Working Paper WP020299 February 2, 1999

The New Economics of Distance: Long Term Trends in Indexes of Spatial Friction

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Background work related to this Working Paper was supported by Hatch Project 1509 on Global Economic Restructuring and its Implications for South Carolina, funded through the South Carolina Agriculture and Forestry Research System.

Preface

It is part of the conventional wisdom that dramatic changes have occurred since 1960 in the costs and efficiency of transporting information, people, and materials from one place to another. The present Working Paper presents data which show that, indeed, the costs of transporting information, people, and materials by SOME modes and media have dropped at astonishing rates and to astonishingly-low levels over the past three decades. This has been particularly true for INFORMATION.

A second conventional wisdom that is trying to emerge from the dramatic decreases in the cost of moving INFORMATION is that "distance is dead" as a factor in economics. However, our data show that the costs of moving PEOPLE and MATERIALS have NOT dropped as fast nor to as low a level as have the costs of moving information. In addition, the 'border effect' — for which cost data are more problematic — seems to have practically no effect on the international movement of information, while it remains a significant barrier to moving people and materials internationally.

If the economy used and consumed only "information", then 'death of distance' would be accurate enough as a general term. Or if information, people, and materials were perfect substitutes for each other—both in production and in consumption—then the aphorism also would be OK. We will grant that much is happening in the broader economy that is increasing both the consumption of information as a 'product' while at the same time increasing the substitutability between information, people and materials in production. But the global economy and its constituent parts are still a long way from surviving simply on information. Thus, any conventional wisdom about the death of distance needs to differentiate between categories of resources.

We believe that looking at some simple index numbers regarding the changing costs of moving each of the above three categories of resources helps one to better understand a number of changes that are occurring in the US and global economies in the 1990s. Of particular interest to us — because of related research that we are just beginning — is the restructuring that is occurring in the firms and sectors that provide logistics services and in the logistics management operations within individual manufacturing firms. The data presented herein suggest the following:

1. The rates of change in transport costs vary greatly between three categories of resource flows: (a) Information, (b) People, and (c) Materials. No mode or media for moving PEOPLE and MATERIALS has been able to match the efficiency increases experienced in processing and moving INFORMATION between 1960-1998.
2. In addition to the differences between information and the other two resource flows, the rates of change in costs vary greatly between the various modes by which both PEOPLE and MATERIALS are moved.
3. Reductions in ARTIFICIAL barriers to moving people and goods internationally have occurred apace—as some of our data show. However, INSTITUTIONAL and other barriers to international movements remain and result in a difficult-to-quantify

BORDER EFFECT that is nevertheless significant for those firms that would engage in international trade or in production integration.

The indicated patterns of change in costs of domestic and international transport of information, people and materials lead to a logical conclusion that creative individuals will seek ways to substitute between resource types, modes, and media in managing production processes and—in particular—the logistics functions related thereto. These and related factors lead to three, observable forms of ECONOMIC RESTRUCTURING that are occurring around the logistics management function: (i) Within manufacturing firms, (ii) Within the logistics firms, and (iii) In the relationships between users and providers of logistics services.

While we recognize their importance, it is not the objective of this Working Paper either to explain the trends that are reported herein or to explain where it is leading in terms of industrial location, logistics management, or economic restructuring. On the first count, we leave it to other analysts to explain the *causes* of the changes in transport costs. On the second count, we are at the beginning stages of research that will be directed at selected aspects of the restructuring and other consequences of these changes.

Those readers who are interested in the underlying factors driving the data that we present may wish to consult other sources—in particular, a masterful piece of research published in 1990 by Arnulf Grübler in which he "...tries to merge two streams of analysis: diffusion research ...and the long established disciplines of transportation planning and the economic history of transport systems."[1] In that work, the author develops theoretical models of evolutionary change in transport systems. Using a quantitative approach to historical interpretation, he models the periods of development, competition, dominance and replacement for various transport technologies. In the process, he assesses the increasing interplay between the movement of information, people, and materials.

As we have said, the present Working Paper has much more modest ambitions than did the Grübler book. Our objective is simply to take a quantitative look at the order of magnitude of changes in costs associated with various methods for transporting information, people and materials so that we can begin the process of assessing the implications for the small and rural businesses that are facing these changes. We take such a modest focus because the Working Paper developed out of studies of factors affecting the ability of small/rural firms in South Carolina to integrate into global trading and production systems. The first step in developing any such study should be to estimate the degree of importance of the issue in the grander scheme of things. Have there been major changes in transport costs? Do the changes differ across mode, media and resource? Are those changes associated with increasing/decreasing complications in managing logistics? Is the cost of logistics important to the categories of businesses to be included in the broader study that is being prepared? These were the basic questions that

[1] Arnulf Grübler. *The Rise and Fall of Infrastructures: Dynamics of Evolution and Technological Change in Transport*. Heidelberg (and New York): Physica-Verlag (Springer-Verlag), 1990.

we sought to answer for ourselves by pulling together the secondary data presented in this Working Paper.[2]

Having pulled these data together for our own use, it was a minor undertaking for us to produce a Working Paper that makes the data, as well as some of our ruminations about the data, available to other researchers and to interested individuals. Because our primary interest is in making the data available to others, we are unapologetic about presenting a paper that is light on policy analysis and prescriptions. We will appreciate feedback from readers regarding other data sources, implications of these and other data, and related work that others might be doing along similar lines.

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[2] The research was undertaken preparatory to submitting a proposal to the South Carolina Agricultural and Forestry Research System for a project to study the transaction costs associated with international trade and production integration faced by small/rural firms in South Carolina.

The New Economics of Distance: Long-term Trends in Indexes of Spatial Friction

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Abstract: Distance-related costs have changed at different rates across categories of resource flows and across modes and media between 1960 and 1998. The cost of moving knowledge/information has dropped much faster than the costs of moving people or materials. The costs of processing and of moving information have dropped by 98% and 92%, respectively, in real terms since 1960. In addition, there are big differences in the rates of change within the real costs of moving people using different travel modes—just as big differences exist within the real costs of moving materials using different modes. For example, the real costs of moving materials by domestic rail and inland waterway have decreased by 58% and 42% in real terms, respectively, while inter-city trucking costs have not changed significantly in real terms since 1960. Thus, this Working Paper suggests that the 'new economics of distance' is not about the disappearance of distance nor the demise of borders as factors in economics. Rather, 'the new economics of distance' is about the increasing role played by logistics management and the adjustment processes that are occurring as firms creatively seek to substitute between types of resources and between the modes and media for moving those resources.

Is distance dead? How will the reputed death of distance alter the agglomeration economies surrounding urbanization? Do borders no longer matter in economics? Are models of trade and location that use a monolithic concept of "transport" adequate?[3] Can one brief Working Paper answer all of these questions?

We do not propose to lay to rest the concept of dead distance nor the agglomeration issues that would enter an altered state along with it. Neither do we propose to prove or even to argue vehemently that borders matter. And we will not take on the innumerable and illustrious group of trade and economic geography theoreticians who seek to simplify and explain interrelations between scale and space by using a simple concept of "transport". Rather, we propose to make a simple, descriptive presentation regarding two points and to let the research programs of our readers address the above questions after contemplating our descriptive analysis:

(1) We suggest and then seek to demonstrate that "distance" and "borders" can be addressed by defining three different categories of resources that are moved across space in the process of producing and marketing goods and services—(a) Information, (b) People, and (c) Materials; and

[3] On the 'death of distance', see Cairncross (1997). On the demise of borders, see Ohmae (1990). On the issue of distance costs and the economics of urban versus rural location, see Gottman (1985), Guilder (1995), Hite (1997), Malecki and Boush (1998), Moss (1996), Moss and Townsend (1998a and 1998b). On models of trade and of economic geography, see Kibritçioglu (1997), Helpman and Krugman (1985, 1989), and Krugman (ed. 1986, 1990, 1991, 1995, 1996, 1998).

(2) We present secondary data on long-term trends (1960-1998, mostly, with some longer and some shorter series) in the real costs of moving these different categories of resources *via* different modes and media, domestically and internationally.

Our data show that the costs of moving the different resources have neither universally "disappeared" nor have they changed at the same rates. This finding suggests to us that each of the above questions needs to be looked at with much more precision than has been the case in the decade of the 1990s. We think our modest introduction of resource differentiation and related accounting precision suggests further that the "new economics of distance" is not about the disappearance of distance nor the demise of borders. Rather, it is about the increasingly important role that logistics management and factor substitution across categories of resources play in an environment in which the costs of moving different resources by differing modes and media are changing at sometimes rapid but surely differential rates. We believe that these two, simple applications of descriptive analysis help one to better understand the adjustment processes that are occurring in logistics management as we approach the end of the 20th Century.

Description of the Resource Flows, Modes & Media Studied

Categories of Resource Flows. We will define three categories of 'resources' that are involved in economic activity and that represent important flows between economic actors located across economic space:

1. Knowledge/information;
2. People;
3. Material inputs and material outputs.

We will adopt the WDR 1998/99 definition of "knowledge" as being of two kinds: (a) The 'know-how' that is linked to 'technology' and to 'human capital', and (b) Knowledge of 'attributes' of persons and things, such that formalized impersonal trading can occur with some degree of security. Following WDR 1998/99, we can refer to the first of these as 'know-how' and the second as 'information'. For the purpose of the present paper, we can be imprecise about which of these two kinds of knowledge moves across space and the precise mode/media by which it moves (e.g., via computer/telecom links or by the movement of people and technology-embodied machinery and systems). We can be imprecise because we simply seek to show that the rates of change differ across the modes and media for moving these resources—in some cases, significantly.

Modes and Media by Which Flows Occur. We will analyze the following elements of the modes and media by which the above resources flow among economic actors:

A. Knowledge/information processors and movers, including
   - Computers
   - Telecommunications

B. People movers, including
   - Air travel
   - Inter-city Amtrak
   - Inter-city bus
   - Commuter rail

C. Materials (freight) movers, including
   - Domestic
     - — Air freight
     - — Railway freight
     - — Inland waterway freight
     - — Inter-city motor carrier freight
   - International
     - — Ocean freight
     - — Port charges
     - — Tariff barriers
     - — Transaction costs and non-traditional barriers
     - — Organizational efficiencies from deregulation and reorganization (e.g., Inter-modal transport)

Among the above categories, we will be able to make some distinctions between movers of 'bulk commodity' freight versus 'general cargo' freight, which might suggest to some readers a number of implications for trends in our indexes upon various categories of producers.

Indexes of Friction Among the Various Modes and Media. For the most part, we will not concern ourselves with micro-analytic analyses of the way that all of the above modes and media work. Nor will we attempt to explain in this paper exactly *why* the various indexes of friction have behaved over time as they have, other than to provide broad generalizations about why a number of them have trended downwards over the period that we have studied (1960-1998). The only indexes for spatial friction that we will present will be cost-based indexes. We recognize that other elements of friction are important—in particular, the element of 'time'. Again, as with the micro-analytics of individual modes and media, we will leave these other measures of friction for other analysts to study. Our indexes will be presented in "real" terms—i.e., they will be adjusted for purchasing power changes in the US$ over the time horizon of our study (passenger travel is adjusted by the CPI, while other modes/media are adjusted by the PPI).

Driving Forces in Reducing Spatial Friction: 1960-1998. In collecting the data that follow and in reading and discussing the work of other analysts, we believe that three inter-linked factors explain much of the downward trends in spatial frictions with respect to some (though not all) of the modes and media that we study in this paper:

(1) Technologies flowing from the integrated circuit, which began to have its greatest effect after 1960;
(2) Containerization and the related development of inter-modal transport systems, which came into force primarily from the early 1960s (much of which we have been unable to capture); and
(3) Deregulation and related re-organization and restructuring of the various modes and media covered by this study, which had their greatest effects from the late-1970s.

In looking at the trends in spatial frictions affecting various modes and media, we explore both the "natural" and the "artificial" barriers to movement of information,

people, and materials. We track — as well as the data series will allow us — the changes in various measures of spatial friction far back into the past. Wherever feasible, we take the data series back at least as far as 1960, under the assumption that this will give us a view of space and friction as these factors existed before the above three factors had their biggest impacts. In a few cases, we are able to go further back into the past than 1960 (e.g., our long distance phone charge series goes back to 1927). In other cases, we are not yet able to construct full data series back to 1960 (e.g., the BFI that we use for ocean bulk freight started only in 1985) and have relied upon other studies and by anecdotal information where necessary and where feasible.

Study Findings—by Category of Mode and Media

Telecommunications and Computing Costs over Time

Among all the modes and media discussed in this paper, the costs of electronic computing and of telecommunications have been the most strongly affected by technological developments since 1960. Technology has played the largest role in these cost reductions, though changes in organization and regulatory regime also have played a part in the changing economics of telecommunications (Economides 1998; Mitchell and Townsend 1998a and 1998b).

Table 1. Indicative Costs of Telephone Calls and Electronic Computing, Selected Years 1930-1990 (1990 dollars, unless otherwise indicated)

Year	Cost of a 3-minute call New York to London	Department of Commerce computer price deflator (1990 = 1000)
1930	244.65	n.a.
1940	188.51	n.a.
1950	53.20	n.a.
1960	45.86	125,000
1970	31.58	19,474
1980	4.80	3,620
1990	3.32	1,000

Source: Gary Hufbauer, "World Economic Integration: The Long View," *International Economic Insights*, vol. 11 (May-June 1991). Presented in Herring and Litan (1995).

Data from Huffbauer (1991) indicate the dramatic decrease in costs of computers and telecommunications between 1930 and 1990 (Table 1—For more details on these changes, see also Annex Tables 7 and 8 of the present Working Paper). This suggests that the costs of overseas telecommunications originating in the U.S. have dropped by more than 92% since 1960 alone. In comparison to 1930, the decrease has been more than 98%.

Among the electronics technologies, telecommunications has not been alone in experiencing deep reductions in costs. As Table 1 indicates, the costs of computing decreased at an even greater rate between 1960 and 1990 than did telecommunications costs. Using a relatively new Producer Price Index series for computing provided by the Bureau of Labor Statistics, we show in Table 2 that the cost of computing has continued to decrease since 1990. Among the three types of computers presented in Table 2, the price index for personal computers experienced the most dramatic decrease in the 1990s — a drop of approximately 82% between 1992 and 1998 alone.

Table 2. Further Reductions in Costs of Computing Since 1990

Year	Electronic computers	Large-scale (64MB or more in minimum main memory configuration)	Personal computers and workstations (excluding portable computers)	General purpose digital computers
1990	100.00	100.00		
1991	88.90	95.30		
1992	74.50	86.40	100.00	100.00
1993	65.40	71.60	88.40	91.00
1994	60.10	66.40	78.20	83.70
1995	53.80	63.30	63.00	72.70
1996	45.20	61.50	43.60	57.20
1997	36.50	58.00	29.40	43.70
1998*	26.29	51.07	18.79	32.50

[a] Source: Bureau of Labor Statistics Data website:http://www.bls.gov
All index series are subject to revision four months after original publication.
* The data for 1998 are based on preliminary data from Jan. to Sept.

The Cost of Moving People

A major element of the shrinking globe thesis is the idea that reductions in telecommunications costs substitute for moving people around.[4] This is an interesting hypothesis, since the rate of reduction in airfares has been surpassed only by the rate of

[4] Moss and Townsend (1998a) comment that "All too often, telecommunications systems are treated as an alternative to transportation systems, as a substitute for the physical movement of people and services." We suggest in the final section of the present Paper that the concept of substituting information for people and/or materials is not totally farfetched. Indeed, economics teaches us that 'entrepreneurs' will seek to develop technologies that allow the substitution of decreasing cost resources in place of increasing cost resources or for those that are not decreasing as fast.

reduction in computing and telecom costs among all the modes and media that we discuss in this paper.

As indicated in Table 3, there has been a fairly dramatic decrease in the cost of moving people by air (See also Figure 4. The Figures are at the back of the Working Paper). Air travel costs decreased in real terms by about 58% between 1960 and 1996, while computing costs and telecommunications costs decreased in real terms by approximately 98% and 92%, respectively, during that same period.

The closest competitor to air travel (commuter rail) for moving people around experienced real fare decreases at one-third the rate of the airfare decreases over the period 1960 to 1996 (a 17% reduction for commuter rail, versus a 58% reduction for airfares—see Figure 2). Amtrak fares in real terms showed a checkered pattern over the same period, with the 1996 index of real fares actually being slightly above the real fare index for Amtrak for 1960 (though the indices for 1992 through 1995 were below the level of the 1960 index). [See Annex Table 1 for the long-term series covering this and selected other transport/travel costs 1928-1996] Inter-city bus fare movements also were not monotonic, though the index of real costs for 1996 was down by almost fourteen percent compared to the index for 1960. Similarly, commuter rail fares both rose and fell in real terms over the 1960-96 period, ending up at a real cost reduction of about 17% in 1996 compared to 1960.

Table 3. Indexes of Real Costs of Moving People in the U.S. by Various Public Travel Modes, 1960 to 1996*

Year	Index of Air Fares	Index of Commuter Rail Fares	Index of Inter-city Amtrak Fares	Index of Class I Inter-city Bus Fares
1960	100.00	100.00	100.00	100.00
1965	93.51	106.20	97.38	99.86
1970	75.16	97.97	101.21	101.34
1975	69.38	86.11	103.68	98.46
1980	67.77	82.42	96.98	96.23
1985	55.15	113.81	102.59	100.60
1990	49.94	104.32	105.39	96.52
1991	46.46	96.38	101.13	96.47
1992	44.52	96.10	98.18	91.86
1993	45.92	99.97	94.32	89.64
1994	43.02	93.15	90.43	85.61
1995	43.17	86.70	93.83	87.67
1996	42.41	83.30	103.29	86.27

Source: Summarized from calculations in Annex Table 4.
* Indexes include adjustment by Consumer Price Index to 1960 base.

The Cost of Moving Goods Domestically

Next we look at our index series for the various modes of domestic shipment of materials. The greatest reductions in real costs occurred in rail freight (a 58% reduction from 1960 to 1996—a rate comparable to real airfare reductions) and inland waterway freight (a reduction of 46% during the same period). These trends are summarized in Figure 3. Interestingly, these are the two modes that are best suited to hauling "commodities" having a low ratio of value-to-bulk.

The two modes that are better suited to moving "products" having a relatively high ratio of value-to-bulk (airfreight and inter-city motor carrier) did not demonstrate such clear-cut reductions in costs as did the "commodity" carriers over the 1960-1996 period. While the index for airfreight declined substantially between 1960 and 1985 (dropping from 100.00 down to 67.23 — i.e., a decline of about one-third), the index then proceeded to rise again over the period from 1985 to 1996 (from 67.23 back up to 90.05). One hesitates to report a 10% reduction in real airfreight costs over the period 1960-1996 when the trend from 1985 to 1996 was actually upwards. Likewise, inter-city motor carrier costs showed no clear downward trend during the 1960-1996 period, actually ending 1996 at a real level four percent higher than the 1960 level of inter-city motor carrier costs.

Table 4. Indexes of Real Costs of Moving Goods in the U.S. by Various Shipping Modes, 1960 to 1996

Year	Index of Air Freight Charges	Index of Class I Rail Freight Charges	Index of Class I Inter-City Motor Carrier Charges	Index of Inland Waterway Carrier Charges
1960	100.00	100.00	100.00	-
1965	87.10	88.05	99.37	100.00
1970	81.31	86.43	113.98	74.73
1975	70.42	82.91	104.60	87.09
1980	76.17	76.88	106.97	85.00
1985	67.23	68.24	114.06	74.01
1990	72.93	52.69	107.14	62.04
1991	76.89	50.04	106.40	62.11
1992	77.31	49.44	98.22	60.02
1993	82.67	47.52	104.60	59.06
1994	82.94	46.58	103.77	57.05
1995	86.50	44.20	102.55	55.40
1996	90.05	42.28	104.20	54.13

Source: Annex Table 3. Adjusted using Producer Price Index.

The Cost of Moving Goods Internationally by Ocean Freight

Generally, both greater costs and greater hassles are associated with moving goods internationally than with shipping the same goods domestically. This is true not only because of a number of tasks (Box 1) that must be accomplished as one moves across international borders but also because of "transaction costs" and "non-conventional barriers" that occur with international trade that are not present with domestic shipments. Some of the frictions associated with international movement of goods are directly comparable to those involved in domestic shipment, while other frictions are more ephemeral (i.e., the non-conventional and some of the transaction costs). Thus far, analysts have not found a convenient and consistent way to convert these latter frictions into indexes of the type we present in the present paper.

Box 1. Costs and Frictions Associated with Shipping Goods Internationally

Identifiable costs associated with international ocean freight shipments vary by type of freight (see Box 2) and typically include:

1. International freight and insurance;
2. On-land freight charges in both countries;
3. Port charges at both ports;
4. Tariffs, excises and other assessments at the port of entry (and sometimes export taxes at port of export);
5. "Handling" charges imposed by freight forwarders, brokers and bonded agents;
6. Payments arrangements involving multiple currencies (and related exchange rate risk management) and correspondent banks;
7. Transaction costs associated with legal documents that may involve one or more unfamiliar legal/court systems; and
8. Costs of dealing with bureaucracy and unions at ports of entry—including the need to pay bribes in some cases (particularly in less developed countries or 'emerging markets').

As Box 2 suggests, there is a hierarchy of 'modes' involved in moving goods that conforms to the value/bulk ratio and to the urgency with which the goods must be transported. Generally, airfreight is reserved for goods that have a high ratio of value/bulk and/or for which rapid movement is urgent. Thus, fresh cut flowers move by airfreight between a number of producing centers and points of final use. Likewise, replacement parts for critical machinery also will sometimes move by airfreight. A number of different carriers operate in the general market and in 'niche' sections of the airfreight market (see ATW 1998 for an overview of U.S. air cargo carriers).

The next general level down in the value/bulk hierarchy below international airfreight is containerized cargo freight, and then the dry and liquid bulk cargoes. Trends for these three general groupings – i.e., (1) Airfreight, (2) Container freight, and (3) Bulk freight – are affected by different patterns of change in technology and organization and, thus, show different trends with respect to the frictions that we are attempting to report upon here. For example, bulk cargoes have experienced efficiency improvements via larger and more efficient ships and from improved handling at ports. But these changes do not seem to have been nearly as dramatic as the changes affecting general cargo via containerization and inter-modal organization. Because of our lack of success in finding long-term indexes covering each of these categories of international shipping, this section of the paper will rely upon trade journal reports and anecdotal information more so than did previous sections.

To some extent, the hierarchy suggested above can be related to the difference between differentiated "products" and undifferentiated "commodities" – and to variations in between. We will return to these distinctions in following paragraphs as we explore developments for different kinds of international shipping.

Box 2. Types of Ocean Freight

"Goods being transported can be classified into general cargo, or package freight, on the one hand and bulk cargo on the other. General cargo usually consists of merchandise … that has a high value in proportion to its weight or to the space it occupies in a vehicle. Bulk cargo generally consists of goods that are of low value in proportion to their weight or bulk. They include ores, grains, coal, oil, petroleum products, and other raw materials and fuels.

"General cargo may be transported in boxes, crates, bales, barrels, and other containers. … Bulk goods can be conveniently taken on and off ships, railroad cars, trucks, barges, and other carriers by means of gravity, suction, conveyor belts, pipes, or other continuous-flow devices. … Most of the world's shipping is designed primarily for the movement of bulk goods.

"Bulk cargoes can be classified into dry bulk and liquid bulk. … Dry bulk goods often are moved in specially designed vessels. They frequently are handled in ships as "bottoming cargo," to fill any last-minute unused capacity.…

"Liquid bulk goods are transported either by continuous flow in pipelines or by tankers, barges, trucks, or railroad cars. Tankers account for about half the tonnage capacity of all oceangoing merchant ships.… The principal cargo carried by tankers is crude oil, the leading commodity in international trade. "

Compton's Interactive Encyclopedia. Copyright (c) 1994, 1995, 1996 SoftKey Multimedia Inc.

We have data series for the on-land part (item 2 of Box 1) for the U.S. side of international trade — this was covered in the section above on "The Cost of Moving Goods Domestically". We have a representative series for the third item above (an index of port charges) with respect to the Port of Charleston (S.C.), and we have anecdotal information from the New York Port Authority that suggests a similar pattern. We also have the fourth item (an index of U.S. tariff rates) for imported goods into the U.S. The remaining four items we can call "transaction costs". Or we can call them "non-conventional barriers" to trade, as some analysts have done (for example, Davis 1997; Engle and Rogers 1996; McCullum 1995). These latter costs are associated with the presence of international borders separating economic actors. Let us look at each of these sets of data as we have been able to assemble them. Then we will see if we can surmise what all of this might imply for spatial frictions involved in moving goods between countries.

Data provided by the Port of Charleston have been used to calculate an index series for port operating costs (proxied by operating revenue per ton handled). The Port of Charleston has rapidly gained a reputation as one of the nation's more efficient container-handling ports. Being ranked as the tenth largest US handler of container cargoes makes it a good indicator of trends in port costs—especially with respect to handling container cargo. As with the other indices presented in this paper, the index has been converted to "real" values (in this case, using the PPI). The index of real costs (Table 5) increased between 1950 and 1960 by 73.66% before beginning a downward trend that brought 1996 costs in real terms down by twenty-two percent in comparison to 1950 and by about fifty-five percent in comparison to costs experienced in 1960.

Table 5. Port of Charleston (SC) Index of Operating Costs (in Real Terms), 1950 to 1996

Fiscal Year	Operating Cost per Ton	Producer Price Index	Index of Real Operating Costs (1960=100)	Port Charges as % of Dutiable Values
1950	$1.620	28.20	57.58	0.425%
1955	$2.571	30.50	84.49	0.700%
1960	$3.333	33.40	100.00	1.065%
1965	$2.821	34.09	82.92	1.143%
1970	$2.676	39.29	68.26	1.248%
1975	$3.563	58.21	61.35	0.653%
1980	$5.353	88.03	60.95	0.472%
1985	$6.895	104.71	65.99	0.521%
1990	$5.282	119.19	44.42	0.333%
1995	$5.386	127.88	42.22	0.250%
1996	$5.950	131.23	45.44	0.255%

Source: Personal communications with Byron Miller of SC State Ports Authority (December 1998 and January 1999).

South Carolina State Ports Authority officials report that the three most important factors in reducing operating costs between 1960 and 1996 were (a) containerization, (b) getting to a volume that allowed them to mechanize, and (c) competition from other ports. Both the Port of Charleston and the Port Authority of New York report a 90% reduction in staffing costs per ton of cargo handled as a result of their movement from primarily dealing in break-bulk cargo before 1960 to the handling of containerized cargo by the mid-1990s.

Table 6. U. S. Imports for Consumption — Values and Duties, (1960-1996)[1]

Year	Total Values *(mil.dol.)*	Percent Duty Free	Duties Calculated[2] *(mil.dol.)*	Ratio of Duties to Values *Total imports (percent)*	*Dutiable imports (percent)*
1960	14,700	39	1,100	7.50	12.35
1965	21,300	35	1,600	7.50	11.59
1970	39,800	35	2,600	6.50	10.03
1975	96,500	32	3,800	3.90	5.80
1980	244,007	45	7,535	3.10	5.70
1985	343,553	31	13,067	3.80	5.50
1990	490,554	33	16,339	3.30	5.00
1991	483,028	35	16,197	3.40	5.10
1992	525,091	37	17,164	3.30	5.20
1993	574,863	41	18,334	3.20	5.40
1994	657,885	44	19,846	3.00	5.60
1995	739,660	51	18,597	2.50	5.10
1996	790,470	51	18,005	2.30	4.70

[1] Source: The data of 1960-1979 are from Statistical Abstracts of the United States 1980. The data of 1980-1996 are from Statistical Abstracts of the United States 1997

[2] Imports are on customs value basis. Includes trade of Virgin Islands with foreign countries. Customs duties (including imports excise taxes) calculated on the basis of reports of quantity and value of imports merchandise entered directly for consumption or withdrawn from bonded customs warehouses.

We also have data on average tariff rates for imports of goods into the U.S. during the period 1960 to 1996. These are presented in Table 6. The average tariff on imports into the U.S. decreased from an average rate of 12.35% *ad valorem* on dutiable imports (and 7.50% as a percent of total imports) in 1960 to an average rate of 4.70% *ad valorem* on dutiable imports (and 2.30% as a percent of total import values) in 1996. This represented a 62% decrease in the average duty rate on dutiable imports (and 69% decrease on total import values) over that period of time. Had tariffs been a substantial proportion of landed values of imports at the beginning of this period, this percentage change would have indicated a major change in the artificial barrier component of "spatial friction" related to international imports of goods. Computed against the CIF (Cost, Insurance and Freight) value as a whole for all imports, these changes represent a reduction of approximately 5% of the landed cost of imported goods over the period 1960-1996.

We have an index series for dry bulk cargo shipments—the "Baltic Freight Index" (BFI), which begins from January 1985. After adjusting the BFI for movements in the U.S. Producer Price Index (PPI), we find that this particular index of ocean freight costs has NOT declined in real terms since it was started in 1985.

The history and uses of the BFI are instructive in terms of the "trends" indicated in Table 7. Negotiated rates for ocean freight—i.e., rates occurring outside of "conference schedules"—are notably volatile. The BFI was developed to assist shippers to deal with the risks caused by this volatility. Units of the BFI are tradable on the LIFFE, allowing major operators in related segments of ocean shipping to hedge the risks of rate changes. The intra-year volatility that leads to the need for such hedges is indicated by Columns 3-6 of Table 7.

Table 7. Trends in Simple Annual Average of the Baltic Freight Index, 1985-96

1	2	3	4	5	6	7	8
Year	BFI Annual Mean	BFI Annual Minimum	BFI Annual Maximum	BFI Annual Range	Range as % of Mean	US PPI	BFI Mean Adjusted for US PPI
1985	906.318	711.5	1064.5	353	39%	105	863.16
1990	1364.077	1056	1669	613	45%	119	1,146.28
1991	1591.536	1432	1780	348	22%	122	1,304.54
1992	1201.941	1033	1534	501	42%	123	977.19
1993	1398.901	1215	1642	427	31%	125	1,119.12
1994	1477.567	1110	2043	933	63%	126	1,172.67
1995	1980.754	1538	2352	814	41%	128	1,547.46
1996	1313.838	992	1598	606	46%	131	1,002.93

Roehner (1996) also provides us with a long-term index series for international ocean freight for bulk commodity shipments. His article contains a table showing cost per ton (in 1980 dollars) for Atlantic shipments of wheat from 1953 to 1990. As Roehner points out, these data show no clear trend in shipping costs—though, like other commodity freight rates, they show striking volatility.

A recent study by Rauch (1996) provides estimates of trends in shipping costs relative to the customs value of differentiated imports (products) compared to homogeneous imports (commodities) and near-homogeneous imports (quasi-commodities). These estimates are reproduced in Table 8, below. Rauch's objective was to assess the relative costs of trading homogeneous versus differentiated goods. For this purpose, he divided the goods into three groups: (1) Those traded on an organized exchange; (2) Those with a reference price in industry journals; and (3) Those which fail to enter the first two categories. The following Table uses Davis' respective terminology of "homogeneous", "near-homogeneous", and "differentiated" goods.[5]

[5] Davis (1997) states that "Curiously, these measures are substantially lower than the typical transport factors reported by Harrigan (1993) for 1983 OECD trade, although one might have suspected they would be higher given Rauch's focus on Japan-US trade."

Table 8. Transport Costs as a Share of Customs Value (%)

	1970	1980	1990
Homogeneous	15.59	12.45	13.51
Near-Homogeneous	13.06	12.19	12.05
Differentiated	6.58	6.40	5.88

Source: Rauch (1996), presented as Table 1 of Davis (1997).

Two issues are important to us here:
(a) How large are the transport costs as a percent of landed cost for imported goods? and
(b) Has there been a significant downward trend in these costs over time?

Table 9. Combined Effects of Transport Costs and Import Duties on Cost of U. S. Imports, 1970 to 1990 (as % of dutiable value)[6]

	1970	1980	1990
Homogeneous goods	**22.09**	**15.55**	**16.81**
Transport	15.59	12.45	13.51
Import Duties	6.50	3.10	3.30
Near-Homogeneous Goods	**19.56**	**15.29**	**15.35**
Transport	13.06	12.19	12.05
Import Duties	6.50	3.10	3.30
Differentiated Goods	**13.08**	**9.50**	**9.18**
Transport	6.58	6.40	5.88
Import Duties	6.50	3.10	3.30

Source: Tables 6 and 7.

For the homogeneous goods (i.e., commodities) shown in Table 8, transport costs as a percentage of dutiable value is fairly large. In addition, while there was some downward trend between 1970 and 1990, it is not the kind of pronounced reduction in costs indicated earlier for a number of other modes and media. By linking Tables 6 and 8, we can get a rough measure of the combined effects of trends in transport costs and tariffs on the landed cost of imported goods. Table 9 uses the average tariff rate on all imports for the same respective years indicated in Table 8.

[6] Note that this calculation is approximate only, since the transport cost is a percentage of the dutiable value, while the import tariff is a percentage imposed on top of the dutiable value. Also, as indicated in the text, port charges are so small as to be safely ignored in the Table.

We find the Rauch results striking in that they bear little relation to the statement in *The Economist* (1998) that, since the introduction of containerized shipping in the late 1950s, seaborne freight costs have dropped from a range of 5-10% of the price of a 'typical' product to a range of 1-1.5% of typical product prices. These numbers may be put into a more complete perspective by looking at logistics costs (defined to include in-bound and out-bound logistics plus warehousing expenses) as a percent of GDP across a range of countries in 1998 (Bowersox and Calantone 1998):

United States (implied global leader in logistics efficiency)	10.5 percent
United Kingdom	10.63 percent
France	11.14 percent
North American average	10.77 percent
12 original European Union countries average	11.79 percent
Asia	11.64 percent
Aggregate for all remaining countries, including developing nations	12.94 percent.

From Table 5, the reader can see that port charges in the most efficient ports in the U.S. comprise an insignificant proportion of the dutiable value of traded goods. In the case of the Port of Charleston in 1996 (data for 1997, not shown in Table 5, are consistent with the reported trend) port charges were about one-fourth of one percent of the dutiable value of goods moved through the port. Thus, we have not bothered to include port charges in Table 9, though they show comparable downward trends to those of freight charges and import duties during the period 1970 to 1990.

In addition to port charges, shipping contracts will sometimes contain 'brokerage' or 'forwarder compensation' charges as add-ons to the freight charges. In other cases, this compensation will be paid by the shipper out of the sums that the shipper receives. "Brokerage" or "forwarder compensation" in the U. S. was authorized for forwarders in the 1916 and 1984 shipping acts. Ocean carriers must pay brokerage on the full ocean rate if they have filed it in their tariff. "Members of ocean carrier conferences usually pay at a rate of 1.25 percent of the ocean freight. Some carriers offer up to 2.5 percent, and non-vessel-operating common carriers typically pay 5 to 10 percent. Project-cargo and large parcel forwarders often negotiate higher commissions, typically up to 5 percent." (*American Shipper*, 1996) The trade journals report widespread consolidation across the eight functions involved in moving goods internationally that were listed in Box 1, which likely will affect not only shipping costs but also the costs of agenting, forwarding, etc. (See Slack 1996; Platt 1997; Linn 1998; and Reyes. 1998, for example).

Non-Conventional Frictions Affecting International Trade: The Cost of Borders

Peter Isard (1977) is sometimes cited as being the first to explicitly recognize that international borders often intervene to circumvent the "law of one price" from operating, when he observed that price differences between countries could not be explained by shipping costs alone. In its most rational form, the law of one price states that the price of the same good should be everywhere the same, save for the cost of conducting "real goods arbitrage"—i.e., the cost of moving the good from a low-price to a high-price location. A number of studies have attempted to measure the "cost of borders" originally addressed by Isard.

John Helliwell (1998) "…found that a Canadian province in 1996 was 12 times more likely to trade merchandise and 40 times more likely to trade services with another Canadian province than with an American state of similar size and distance. Interprovincial immigration was 100 times more likely, after adjusting for income difference and population size….Mr. Helliwell's research showed that the Free Trade Act, which came into effect in 1989, did have an impact: the ratio of traded goods had fallen from about 20:1 to 12:1 by 1993. But the level has held steady since. Although the figures are less reliable, Mr. Helliwell also estimates that 'trade densities' within countries in the European Union are around six times greater than those between members of the EU." (*The Economist* 1998b)

In another issue, *The Economist* (1998a) discusses price differences across Europe and speculates that the Euro will increase competition and will erode some of the price differences. The article contains a chart showing "standard deviation in European prices" for Bank-account charges (more than 50%), household insurance (more than 50%), Coca-Cola (more than 20%), Local telephone call (more than 20%), Yoghurt (more than 20%), IBM Thinkpad (more than 20%), Petrol (more than 10%), Big Mac (more than 10%), Levi 501s (more than 10%), and VW Golf (less than 10%).

In a similar vein, Engel and Rogers (1996) find that "While distance is an economically significant determinant of price dispersion, the effect of the border relative to distance is extremely large.…[C]rossing the border adds 11.9×10^{-3} to the average standard deviation of prices between pairs of cities. In order to generate that much volatility by distance, the cities would have to be 75,000 miles apart."

Similarly, Sazanami, Kimura, and Kawai (1997) find that prices of tradable goods in Japan do not adjust to changes in the exchange rate, as the law of one price would suggest should happen: "…[S]ome sort of handicap is imposed on imported goods and the large fraction of rent generated by the yen appreciation is intercepted in the middle."

McCullum (1995) concludes "Whatever the reasons may be and whatever the future may hold, the fact that even the relatively innocuous Canada-U.S. border continues to have a decisive effect on continental trade patterns suggests that national borders in general continue to matter. That is the basic message of this paper."

The gist of this sub-section is that national borders pose costs that are generally unrelated to "distances" the goods must be shipped. The difficulties experienced in dealing with borders appears to be greater than that experienced in dealing with distance – or, at least, the difficulties are more uncertain.

It is also quite possible that the 'transaction costs' or 'non-conventional' barriers associated with borders might affect different firms differently. For example, the costs associated with understanding the trading process and of affecting and controlling transactions may occur in the form of large fixed costs that favor large firms over small firms. Likewise, to the extent that such functions can be provided by a 'third-party logistics firm', these transaction costs may favor firms in urban areas over those located in rural or 'remote' areas. These issues are being explored separately by the authors of the present Working Paper.

Summary, Implications & Suggested Follow Up

Our data collection effort reveals that, indeed, there have been dramatic reductions in the real costs associated with transporting information, people, and materials across economic space since 1960—in general. However, reductions in some spatial frictions have been much greater than those of others, and for some categories of mode/media there have been no notable downward trends at all. Knowledge/information flows have experienced greater cost reductions than have people or materials flows. Similarly, differences exist *within* categories of resource flows—e.g., as between domestic and international shipping costs for bulk cargo. Shipping costs by domestic rail and domestic waterborne transport are down considerably, while the measures that we have for ocean shipping of bulk commodities do not show comparable downward trends.

Our data suggest that the dramatic reduction in spatial friction to which many popular analysts are reacting is a phenomenon that inordinantly affects knowledge/ information and that occurs via dramatic improvements in the efficiencies of the media of computing and telecommunications. This becomes clearer when we factor the patterns of friction changes into three distinguishable groups and observe the points at which discontinuities occur between these three groups:

- **Group One—Rapid Declines**. (a) Computing (99% decrease in real cost since 1960); (b) Telecommunications (92% decrease in real cost since 1960).
- **Group Two—Moderate Declines**. (a) Import tariffs (60% decrease in real costs since 1960); (b) Passenger travel by air (58% cost decrease); (c) Domestic railway freight (58% cost decrease); (d) Port charges (55% decrease in real cost); (e) Domestic waterborne freight (42% cost decrease); and (f) Anecdotal information suggesting major reductions in costs associated with managing/moving containerized general cargo.
- **Group Three—Small/Zero Declines**. (a) Domestic, non-air modes for moving people (real cost decreases ranging from zero to 16%); (b) Ocean bulk freight (dramatic volatility with no definite upward or downward trend); (c) Domestic inter-city motor carriers (some year-on-year variation with no meaningful trend up or down); and (d) Transaction costs and non-conventional barriers to international trade (various individual measures found in the literature, with indications that—though declining—they still cause substantial problems).

Our focus has been to provide empirical measures of differences in trends in friction across modes and media by which information, people, and materials flow. We

are aware that the measures we present do not adequately capture gains that have been made via integrated, inter-modal management of shipping or via the phenomenon of warehousing-within-the-shipping-vessel (discussed further below). Also, our data do not deal with issues such as timing, flexibility or quality. At this stage, our interest has been primarily in exploring for ourselves and presenting for others the empirical data relating to quantifiable cost differences across modes and media.

While recognizing that our findings are in no way 'complete', we nevertheless feel that a number of important points arise out of our descriptive analysis. First is our beginning suggestion that the reality of distance in economic terms is more complex than it is in either formal theory or in popular hyperbole. The economics of distance is not 'unitary' in the sense that only one 'transport' variable will suffice for modeling real world reality. Neither is distance unitary in the sense that all modes and media have exhibited the same *degree* of movement in real costs during 1960-1998. Thus, the major point that arises from our analysis is that the New Economics of Distance is **not** an issue of zero costs associated with all aspects of distance. Rather, it is that the differential rates of change across resources and across modes and media have triggered two processes that distinguish what we are calling *The New Economics of Distance*:

1. The need for creativity in finding ways to **substitute** across resource categories and between modes and media.
2. The drive to **restructure** "logistics management" (defined to include both transport and warehousing) — within individual firms, between firms and 'third-party' firms, and across 'sectors'.

Within all of this, we may observe some differential impacts upon different types of users of modes and media. In the first instance, it is obvious that users and producers of 'knowledge/information' have experienced greater logistics cost reductions than have users of mobile people and users/producers of 'materials'. Thus, we might expect that a number of types of 'service' firms and sectors would be strongly affected by these changes. And, indeed, that is exactly what we are able to observe.

Within the users/producers of materials, those firms that rely upon domestic bulk shipments by rail or by water have realized logistics costs reductions relative to those firms that must ship via intercity motor carrier. Similarly, international containerized cargoes appear to have benefited from cost reductions that exceed those of international bulk shipments.

Also arising from the foregoing analysis is the implication of the reported differential rates of change in costs upon the optimal organization of warehousing and in-bound/out-bound logistics for individual manufacturing firms. To the extent feasible, it would make sense to substitute 'knowledge/information' in place of 'materials'. Indeed, when we observe 'just-in-time' inventory management, that seems to be what we are seeing. For example, one automobile assembly plant now keeps only two hours inventory of plastic bumper shields in inventory at the plant, compared to a much higher level of such inventories in other automobile plants a few years back. The combination of cellular telecommunications, global positioning satellites, and information technology allows the production manager to know that the bumper shields that will be installed in three hours time are in a trailer rig at mile marker 45 on Interstate-85 and will be in-house

in seventeen minutes time. In today's environment, that kind of access to 'information' – and, thus, control – is as good as the 'control' that previously was implied by having the shields already in-house and sitting on shelf #32A.[7]

And, of course, there is the attempt to substitute 'telecommuting' for bringing workers to a central work point. Telecommuting is not just a matter of the relative 'costs' of commuting versus computing—the issues that our study covers. It also involves — perhaps more importantly — issues of lifestyles, worker synergy, agglomeration economies, and management. But, again, we leave these details for others to study and to argue.

While our brief foray into some of the outcomes of the New Economics of Distance are designed to be illustrative, these examples are in no way exhaustive. The trade journals listed in the "sources" contain a wealth of examples of the adjustments that are being made in logistics management. The technological and organizational changes affecting the differential costs of moving knowledge/information, people and materials have triggered a spreading wave of adjustment and restructuring that goes beyond logistics management alone. These changes affect the way that businesses are organized internally, as well as they way that firms relate to each other. Again, this is not because distance no longer matters. Rather, as we believe we have illustrated, it is because distance matters in different ways with respect to different resources and different modes and media for moving those resources. It is upon the impact of these differences that a new round of research needs to be focused.

[7] This example of substituting information for inventory was pointed out to us by our colleague Mark Henry.

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Annex 1. Tables

Annex Table 1. Long Series Trend of Average Rail Passenger Fares (per mile) and Freight Rate Per Ton Per Mile in the U.S., 1928 to 1996.

Year	Average Passenger Fare (Cents/mile)	Average Freight Rate (Cents/ ton/mile)	CPI	PPI	CPI-adjusted Passenger Fare	PPI -adjusted Freight Rate
1928	2.85	1.081	17.162	17.33	16.61	6.24
1929	2.81	1.08	17.16	17.07	16.36	6.30
1930	2.72	1.06	16.73	15.48	16.24	6.87
1931	2.51	1.05	15.24	13.08	16.49	8.04
1932	2.22	1.05	13.68	11.61	16.22	9.01
1933	2.01	1.00	12.97	11.81	15.53	8.46
1934	1.92	0.98	13.40	13.42	14.32	7.29
1935	1.94	0.99	13.74	14.33	14.08	6.89
1936	1.84	0.97	13.89	14.48	13.24	6.73
1937	1.80	0.94	14.37	15.46	12.49	6.05
1938	1.87	0.98	14.12	14.08	13.28	6.98
1939	1.84	0.97	13.91	13.81	13.22	7.04
1940	1.75	0.95	14.03	14.08	12.50	6.72
1941	1.75	0.94	14.75	15.64	11.89	5.98
1942	1.92	0.93	16.33	17.70	11.73	5.27
1943	1.88	0.93	17.33	18.47	10.86	5.05
1944	1.87	0.95	17.62	18.63	10.63	5.09
1945	1.87	0.96	18.02	18.96	10.38	5.06
1946	1.95	0.98	19.55	21.70	9.96	4.51
1947	2.10	1.08	22.37	27.25	9.38	3.95
1948	2.34	1.25	24.09	29.58	9.72	4.23
1949	2.45	1.34	23.86	27.77	10.28	4.82
1950	2.56	1.33	24.09	28.20	10.63	4.71
1951	2.60	1.33	26.00	30.80	10.00	4.33
1952	2.66	1.43	26.56	30.60	10.03	4.67
1953	2.66	1.48	26.76	30.30	9.93	4.88
1954	2.62	1.42	26.90	30.40	9.73	4.67
1955	2.60	1.37	26.80	30.50	9.71	4.49
1956	2.68	1.38	27.19	31.30	9.87	4.42
1957	2.84	1.45	28.18	32.50	10.08	4.45
1958	2.90	1.46	28.93	33.20	10.03	4.41
1959	2.95	1.45	29.18	33.10	10.11	4.37
1960	3.01	1.40	29.65	33.40	10.16	4.20
1961	3.08	1.37	29.94	33.40	10.28	4.11
1962	3.11	1.35	30.27	33.50	10.28	4.02
1963	3.18	1.31	30.63	33.40	10.38	3.92
1964	3.17	1.28	31.06	33.50	10.20	3.83
1965	3.18	1.27	31.59	34.09	10.07	3.71
1966	3.18	1.26	32.47	35.20	9.79	3.57
1967	3.20	1.27	33.41	35.60	9.56	3.56

Continued on next page

Year	Average Passenger Fare (Cents/mile)	Average Freight Rate (Cents/ ton/mile)	CPI	PPI	CPI-adjusted Passenger Fare	PPI -adjusted Freight Rate
1968	3.38	1.31	34.81	36.60	9.71	3.58
1969	3.61	1.35	36.68	37.99	9.84	3.55
1970	3.92	1.43	38.85	39.29	10.08	3.63
1971	4.24	1.59	40.55	40.50	10.45	3.93
1972	4.79	1.62	41.82	41.81	11.46	3.87
1973	4.75	1.62	44.42	45.60	10.70	3.55
1974	5.20	1.85	49.29	52.60	10.55	3.52
1975	5.40	2.04	53.79	58.21	10.03	3.50
1976	5.86	2.19	56.92	60.79	10.30	3.61
1977	5.92	2.29	60.64	64.68	9.76	3.53
1978	5.95	2.36	65.27	69.78	9.11	3.38
1979	6.26	2.60	72.46	77.58	8.64	3.35
1980	7.34	2.85	82.30	88.03	8.91	3.24
1981	9.38	3.16	91.07	96.06	10.30	3.28
1982	10.19	3.21	96.62	100.00	10.55	3.21
1983	10.65	3.12	99.70	101.63	10.68	3.07
1984	10.91	3.09	104.06	103.73	10.48	2.98
1985	11.27	3.04	107.76	104.71	10.46	2.91
1986	10.60	2.92	109.53	103.20	9.68	2.83
1987	10.58	2.73	113.64	105.37	9.31	2.59
1988	11.46	2.72	118.20	107.99	9.70	2.52
1989	12.62	2.67	123.92	113.64	10.18	2.35
1990	14.12	2.65	130.55	119.19	10.82	2.23
1991	14.14	2.59	136.24	121.65	10.38	2.13
1992	14.05	2.58	140.25	123.15	10.02	2.09
1993	14.03	2.53	144.51	124.69	9.71	2.03
1994	13.65	2.49	148.15	125.47	9.21	1.99
1995	14.60	2.40	152.44	127.88	9.58	1.88
1996	16.60	2.35	156.74	131.23	10.59	1.79

Sources: Moody's transportation Manual, 1997. PPI, 1982=100, and CPI, 1982-84=100. Bureau of Transportation Statistics (BTS). The actual passenger fares per mile from 1985 to 1996 are not reported. Therefore, passenger fares from 1985-96 are average passenger revenue per mile (Intercity/Amtrak) as reported in publications of BTS.

Annex Table 2. Average Passenger Revenue per Passenger-Mile in the U.S., 1960-1996

Year	Air Carrier, certified, domestic, scheduled service		Commuter Rail		Intercity/Amtrak[a]		Class I Bus, Intercity[b]	
	Cents/ Mile	CPI Adjusted index	Cents/ Mile	CPI Adjusted Index	Cents/ Mile	CPI Adjusted Index	Cents/ Mile	CPI Adjusted Index
1960	6.1	**100**	2.9	**100**	3.0	**100**	2.7	**100**
1961	6.2	**101**	3.1	**104**	3.1	**101**	2.7	**98**
1962	6.5	**104**	3.1	**105**	3.1	**100**	2.7	**98**
1963	6.2	**98**	3.2	**105**	3.2	**102**	2.8	**99**
1964	6.1	**96**	3.2	**105**	3.2	**100**	2.8	**99**
1965	6.1	**94**	3.3	**106**	3.1	**97**	2.9	**100**
1966	5.8	**87**	3.3	**104**	3.1	**94**	2.9	**97**
1967	5.6	**82**	3.4	**102**	3.1	**92**	3.0	**97**
1968	5.6	**78**	3.5	**102**	3.3	**93**	3.2	**100**
1969	5.8	**77**	3.6	**98**	3.6	**97**	3.4	**101**
1970	6.0	**75**	3.8	**98**	4.0	**101**	3.6	**101**
1971	6.3	**76**	3.9	**98**	4.4	**106**	3.8	**103**
1972	6.4	**74**	4.2	**102**	4.4	**103**	4.0	**104**
1973	6.6	**73**	4.3	**97**	4.4	**98**	4.1	**100**
1974	7.5	**74**	4.4	**91**	5.3	**105**	4.4	**98**
1975	7.7	**69**	4.6	**86**	5.7	**104**	4.9	**98**
1976	8.2	**70**	5.0	**89**	5.6	**96**	5.1	**99**
1977	8.6	**69**	5.6	**94**	5.8	**94**	5.1	**92**
1978	8.5	**63**	6.0	**93**	6.1	**91**	5.6	**94**
1979	9.0	**60**	6.3	**88**	6.6	**89**	6.2	**93**
1980	11.5	**68**	6.7	**82**	8.2	**97**	7.3	**96**
1981	13.1	**70**	7.3	**81**	9.4	**101**	8.4	**100**
1982	12.2	**61**	8.1	**85**	10.2	**103**	8.2	**93**
1983	12.1	**59**	9.9	**101**	10.7	**104**	8.4	**92**
1984	12.7	**59**	11.0	**107**	10.9	**103**	9.1	**95**
1985	12.2	**55**	12.1	**114**	10.5	**95**	9.9	**101**
1986	11.1	**49**	12.1	**112**	10.6	**94**	10.5	**104**
1987	11.4	**49**	12.2	**109**	10.6	**91**	10.1	**97**
1988	12.3	**51**	12.4	**106**	11.5	**95**	10.7	**99**
1989	13.1	**51**	12.6	**103**	12.6	**99**	11.2	**98**
1990	13.4	**50**	13.5	**104**	14.1	**105**	11.6	**97**
1991	13.0	**46**	13.0	**96**	14.1	**101**	12.0	**96**
1992	12.9	**45**	13.3	**96**	14.1	**98**	11.8	**92**
1993	13.7	**46**	14.3	**100**	14.0	**94**	11.9	**90**
1994	13.1	**43**	13.6	**93**	13.7	**90**	11.6	**86**
1995	13.5	**43**	13.0[r]	**87**	14.6	**94**	12.2	**88**
1996	13.7	**42**	12.9[p]	**83**	16.6	**103**	12.4	**86**

[r] revised
[p] preliminary
[a] Amtrak, 1971–1992.
[b] Regular route intercity service.
Producer Price Index, 1980 = 100.

Source: Publications of Bureau of Transportation Statistics (BTS), available at http://www.bts.gov/ntl/DOCS/nts/1995/tables; and other annual publications of BTS

Annex Table 3. Average Freight Revenue (nominal value & real index) per Ton-Mile in the U.S., 1960-1996

	Air Carrier -- Certified, Domestic, Scheduled Service		Class I Rail Service		Class I Inter-City Motor Carriers[a]		Inland Waterway Carriers[b]	
Year	Cents/ Mile	Index	Cents/ Mile	Index	Cents/ Mile	Index	Cents/ Mile	Index
1960	22.80	100	1.40	100	6.31	100	-	-
1961	22.08	97	1.37	98	6.30	100	-	-
1962	21.31	93	1.35	96	6.41	102	-	-
1963	21.72	95	1.31	94	6.38	101	-	-
1964	20.97	92	1.28	91	6.66	106	0.36	106
1965	20.46	87	1.27	88	6.46	99	0.35	100
1966	20.21	84	1.26	85	6.34	95	0.33	92
1967	19.90	80	1.27	83	6.65	97	0.29	78
1968	19.97	78	1.31	83	6.93	98	0.31	81
1969	21.03	80	1.35	84	7.08	97	0.29	74
1970	21.91	81	1.43	86	8.50	114	0.30	75
1971	22.58	80	1.59	91	9.30	119	0.34	81
1972	22.75	78	1.62	91	9.50	118	0.33	76
1973	23.31	73	1.62	83	9.80	111	0.38	80
1974	25.92	71	1.85	82	10.40	103	0.49	90
1975	28.22	70	2.04	83	11.60	105	0.52	87
1976	31.81	75	2.19	85	12.00	103	0.51	81
1977	34.22	76	2.29	83	12.70	102	0.56	84
1978	37.10	77	2.36	79	13.40	100	0.62	86
1979	41.02	76	2.61	79	15.20	102	0.67	83
1980	46.31	76	2.87	77	18.00	107	0.77	85
1981	50.15	76	3.18	78	20.00	109	0.85	86
1982	49.69	72	3.21	76	20.77	109	0.84	82
1983	49.30	70	3.12	72	21.23	109	0.82	78
1984	50.20	70	3.09	70	21.54	108	0.82	77
1985	48.77	67	3.04	68	22.90	114	0.80	74
1986	105.43	148	2.92	67	21.63	110	0.76	72
1987	109.79	151	2.73	61	22.48	112	0.73	68
1988	113.66	152	2.72	59	23.17	112	0.75	67
1989	96.84	123	2.67	55	23.91	110	0.77	66
1990	59.96	73	2.66	53	24.38	107	0.76	62
1991	64.81	77	2.59	50	24.82	106	0.78	62
1992	65.70	77	2.58	49	23.10	98	0.76	60
1993	71.40	83	2.52	48	25.00	105	0.76	59
1994	72.20	83	2.49	47	25.00	104	0.74	57
1995	76.50	87	2.40	44	25.10	103	0.73	55
1996	81.50	90	2.35	42	26.10	104	0.73	54

Note: All indexes are PPI adjusted

[a] Intercity service excluding carriers of household goods.

[b] Barge lines operating on Mississippi River and Tributaries.

Source: Publications of Bureau of Transportation Statistics (BTS), available at http://www.bts.gov/ntl/DOCS/nts/1995/tables; and other annual publications of BTS of various years.

Annex Table 4. Average Passenger Fares in the U.S. by Various Modes, 1960-1996

	Air Carrier, certified, domestic, scheduled service		Class 1 Bus, Intercity[a]		Transit, all modes[b] (unlinked)		Commuter Rail	
Year	**Dollars**	**Index**	**Dollars**	**Index**	**Dollars**	**Index**	**Dollars**	**Index**
1960	34.12	**100**	2.46	**100**	0.14	**100**	0.64	**100**
1961	34.15	**99**	2.48	**100**	0.14	**99**	0.65	**101**
1962	34.18	**98**	2.50	**100**	0.15	**105**	0.66	**101**
1963	34.22	**97**	2.52	**99**	0.15	**104**	0.67	**101**
1964	34.13	**96**	2.55	**99**	0.15	**102**	0.68	**101**
1965	34.12	**94**	2.73	**104**	0.16	**107**	0.71	**104**
1966	33.41	**89**	2.71	**101**	0.16	**104**	0.72	**103**
1967	33.16	**86**	2.79	**101**	0.17	**108**	0.72	**100**
1968	33.70	**84**	2.91	**101**	0.19	**115**	0.75	**100**
1969	37.52	**89**	3.55	**116**	0.21	**121**	0.78	**98**
1970	40.65	**91**	3.81	**118**	0.22	**120**	0.84	**100**
1971	43.13	**92**	4.19	**124**	0.23	**120**	0.87	**99**
1972	43.87	**91**	4.25	**122**	0.24	**121**	0.93	**103**
1973	45.72	**89**	4.73	**128**	0.25	**119**	0.95	**99**
1974	51.43	**91**	5.13	**125**	0.27	**116**	1.00	**94**
1975	53.64	**86**	5.46	**122**	0.27	**106**	1.04	**89**
1976	57.47	**88**	5.76	**122**	0.27	**100**	1.15	**93**
1977	60.67	**87**	6.48	**129**	0.28	**98**	1.16	**89**
1978	61.07	**81**	6.89	**127**	0.29	**94**	1.20	**85**
1979	63.81	**76**	7.71	**128**	0.29	**84**	1.25	**80**
1980	84.55	**89**	10.57	**154**	0.30	**77**	1.41	**79**
1981	95.42	**91**	10.30	**136**	0.33	**77**	1.70	**86**
1982	92.08	**83**	10.90	**136**	0.38	**83**	1.89	**91**
1983	92.17	**80**	10.66	**129**	0.39	**83**	2.31	**107**
1984	97.10	**81**	11.09	**128**	0.50	**102**	2.92	**130**
1985	92.53	**75**	11.02	**123**	0.53	**104**	2.85	**123**
1986	84.99	**67**	12.35	**136**	0.58	**112**	3.07	**130**
1987	88.95	**68**	12.28	**130**	0.59	**110**	3.18	**129**
1988	96.67	**71**	17.15	**174**	0.60	**107**	3.35	**131**
1989	103.65	**73**	18.62	**181**	0.61	**104**	3.41	**127**
1990	107.86	**72**	20.18	**186**	0.67	**108**	2.90	**103**
1991	106.86	**68**	21.86	**193**	0.70	**109**	3.01	**102**
1992	103.60	**64**	21.15	**181**	0.72	**109**	3.09	**102**
1993	109.80	**66**	21.32	**178**	0.77	**113**	3.09	**99**
1994	103.21	**60**	19.77	**161**	0.85	**121**	3.19	**100**
1995	106.66	**61**	20.10	**159**	0.87	**121**	3.13	**95**
1996	110.17	**61**	22.85	**175**	0.93	**125**	3.24	**96**

Note: All indexes are CPI adjusted

[a] Regular route intercity service.

[b] Prior to 1984, excludes commuter railroad, automated guideway, urban ferry boat, demand response and most rural and smaller systems.

[c] Amtrak, 1971–1992.

Source: Publications of Bureau of Transportation Statistics (BTS), available at http://www.bts.gov/ntl/DOCS/nts/1995/tables; and other annual publications of BTS.

Annex Table 5. Changes in Average Operating Revenue Over Time—Port of Charleston, 1950-96

Fiscal Year	Total SCSPA Tons	SCSPA Operating Revenue ($)	Operating Revenue per ton ($)	Producer Price Index (PPI)	Operating Revenue per ton (PPI-adjusted)	PPI-Adjusted Index of Port Costs
1950	286,949	464,921	1.62	28.20	**5.75**	100
1951	450,087	737,602	1.64	30.80	**5.32**	93
1952	504,796	652,507	1.29	30.60	**4.22**	74
1953	452,159	866,940	1.92	30.30	**6.33**	110
1954	430,933	1,196,302	2.78	30.40	**9.13**	159
1955	533,734	1,372,244	2.57	30.50	**8.43**	147
1956	685,883	1,422,982	2.07	31.30	**6.63**	115
1957	689,644	1,750,074	2.54	32.50	**7.81**	136
1958	604,441	1,619,319	2.68	33.20	**8.07**	140
1959	619,032	1,966,534	3.18	33.10	**9.60**	167
1960	768,634	2,561,483	3.33	33.40	**9.98**	174
1961	897,230	2,957,806	3.30	33.40	**9.87**	172
1962	1,003,969	3,494,400	3.48	33.50	**10.39**	181
1963	1,139,603	3,808,645	3.34	33.40	**10.01**	174
1964	1,406,997	4,181,425	2.97	33.50	**8.87**	154
1965	1,442,855	4,070,229	2.82	34.09	**8.27**	144
1966	1,647,158	4,706,363	2.86	35.20	**8.12**	141
1967	1,956,951	5,184,644	2.65	35.60	**7.44**	130
1968	2,258,047	5,608,957	2.48	36.60	**6.79**	118
1969	2,161,062	5,703,961	2.64	37.99	**6.95**	121
1970	2,220,195	5,941,347	2.68	39.29	**6.81**	119
1971	2,327,881	6,254,023	2.69	40.50	**6.63**	115
1972	2,406,074	7,084,404	2.94	41.81	**7.04**	123
1973	2,741,967	8,292,753	3.02	45.60	**6.63**	115
1974	2,913,138	10,289,422	3.53	52.60	**6.71**	117
1975	2,995,802	10,674,813	3.56	58.21	**6.12**	107
1976	3,478,460	13,264,787	3.81	60.79	**6.27**	109
1977	4,223,515	16,248,687	3.85	64.68	**5.95**	104
1978	3,773,383	18,158,448	4.81	69.78	**6.90**	120
1979	4,365,145	22,264,764	5.10	77.58	**6.57**	114
1980	4,367,911	23,381,683	5.35	88.03	**6.08**	106
1981	4,339,475	27,344,109	6.30	96.06	**6.56**	114
1982	4,115,465	27,772,165	6.75	100.00	**6.75**	117
1983	3,980,342	24,905,396	6.26	101.63	**6.16**	107
1984	4,647,030	29,252,454	6.29	103.73	**6.07**	106
1985	4,807,573	33,147,198	6.89	104.71	**6.58**	115
1986	5,455,802	30,960,424	5.67	103.20	**5.50**	96
1987	6,213,083	35,905,596	5.78	105.37	**5.48**	95
1988	7,025,940	43,408,117	6.18	107.99	**5.72**	100
1989	8,328,447	43,959,333	5.28	113.64	**4.64**	81
1990	8,538,208	45,098,563	5.28	119.19	**4.43**	77
1991	8,334,158	46,553,741	5.59	121.65	**4.59**	80
1992	8,257,070	46,414,424	5.62	123.15	**4.56**	79
1993	8,469,981	45,335,004	5.35	124.69	**4.29**	75
1994	8,944,047	45,583,755	5.10	125.47	**4.06**	71
1995	10,262,659	55,277,934	5.39	127.88	**4.21**	73
1996	10,462,564	62,253,978	5.95	131.23	**4.53**	79
1997	11,919,976	71,024,221	5.96			
1998	12,711,412	80,965,133	6.37			

Source: Byron Miller, South Carolina State Ports Authority (SCSPA). PPI and CPI are collected from various volumes of National Transportation Statistics, Bureau of Transportation Statistics, DOT.

Annex Table 6. United States Imports for Consumption—Values, Duties, and Average Duty Rates, 1960-1996.

	U. S. Imports			Ratio of Duties to Values	
Year	Total ($ million)	Percent duty free	Duties Calculated[1] ($ million)	Total Imports (percent)	Dutiable Imports (percent)
1960	14700	39	1100	7.5	12.4
1965	21300	35	1600	7.5	11.6
1970	39800	35	2600	6.5	10.0
1972	55300	34	3100	5.6	8.5
1973	69000	41	3600	5.2	8.8
1974	100100	52	3800	3.8	7.9
1975	96500	32	3800	3.9	5.8
1976	121100	31	4700	3.9	5.6
1977	147100	30	5500	3.7	5.3
1978	172900	30	7200	4.2	6.0
1979	205900	50	7200	3.5	7.0
1980	244007	45	7535	3.1	5.7
1981	259012	29	8893	3.4	4.9
1982	242340	31	8688	3.6	5.2
1983	256679	32	9430	3.7	5.4
1984	322989	32	12042	3.7	5.5
1985	343553	31	13067	3.8	5.5
1986	368657	33	13312	3.6	5.4
1987	402066	33	13923	3.5	5.2
1988	437140	35	15054	3.4	5.3
1989	468012	33	16096	3.4	5.2
1990	490554	33	16339	3.3	5.0
1991	483028	35	16197	3.4	5.1
1992	525091	37	17164	3.3	5.2
1993	574863	41	18334	3.2	5.4
1994	657885	44	19846	3.0	5.6
1995	739660	51	18597	2.5	5.1
1996	790470	51	18005	2.3	4.7

Source: The data for 1960-1979 are from Statistical Abstract of the United States, 1980.The data for 1980-1996 are from Statistical Abstract of the United States, 1997. Imports are on customs value basis and include trade of Virgin Islands with foreign countries.

[1] Customs duties (including import excise taxes) are calculated on the basis of reports of quantity and value of imported merchandise entered directly for consumption or withdrawn from bonded customs warehouses.

Annex Table 7. Changes in Costs of Telephone Calls (for 3 minutes) from New York City, 1940-1996 (Toll rates in effect Dec. 31 of each year 1940-1981)

Year	Philadelphia[1]	Chicago[1]	San Francisco[1]	Denver[1]	London[2]	Cairo[2]	Tokyo[2]	Buenos Aires[2]
1940	$0.45	$1.90	$4.00	$3.25	$21.00	$30.00	$19.50	$15.00
1944	--	--	--	--	$21.00	$30.00	$19.50	$12.00
1945	--	--	--	--	$12.00	$30.00	$19.50	$12.00
1946	--	--	--	--	$12.00	$12.00	$12.00	$12.00
1950	$0.45	$1.55	$2.50	$2.20	--	--	--	--
1960	$0.50	$1.45	$2.25	$1.80	--	--	--	--
1961	$0.50	$1.45	$2.25	$1.80	--	--	--	--
1962	$0.50	$1.45	$2.25	$1.80	--	--	--	--
1963	$0.50	$1.45	$2.25	$1.80	--	--	--	--
1964	$0.50	$1.45	$2.25	$1.80	--	--	--	--
1965	$0.50	$1.40	$2.00	$1.70	--	--	$9.00	--
1966	$0.50	$1.40	$2.00	$1.70	--	--	--	--
1967	$0.50	$1.40	$1.75	$1.60	--	--	--	--
1968	$0.50	$1.30	$1.70	$1.55	--	--	--	--
1969	$0.50	$1.30	$1.70	$1.55	--	--	--	--
1970	$0.50	$1.05	$1.35	$1.25	$3.60	--	$9.00	$8.00
1971	$0.55	$1.05	$1.35	$1.25	--	--	--	--
1972	$0.55	$1.05	$1.35	$1.25	--	--	--	--
1973	$0.60	$1.15	$1.45	$1.35	--	--	--	--
1974	$0.60	$1.15	$1.45	$1.35	$3.60	$9.00	$9.00	$8.00
1975	$0.90	$1.20	$1.36	$1.30	$3.60	$9.00	$9.00	$8.00
1976	$0.99	$1.18	$1.30	$1.24	$3.60	$9.00	$9.00	$8.00
1977	$1.01	$1.18	$1.30	$1.24	$3.60	$9.00	$9.00	$8.00
1978	$1.01	$1.18	$1.30	$1.24	$4.50	$9.00	$7.80	$8.00
1979	$1.01	$1.18	$1.30	$1.24	$4.50	$9.00	$7.35	$6.75
1980	$1.05	$1.25	$1.37	$1.31	$4.80	$9.45	$7.80	$7.05
1981	$1.22	$1.45	$1.58	$1.52	$3.00	$9.45	$4.95	$4.50
1985*	$1.24	$1.38	$1.61					
1986	$1.17	$1.31	$1.49					
1987	$0.81	$0.96	$1.04					
1988	$0.71	$0.85	$0.92					
1989	$0.69	$0.82	$0.86					
1990	$0.65	$0.72	$0.75					
1991	$0.65	$0.72	$0.75					
1992	$0.63	$0.69	$0.75					
1993	$0.66	$0.69	$0.75					
1994	$0.69	$0.72	$0.75					
1995	$0.78	$0.81	$0.84					
1996	$0.81	$0.84	$0.90					

[1] All Call rates represent station-to-station, daytime, 3-minute call costs.
[2] Represents rate for person-to-person, 3-minute call before 1964. Station-to-Station service available to Tokyo beginning June 18,1964, to London beginning Feb.1, 1967, to Cairo beginning Nov.10,1973 and to Buenos Aires Nov.1, 1969, with 3-minute initial period rates of $9.00 , $9.00, $5.40 and $8.00, respectively. Rate after 1965 is of station-to-station, daytime, 3-minute call.
[3] Source: Figures for 1940-81 are from different volumes of Statistical Abstract of Bureau of Census, DOC.
[4] Figures from 1985 to 1996 are from the personal communication with Sheldon Hochheiser, and Susan M. Eckert, at AT&T Archives, AT&T Office, New Jersey.
[5] All rates are before any custom plan discounts.

Annex Table 8. Long-Term Trends in International Telephone Call Rates—Three minute call from New York to London, 1927-1995

Year	Telephone Tariff Rate in Current Terms	CPI	Equivalent In 1995 Prices	Index of International Telephone Call Rates (1927=100)
1927	$75.00	17.358	$658.66	100.00
1928	$45.00	17.162	$399.71	60.69
1930	$30.00	16.73	$273.35	41.50
1932	$30.00	13.68	$334.30	50.75
1934	$30.00	13.4	$341.28	51.81
1936	$21.00	13.89	$230.47	34.99
1937	$21.00	14.37	$222.77	33.82
1939	$21.00	13.91	$230.14	34.94
1940	$21.00	14.03	$228.17	34.64
1944	$21.00	17.62	$181.68	27.58
1945	$12.00	18.02	$101.51	15.41
1946	$12.00	19.55	$93.57	14.21
1969	$12.00	36.68	$49.87	7.57
1970	$9.60	38.85	$37.67	5.72
1974	$5.40	49.29	$16.70	2.54
1975	$5.40	53.79	$15.30	2.32
1977	$3.60	60.64	$9.05	1.37
1980	$4.80	82.3	$8.89	1.35
1986	$4.43	109.53	$6.17	0.94
1991	$3.32	136.24	$3.71	0.56
1992	$3.32	140.25	$3.61	0.55
1995	$2.40	152.44	$2.40	0.36
1995	$3.37	152.44	$3.37	0.51

Note : 1927 to 1970 rates are for person-to-person calls.
1974 to 1977 rates are for station-to-station calls.
1980 to 1995 rates are for direct-dialed calls.

Sources: CPI are from BLS Publications. Telephone rates are from personal communication with Sheldon Hochheiser, and Susan M. Eckert, AT& T Archives, AT&T Office, New Jersey. February 16,1999.

Annex 2. Tables

Figure: 1. Annual average rail passenger fare and freight rates in the U.S., 1928- 96.

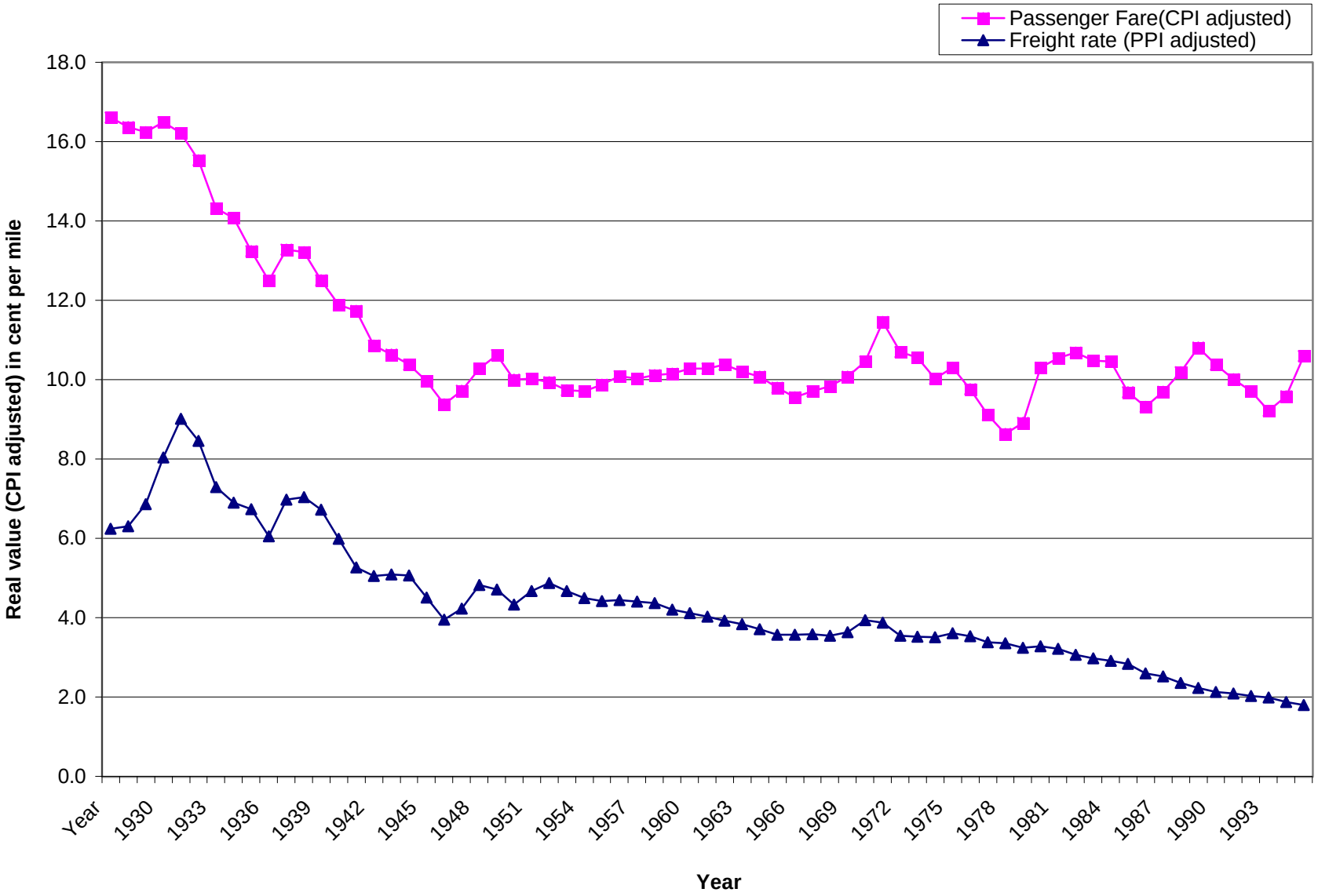

Figure 2. Trends of Nominal and Real (CPI adjusted) Average Passenger Fares Per Mile in the US, 1960-1996

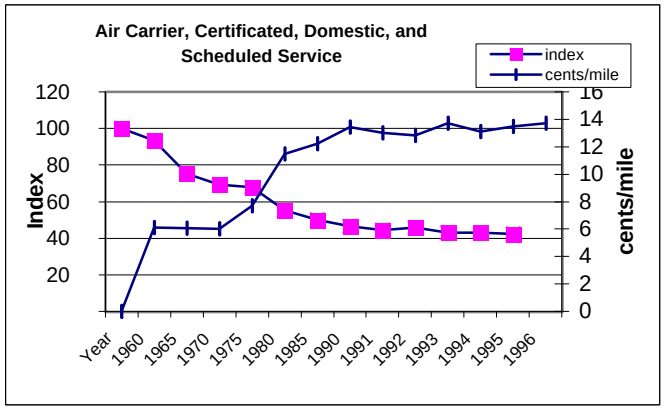

figure 2a.

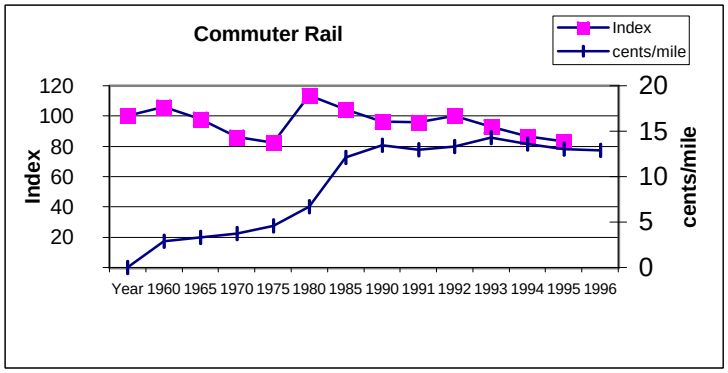

figure 2b.

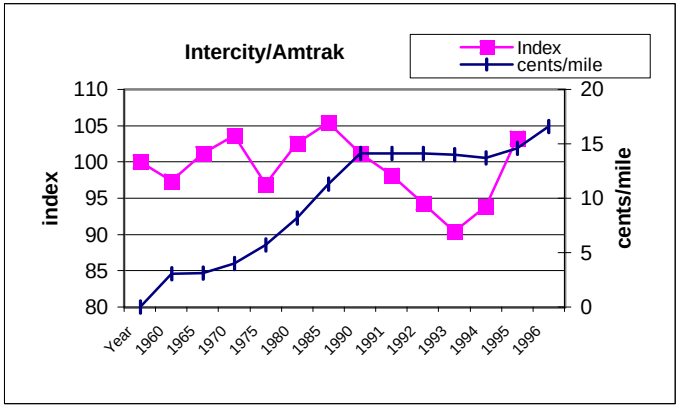

figure 2c.

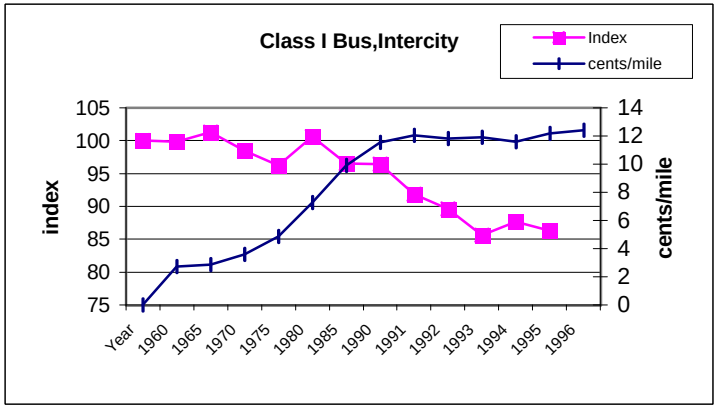

figure 2d.

Note: All indices are CPI adjusted figure (CPI, 1982-84=100). Details in Annex table 2.

Figure 3. Trend of Real Cost of Moving Goods in the U.S., by Various Shipping Modes, 1960-1996.

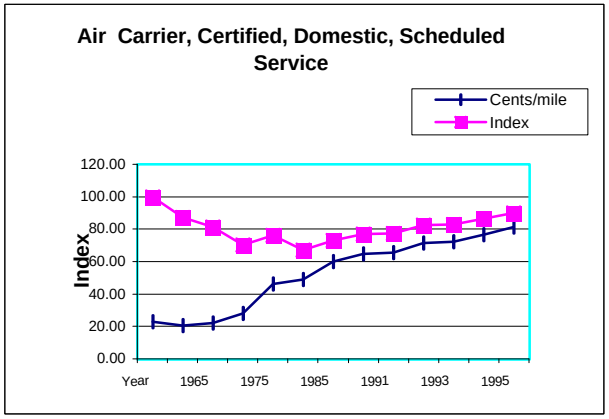

figure 3a.

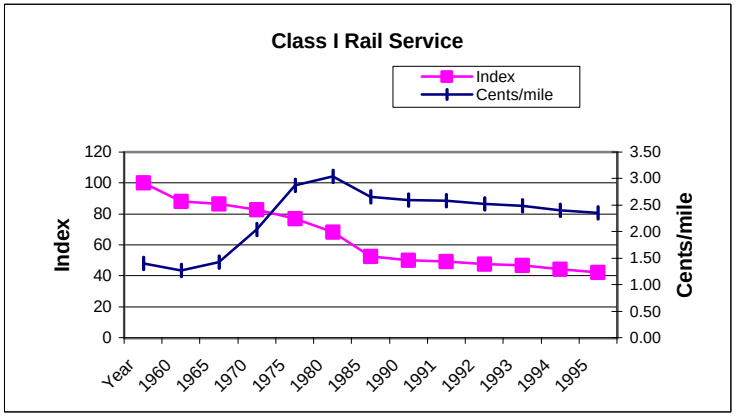

figure 3b.

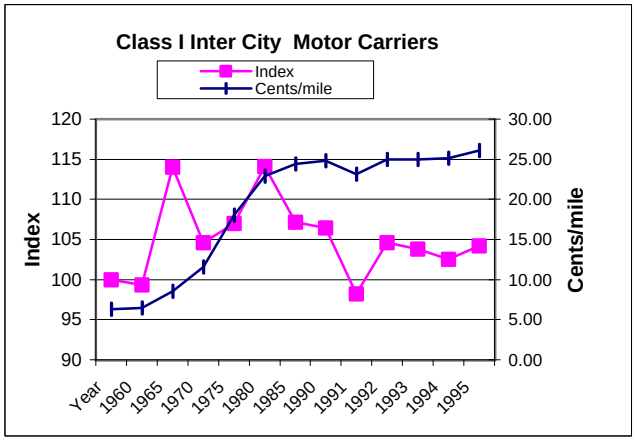

figure 3c.

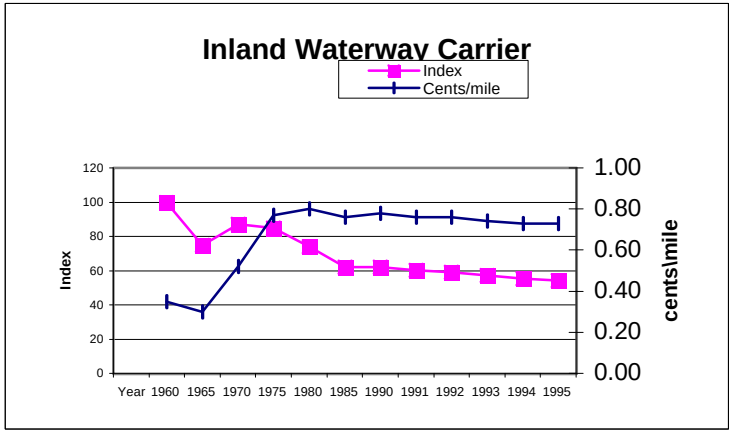

figure 3d.

Note: All indices are PPI adjusted figure (PPI, 1982=100). Details in Annex table 3.

Figure 4. Trends of Average Passenger Fares (nominal and CPI adjusted index) in the U.S., 1960-1996.

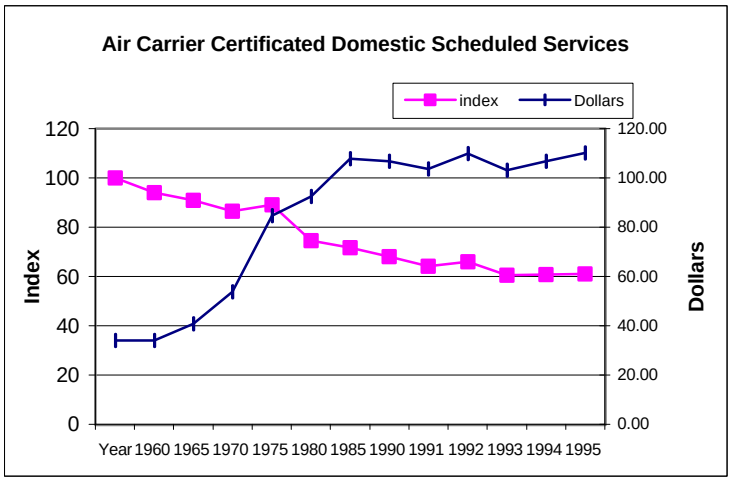

figure 4a

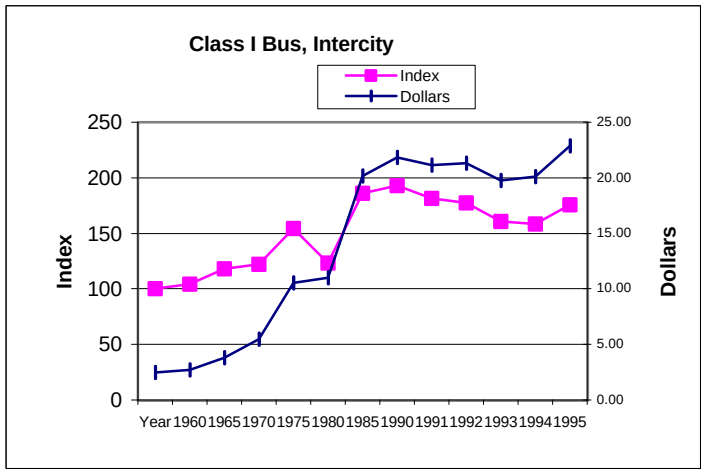

figure 4b.

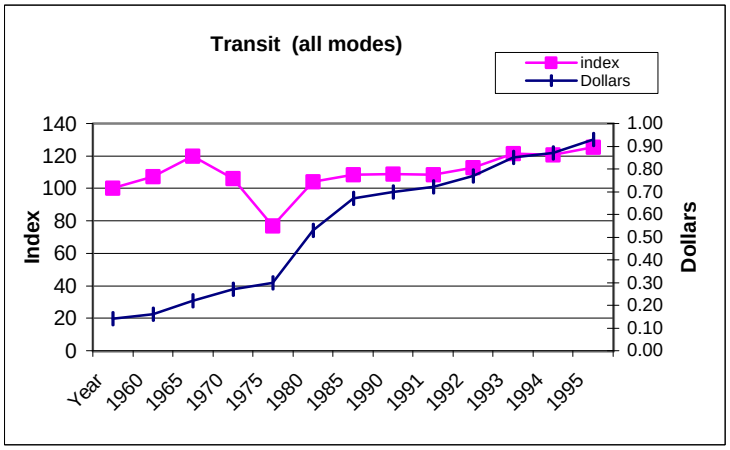

figure 4c.

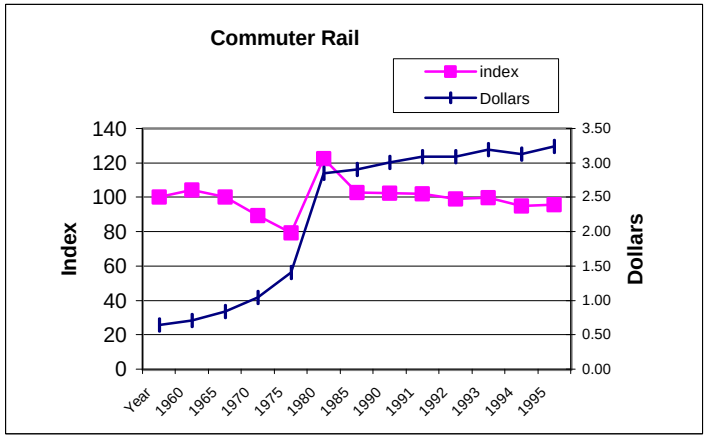

figure 4d.

Note: All indices are CPI adjusted figure (CPI, 1982-84=100). Details in Annex table 4.