertilizers	179	55	36	5	5	5.49	599
Chemical Products	92	90	7	0	3	5.83	732
Plastics & Rubber	130	80	19	0	1	7.44	920
Logs & Other Rough Wood	371	97	2	0	1	4.96	338
Wood Products	329	87	11	0	2	4.67	1,028
Pulp, Newsprint, Paper	152	72	26	0	2	5.13	1,086
Paper or Paperboard Articles	74	98	2	0	0	7.02	1,218
Printed Products	78	99	0	0	1	9.86	1,365
Textiles, Leather	46	99	1	0	1	8.85	1,524
Nonmetallic Mineral Products	910	96	2	1	0	5.40	632
Base Metal Primary/Semifinish	336	83	15	1	1	5.00	768
Articles of Base Metal	107	93	5	0	2	6.52	701
Machinery	50	97	2	0	1	11.14	1,241
Electronic & Other Electrical	40	97	1	0	4	11.27	1,493
Motorized & Other Vehicles	98	83	14	0	3	17.84	806
Transportation Equipment	5	59	32	0	11	14.73	872
Precision Instruments	3	94	0	0	11	10.91	1,770
Furniture, Mattresses	20	99	1	0	0	11.10	1,673
Miscellaneous Manufactured	112	98	1	0	1	10.75	1,369
Waste And Scrap	178	74	23	2	1	6.37	517

Source: Bureau of Transportation Statistics, 2000; Surface Transportation Board, 1999-2001
[1] Modal shares calculated in tons.

The rail industry quality indicator reflects the quartile for the estimated revenue per ton-mile paid for rail service carrying commodities originated in the state (see again table 2). The average revenue per ton-mile paid by states ranges from $0.029 to $0.136. The median per ton-mile payment is $0.053. Given the market-based pricing for rail rates and the wide variation of rates across commodities, the wide range of state average rail rates is as expected. Additional insight may be gained by considering the relative competitiveness of average rail rates in commodity categories, such as natural resource and consumer products.

4.2.3 Water transportation indicator

Water is the final mode considered in the transportation quality index (see again table 2). Overall, about 5 percent of the freight movements reported in the CFS were transported via water. These water movements include inland barge and intercostal vessel movements. Energy, agriculture, and chemical industries are the primary users of water transport, with these industries shipping over 15 percent of their product via water. The utilization of the mode by these industries is logical given that water is the low-cost alternative for longer-distance, bulk shipments. Product characteristics and proximity typically determine the economic viability of water transport.
Inherent qualities make water-based transport rather rigid in terms of geography and capacity. The economics of water transport, for products conducive to this mode, is largely determined by proximity to water. Because the scope of products considered in this research is unlimited, the average distance to water from mesopolitans in a state is offered as a proxy for water transport in the composite transportation service index. Distance to water averaged 169 miles, ranging from 6 miles to more than 600 among the mesopolitan locations. For industries with products suited for the typical large-volume, longer-distance shipments, economic benefits of water proximity are in the ability to access barge and intercoastal shipping alternatives and in the gains associated with water-compelled pricing practices employed to compete with the low-cost carrier.

5. Conclusions

Our understanding of the links between economic growth and the quality and nature of transportation networks is still relatively basic. The problem is much less a matter of intellectual effort, there is an abundance of abstract models in the academic literature, but rather more one of having the data and the quantitative techniques to tease out the magnitudes and directions of key links. The aims here are modest; to make use of public data to develop some measures of the freight transportation quality that is enjoyed by non-metropolitan cities in the US. These are important components of the US economy and are often neglected in analyses. In that sense, the paper is very much more inductive in its approach than much of the abstract modeling that is a feature of this field, but equally it offers a way of gaining enhanced insights as to the underlying parameters involved.
There is no idea index of freight transportation quality; much depends on the types of commodity involved, the mode, and the distant between production and consumption. Any general measures are, thus by their nature indicative. They can show, however, broad trends and provide input into macro, strategic transportation planning.
The findings of this work offer insights into the relative quality of transport services available for economic growth of non-metropolitan cities located across rural regions of the US. The goal is to

estimate indicators of the relative service quality for freight and business travel among mesopolitans. Findings suggest that transport services are largely a function of market competition for natural and man-made resources under the deregulated market scheme initiated with legislation passed over two decades ago. The mesopolitans in the mid-west are found to have the highest overall quality of freight services. A general weakness of overall freight service quality found for mesopolitans in eastern states, along with Florida, Tennessee, and Tennessee, is a concern as research suggests that there is a tendency for those lagging in transport quality to become more disadvantaged over time; they simply cannot keep up with more dynamic areas.

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