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Structure of the Nation's Future Freight System

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It is frequently said that the U.S. transportation system is now mature. That is, with the completion of the Interstate highway system and a few major inland navigation projects now under way, the infrastructure is basically in place. Investment in the system over time will merely involve maintenance and replacement.

I believe, by contrast, that the system is a product of the forces that have shaped it over the years and that, if these basic forces change, the system will change in response. The key questions, then, concern the nature of these basic forces that are shaping the system and whether these forces are likely to change in the near future.

Freight transportation is, of course, a derived good. It is only needed to transport goods from the place where they are produced to a place where they can be consumed. There are many intermediate uses of goods by industry; some goods are also used in the building of the productive system, including the transport system, but it is clear that the final use is to enhance the utility of people. This takes place through the operation of the economy.

For purposes of this discussion, I would like to classify the basic forces shaping the system into one of three general categories: economic growth and development, economic regulation, and technology. The basic forces may also be summarized by noting that the operation of the economy is the game that is played, economic regulation states the rules of that game, and the current state of technology furnishes the physical devices with which the game is played. I would like to briefly review how

these forces have shaped the U.S. freight transportation system in the past, and I would like to speculate on what changes are likely to occur in these forces that will impact the future freight transportation system of the nation.

ECONOMIC GROWTH AND DEVELOPMENT

The long-term development of the U.S. economy has been characterized by the following trends:

1. Steady growth in population. Since well before its founding, the United States has experienced a continuous growth in population. The rate of urban population growth has been even larger than that for the country as a whole. This has led to specialization in the work force and improved efficiency.

2. Substantial economies of scale in production. A steady decrease in the per unit cost of production as the result of learning and increased efficiency can only be realized if the gains are not eaten up by the increased transport cost of serving the larger hinterland that can now be supplied. Thus, low transport costs make economies of scale realizable.

3. A decline in the share of employment found in agriculture and mining. This is paralleled by an increase in the share used in manufacturing, services, and government. It is a natural consequence of mechanization in the agricultural and mining sector. This has,

of course, also had a big influence on the proportion of the population found in rural areas as opposed to urban centers.

4. Recent trends toward vertical integration, conglomeratization, and internationalization. Vertical integration ties together the elements of the supply and marketing channels for the production of basic goods. Conglomeratization tends to exploit the organizational, financial, and management efficiencies of modern business. Finally, internationalization takes advantage of the differential advantages, trade restrictions, and barriers to trade that exist in various countries in an attempt to make the world into a single marketplace.

If any of these long-term trends change, one would expect that it would have an impact on the transportation system. Looking at the period from 1950 to 1976 (1), for example, the population has increased by 141 percent, employment has gone up 145 percent, and gross national product (GNP) has grown by almost 240 percent. Transportation output and ton kilometers have grown by 181 percent and 218 percent, respectively. Interestingly, transportation output per capita has grown from \$179 to \$228, although transportation output per dollar of GNP has shrunk from 4.9 cents/dollar to 3.8 cents/dollar. The population has more money to spend but is choosing to use it on goods and services requiring somewhat less transportation.

The percentage rates of growth between 1950 and 1976 in the various sectors of the economy are as follows (1): GNP, 3.26; population, 1.34; transportation output, 2.43; disposable income, 3.8; personal consumption expenditures, 3.7; fixed investment, 3.4; agriculture, forestry, and fisheries, 0.8; mining, 1.9; manufacturing, 3.3; construction, 2.1; communications, 7.5; utilities, 5.1; wholesale and retail trade, 3.9; government, 2.8; and financial, insurance, and real estate, 4.2. The shift from agriculture and mining is clearly apparent. The growth in service industries is most pronounced with communications, financial, utilities, insurance, and real estate, all well above average. The growth in wholesale and retail trade seems to closely parallel the growth in disposable income and personal consumption expenditures. Manufacturing output, however, is growing at a slightly higher rate than GNP. These growth rates also provide some indication as to why transport output per dollar of GNP is falling because communications, utilities, and services contain a relatively small freight cost per dollar of final output in contrast to mining or agriculture.

It is useful to view the forces acting to change the economy from three separate perspectives: (a) international, (b) national, and (c) urban. Each provides a slightly different view of the system as a whole.

The United States has historically been a rather insular country when compared to most other developed countries. That is, the United States—unlike Japan or England, for example—has had a relatively small percentage of GNP involved in foreign trade. The United States is also unlike those developing countries that earn a large proportion of their foreign exchange from the sale of a single basic commodity—for example, Colombia (coffee), Cuba (sugar), or Chile (copper). However, this insularity is changing rather rapidly as the world becomes more interdependent.

U.S. foreign trade statistics for 1978 indicate that a growth rate of approximately 19 percent for imports and 16½ percent for exports has been realized since 1965. There have even been periods when the growth rate exceeded 30 percent/year. The import figures are, of course, affected by the increase in prices for foreign oil. Nevertheless, the imbalance in trade has tended

to stimulate the export of goods as well. This trend is expected to continue because the large industrialized population of the United States offers quite an attractive market to foreign countries, and the United States still has considerable amounts of domestic raw materials and trained personnel to draw on for developing exports, not to mention the tremendous agricultural potential that the country offers.

From a national perspective, population, agriculture, mining, manufacturing, and services are distributed quite broadly. However, manufacturing has been heaviest in the Northeast and in the North Central states; agriculture is located predominantly in the Midwest, the South, and the Far West. The production of fuel (particularly petroleum) is centered in the Southwest. The net result is that there are large movements taking place between regions of some products, principally agriculture and fuel, along with some ores. In addition, there is a fairly large bidirectional movement of manufacturing from one region to another. The transportation ton miles by commodity for the economy are shown in Figure 1 (2). (SI equivalents are not given in this paper for data presented originally in reference materials in customary units.) A slightly different picture is presented by looking at revenues instead of ton miles in Figure 2 (2).

Much has been said about the movement of industry to the sunbelt regions (the South and West) in recent years. In these regions, industry can take advantage of the cheap, nonunion labor and energy sources that are available.

In addition to the movement from the Northeast to the South and West, there has also been a shift between the urban and rural areas that reflects the general shift in the economy based on agriculture to one based on manufacturing and services.

Within the urban area there has been a shift from the central cities to the urban fringe. These shifts seem to be taking advantage of the greater freedom in location choice that is possible through the use of improved automobile and truck transportation. There has tended to be a drop in both the population and industrial densities. However, there is still a tendency for industry and population to aggregate in relatively large areas that can serve as regional centers. The production process in today's complex world requires many inputs, and there are still tremendous advantages to establishing production close to the inputs, including skilled labor and markets for the finished goods. These large urban areas tend to offer a huge variety of services and inputs. Those that are not produced within the region are imported for wholesale. The result is an environment in which there are no particular advantages to being in one or another of these locations.

Thus the current picture of freight movement that emerges from this examination is one that is complex and changing with time. Ton kilometers are dominated by the long-haul movements by pipeline, rail, and inland waterway of bulk commodities, petroleum, coal, ores, and agriculture. Truck competes actively with rail in the movement of food and manufactured goods. Bulk movements are declining slowly as a percentage of GNP as the economy shifts from agriculture and mining to manufacturing and services. This shift is leading to a more urbanized population and a lower-density one in which truck movement provides a real service advantage to dispersed populations. Manufacturing is also tending to be more equally distributed among the population, with the growth in both population and industry taking place in the South and West at the expense of the Northeast and Midwest. Freight revenues are dominated by truck movements of manufactured and high-value goods. Air

Figure 1. Domestic freight in billions of ton miles by commodity, 1980.

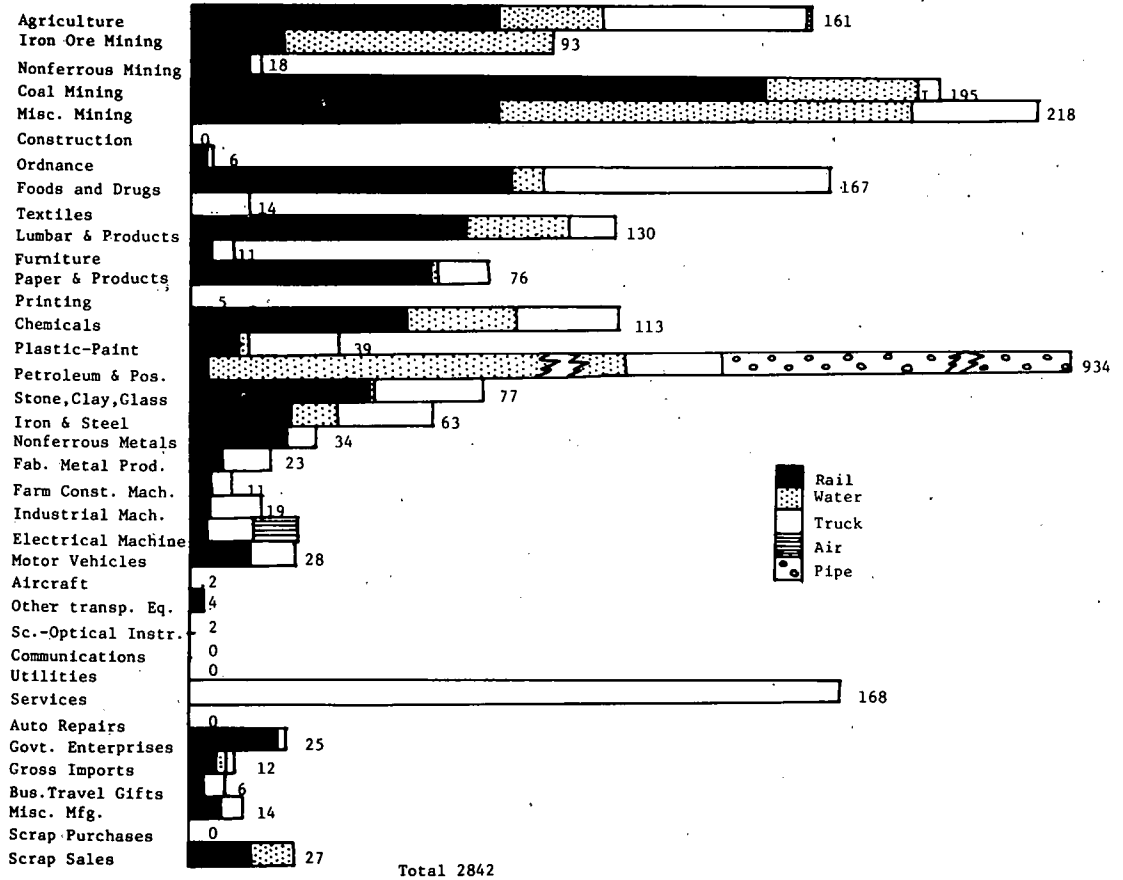
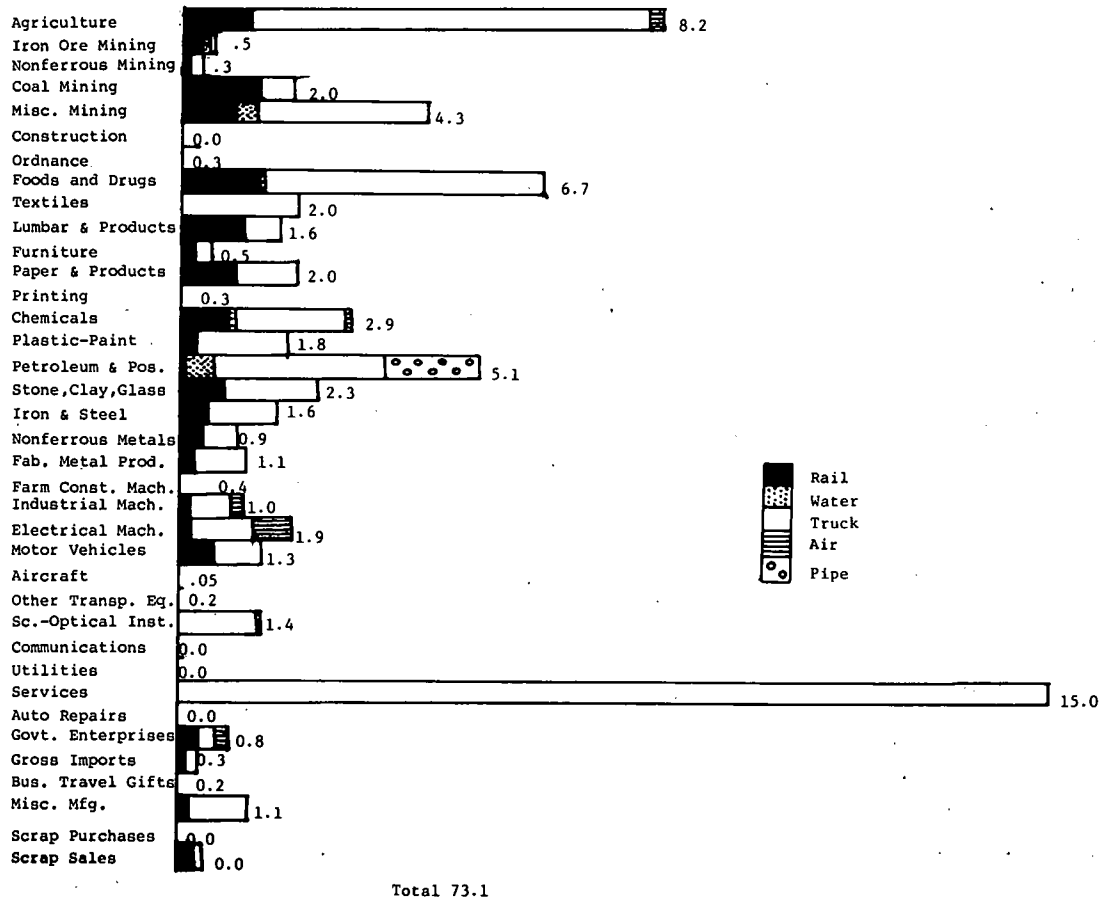


Figure 2. Domestic freight revenues in billions of dollars by commodity, 1980.



also captures a good portion of the revenues. Finally, the rapid increase in foreign trade points to a high revenue potential for those transport modes that can capture a part of the action.

Economic Regulation

For more than 50 years, most of the U.S. freight system has been dominated by the existence of economic regulation. Although some difference exists between modes, the regulatory system has controlled entry, routes and schedules of operation, rate structure and levels, and financial control, including reporting, acquisitions and mergers, service abandonments, operations and operating restrictions generally in the rail, truck, and air modes. Pipeline and barge modes are also partially regulated.

The philosophy behind regulation on the part of the U.S. Congress was the creation of an orderly marketplace without discrimination because of size or location and the provision of an available common carrier system. Underlying the regulatory system is the notion that, if we are going to protect the transportation service provider from the entry of potential competitors, we must make sure that the provider does not charge excessive monopoly prices for services rendered. When the regulatory process was established in the late 1800s and early 1900s, both the carrier and the public felt that economic regulation was preferable to the existing circumstances.

The regulatory process has developed along quasi-legal lines, with case-by-case development of precedents that elaborate the strict wording of the law. There is no grand design for the regulated freight system and no economic criteria by which decisions are made except that services be equitable and nonpredatory.

The nature of the process is such that a new entrant who desires to offer transportation services must prove "convenience and necessity." That is, the potential provider must prove to the satisfaction of the presiding administrative law judge at the required hearing that an existing service is not already being offered. If he fails to prove convenience and necessity, an operating certificate will probably not be granted. The authority to offer service between almost every point in the nation for almost every commodity has already been granted to one or another carrier within each of the modes; thus, it is quite difficult to prove convenience and necessity in most general cases. The proceedings can be long, difficult, and expensive.

The regulatory process has evolved in a manner that provides antitrust immunity to the rate-making process through tariff bureaus. Tariff bureaus, which exist in the rail and truck modes, provide a process whereby carriers and shippers cooperate in the filing of proposed changes to the existing tariffs for subsequent approval or disapproval by the regulatory commission. The rate hearings allow companies (indeed, whole industries) to use the rate-making process to preserve the status quo, that is, to protect against entrants and to ensure that extreme changes will not be made easily.

As a result of this regulatory process, there are very few new entrants in any of the modes except trucking. There have been no new railroads and, until recently, no new regulated airlines. There have been very few new grants of operating authority to regular-route trucking operators. The one place that there has been new entry has been irregular-route trucking. Irregular-route trucking is a very specialized, origin-to-destination, commodity-specific service. The very specialized character of this service enables one to prove convenience and necessity more easily and the Interstate

Commerce Commission (ICC) has been receptive to making new grants of authority in this area.

As a consequence, irregular-route trucking, which typically uses owner operators with their low labor costs for full truckload commodity hauling over long distances, has made substantial inroads into the ton miles of freight normally carried by rail. Figure 3 (1) shows this impact on the ton-mile market share from 1960 through 1975. The effect of truck competition (1) is even more apparent when measured in freight revenues (Figure 4). Inland waterway, which is almost totally unregulated, has been growing at slightly more than 2 percent per year over the last 10 years. Pipeline has also grown substantially. The consequence of this is that rail has been the only mode to lose a market share. All the other modes have gained a market share at rail's expense. Whether rail would have been able to hold its own without the regulatory process is not clear. From the preceding section of this paper it is easy to see that such economic changes are not to rail's advantage. However, it is clear that the regulatory process has not offered any protection for rail. On the contrary, it has allowed the other modes, principally truck and waterway, to erode its market base.

Furthermore, the regulatory process is extremely complex. It requires a specialized knowledge of rules, regulations, tariffs, and procedures in order to use the U.S. freight system. It would be extremely difficult to automate the retrieval of tariffs or their application. The businessperson who attempts to use the freight transportation system must search for exceptions and make every attempt possible to influence the process in his or her favor. It is fair to say, however, that any transportation system involving the movement of thousands of commodities between thousands of different points will inherently be a complex process. The same would probably be true for any system of regulation. It is not clear, however, that greater simplicity would result from deregulation.

Thus, the process is complicated, difficult to rationalize, and subject to many exceptions. Economic regulations, however, are the rules by which the U.S. transportation game is being played. If it is decided to change the rules, then the game is also subject to change.

Technology

Transportation is inherently technology rich. It was an early contributor to the larger base of U.S. technology, as well as a recipient of the benefits of this technology. The steam engine, the railroad, the automobile, the zeppelin, and the airplane were all products of technological innovation in the transportation field. The earliest of railroads could carry 100 times the volume at 10 times the speed and at a cost that was probably less than one-tenth that of the horse-drawn wagon. There was, as a consequence, a fantastic reduction in cost per ton kilometer of transport by land. Although there was not the same cost advantage over the canal boat, the increase in both speed and productivity at a lower capital cost also made it an easy replacement for most of the canals of that day. Thus, early transportation technology innovations were extremely productive, multiplying the nation's transport capabilities by several orders of magnitude over output prior to that date.

Technology still sets the standards for how the system works. Innovation in one of any number of components in the existing systems can have substantial impact. New developments in power, propulsion, load support, guidance and control, loading and unloading, vehicle classification, storage of materials, and materials handling can

Figure 3. Ton miles by mode, 1960-1975.

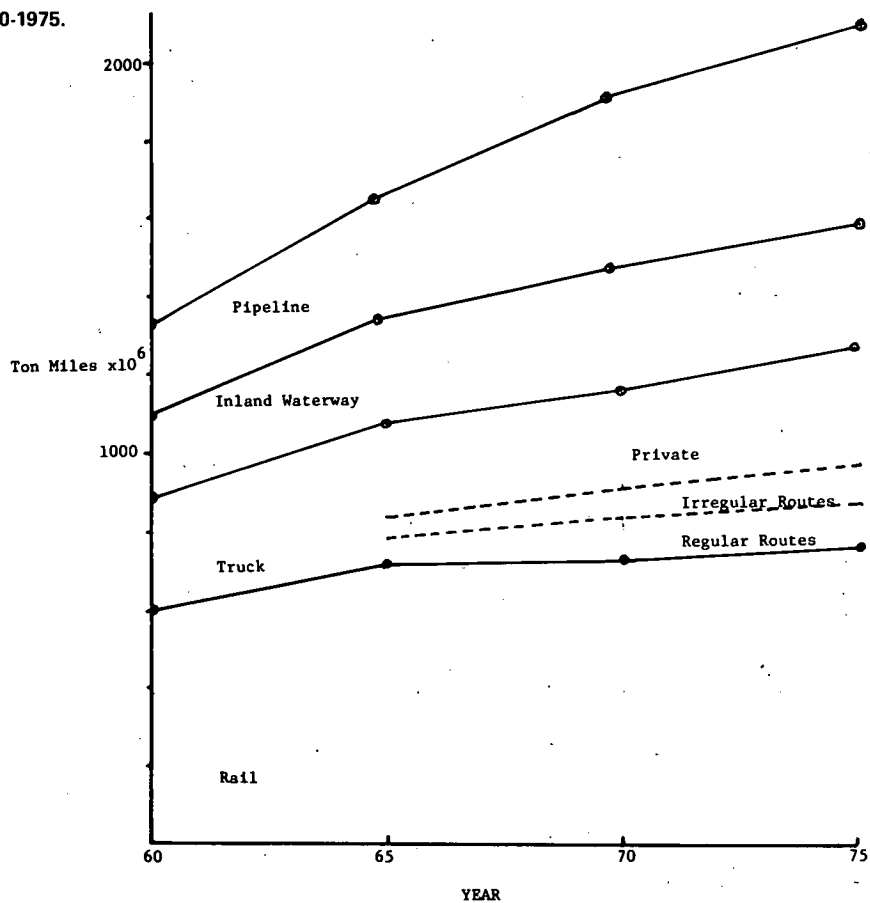
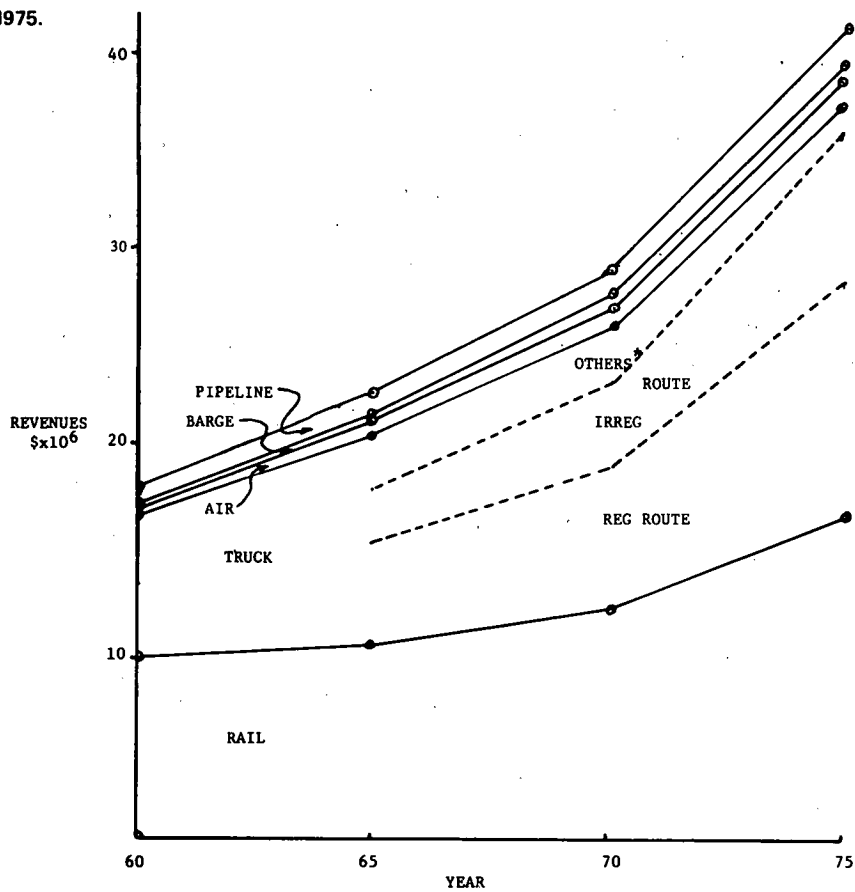


Figure 4. Revenues by mode, 1960-1975.



all influence the economics of system operation. Consequently, they may well influence the way in which the transport system, and indeed the entire economic productive system, is organized.

Although innovations in technology have great appeal to the engineer, it is quite difficult to innovate at the system level. It appears to be almost impossible to develop a whole new mode, at least at this point in time. To be successful, a new mode would have to be built all at once, and because it would divert its traffic from one or another of the existing modes, there would be both institutional and political resistance to its development. Technological innovation at the level of individual components of the system, however, is easier and can have systemwide effects. Frequently these new components can be installed in the current operating system, and their impact on competition with other modes can have systemwide effects. Some innovations that have occurred in the last 20-25 years have included the diesel engine, which replaced steam locomotives, for rail. More recently, the Big John hopper car and the auto-rack car have improved the competitive ability of rail substantially for the commodities that use this specialized equipment.

The development of the diesel engine for trucks and the construction of the Interstate highway system appear to have been what has made modern-day long-haul trucking possible. It is impossible to imagine that small gasoline-powered trucks on a two-lane rural highway could ever have competed with modern-day railroads.

Within the other modes, jet engines for aircraft and navigational improvements for inland waterways are both innovations that have had widespread economic impacts and implications for transport. Likewise, the development of supertankers has made possible the long-distance transport of fuel from the Middle East in economical quantities.

It is clear that the economics of the transportation system greatly influence where a producer's plant can be located. Also, there is a pressure exerted by the demand for services that seems to generate innovations to improve and refine the transport services originally offered. Thus, successful innovations that lower marginal costs from the outset are inherently easier to implement than those with big fixed costs, even if the average costs are lower in the long run. It is important to realize that technological innovations, even those that are considered to be extremely successful, will replace the existing system at a speed of only 10-15 percent/year. Major changes in the system are perceived to take place quite slowly.

Perhaps the most important technological force acting on costs in the transport system has been the use of petroleum-based fuels and internal combustion engines. It is perhaps no chance occurrence that the items cited in this paper as important technological innovations have included a large number of engines. The development of these engines has made possible the use of petroleum fuels with their economical handling and high heat content at constantly declining costs in real terms. It is important to note that, until 1973, the United States and the developed world had never experienced a rise in the real cost for fuel. Learning to cope with this change in a factor of as much importance as fuel may well be one of the most difficult economic lessons to learn in this generation.

In summary, then, technology is important because it establishes the economics of the transport supply process for each of the modal service offerings. If one thinks broadly, this is also where the balance of the institutional structure fits in. That is, this is where

institutions, regulations concerning environmental protection, or even wage and price guidelines should be accounted for. Though these factors are not exactly technological, they do help to determine the overall economics of the supply side. If these factors are examined individually, then their cost should be traced to their impact on the supply cost.

A PROSPECTIVE ANALYSIS

If my thesis is correct, the U.S. freight system has evolved over time under the rather steady influence of the three factors identified earlier: economic growth and development, economic regulation, and technology. If the future is to continue as the past, then there should be essentially no change in the existing freight transport system. But, if the future is to be different from the past, then we can expect the freight system to change as a consequence of the changing forces acting on it.

One can never know the future with certainty. However, some potential future events can be ruled out as highly improbable and others as quite likely. Events that are improbable in the short run may have a substantial cumulative probability of occurrence. Thus, though there may be another Ice Age in front of us, I do not expect that it will become a reality within the next 20 years. Likewise, the probability of a catastrophic occurrence that would change the nature of the entire U.S. freight transportation system seems fairly remote in the short run. By contrast, there are some events that are much more likely to occur and, though we will not know of their occurrence with certainty until they happen, one cannot rule them out as improbable. Though we can never know the future with certainty, the future will be made up of a number of events, most of which are independent and therefore additive. Consequently, planning for the future is a useful exercise in most cases.

I believe that there are a number of changes that could occur to the U.S. freight system with a sufficiently high probability and are worth noting here.

Trends in Economic Growth and Development

I have identified four separate trends in economic growth and development that I feel are likely. These are reduced rate of population growth, accelerated foreign trade, reduced growth rate for southern and western cities, and metropolitan growth and development into the exurbs. The population growth rate that accelerated after World War II has now begun to decline. If the children of this generation, who are now working their way through the school system, also fail to have a large number of children, the decline in the birth rate is likely to accelerate.

The implications of this declining population growth rate for the transport sector are not entirely clear, but they will have to be considered carefully. For the economy, it probably means an older and more affluent population. The decline in school population has already begun. It also means, however, a higher percentage of population in the working force. This will undoubtedly increase per-capita income and with it will come an emphasis on quality as opposed to quantity of output. It also probably means a further increase in the service sectors with an accompanying decline in ton kilometers per dollar of GNP. All of these factors will continue to emphasize the type of service that can be provided by trucking as opposed to that provided by rail.

An acceleration in foreign trade also seems highly probable. Trade from 1974 to late 1977 was depressed for a variety of reasons, and a higher rate of foreign

trade will be required just to catch up. I believe the long-term trend will be higher in general than it has been in the past. However, growth rates as high as 25-30 percent/year could be routinely experienced over the next decade. The development of world markets in raw materials is paralleled right now by markets in manufactured goods, such as automobiles or electronics, and it is hard for any one country to maintain control in a particular area such as the United States has done in the aircraft or computer areas in the past. With the high prices of foreign oil, and indeed of all imports, we must sell abroad to earn the needed foreign exchange to pay for these foreign purchases. To the extent that we do not, the value of U.S. currency drops and the United States becomes more competitive in world markets. Therefore, the process is self-regulating and tends to induce the United States to engage in more foreign trade.

For the transport sector, export-import trade is long-haul and generally lucrative. U.S. carriers, particularly air carriers, can benefit from it. Note that foreign trade is difficult and usually requires bilateral agreements. Moreover, the competition is frequently with a nationalized carrier. It will not always be profitable. The U.S. Merchant Marine has not done well even with its subsidized ship construction and operating differential subsidies. However, the differential wage rate between U.S. mariners and those from Third World countries is closing rapidly, and with the higher technological component usually found in U.S. ships, it is not inconceivable that we could operate a competitive merchant marine. Whether the construction differential subsidy is finally eliminated is largely a political problem. Nevertheless, I believe that we could be competitive over the long term if we are innovative.

I expect these foreign import-export markets to be highly volatile, easily disrupted by political crises, and constantly shifting with changes in currency, new finds of raw materials, and other events. However, the United States is in a potentially good position, geographically (for we are at the center of the Far East-European trade) and in terms of size (because the U.S. has huge markets for foreign products). The United States has both the population and the capability to produce a wide range of products competitively. We have tended to be a bit complacent, however, and have allowed others to get ahead in some areas. I hope that we will use this period while our wage rates are lower to rebuild some of our outmoded capacity and to improve our efficiency in those production areas in which the United States has a natural advantage.

With regard to the domestic economy, I anticipate that there will be reduced growth of southern and western cities. These cities have benefited greatly at the expense of northern and eastern cities, in part because of their good climate, their favorable labor force, and the fact that it is easier to acquire land and to build in virgin territory than to disrupt previously established development. However, this period of accelerated growth will eventually come to an end as the tax rates catch up to meet the payments for schools, water systems, and other municipal services. The environmental movement will also be a factor as it becomes more active in these places. The focus could change back to the North and the East, which are gathering their political power and which are about to become ripe for rehabilitation and renewal. It may well be that as energy prices rise, the North and the East will become more attractive. It is, after all, more energy intensive to cool than it is to heat.

Finally, I expect that metropolitan growth and development will continue right on past the suburbs into the exurbs. Industry can now locate at practically any interchange on the Interstate system and have economic

access to most other areas by using either private or common carrier trucking. Full-truckload trucking that is competitive with rail is available by using irregular-route carriers. However, there are still values to be- longing to large urban areas. Access to a skilled labor pool, to wholesale warehouses that stock infrequently used but necessary input, and the proximity to regional urban markets appear to continue to exert a centralizing force on new industry locations. Most industries, therefore, will continue to associate loosely with large regional centers. Cities, such as Dallas, Fort Worth, Atlanta, and Miami, are all developing into "super-big" urban areas that stretch over literally hundreds of square kilometers. These centers will represent a consolidation point for many transport carriers. For less-than-truckload trucking, for example, freight will be consolidated out of these large urban centers in exactly the same way that it is now from a large region. For rail it will be necessary to rethink the current consolidation schemes. This will certainly be the case for intermodal service, and it could well be the pattern for carload shipments as well. Because most of the import-export trade traveling by container ship or bulk carrier will come into larger and more concentrated ports, there is considerable opportunity for rail to capture the line-haul movement of import-export trade to inland regional centers.

Changes in Economic Regulation

Whereas changes on the economic front look reasonably predictable, or at least understandable, those in the area of economic regulation appear to be completely up in the air. Exactly what will happen will not be known for another year or two, or perhaps even for another five years. Because the rules of the game (economic regulation) had not changed substantively for 35 or 40 years, Congress decided last year to completely deregulate the air freight system. At the moment, pressure to deregulate the balance of the freight system is growing stronger in Congress. At least one mode (rail) has decided that it wants to be deregulated, although it cannot decide exactly how it should be done. Another mode (common carrier trucking) is convinced that it does not want to be deregulated, although some of the owner-operators working for irregular-route carriers support deregulation, at least in the truckload sector. The ICC has decided that it is going to move administratively to deregulate certain aspects of the freight transportation sector as fast as it can, whether or not Congress approves.

At this time, three basic outcomes are possible: (a) the status quo, (b) partial deregulation, and (c) complete deregulation. Because the situation in the truck and rail modes is somewhat different, we should consider them separately. Because the rail system's situation is much clearer, we will treat it first.

The U.S. railroad system is rapidly approaching a very deep crisis. The solution of the Consolidated Rail Corporation (Conrail) for the bankrupt northeastern carriers does not appear to be working. More railroads are encountering financial difficulty, and no end is currently in sight. Earnings for many of the carriers in the rail industry are not high enough to allow the replacement of capital assets. In short, the railroads are living off of their depreciation. The entire system appears to be "frozen" into providing service for which it cannot generate revenues to cover fully allocated costs. Even after bankruptcy, many railroads are required to continue to operate unprofitable services. Union work rules are onerous, requiring large crews and a day's wages for every 160 km (100 miles) traveled. The management of individual railroad firms has difficulty in making uni-

lateral decisions about such things as equipment, pricing, work rules, and scheduling. Some 70 percent of the revenue comes from shipments that must travel on more than one railroad. Almost 18 percent of the railroad moves involves as many as three railroads. Net income after taxes for Class I railroads as a percentage of net worth was 1.8 percent for the industry as a whole. Freight car use is so bad that frequently a rail car will only get one round trip per month.

It is precisely this inability to manipulate management choices that makes railroads want to be deregulated. They speculate that management initiative has been badly constrained by the regulatory process. In this respect the recent ICC decision to deregulate the fresh fruit and vegetable markets for railroads will be an interesting test case. It may be too little and too late, but complete deregulation of this sector should offer a possible demonstration of the correctness or the falseness of the railroad's thesis that "deregulation is a necessary precondition to proper management."

Congress must, in the final analysis, decide what to do about deregulation. The reason that railroads were regulated in the first place was that they had in many places become a monopoly. However, most knowledgeable transport analysts would argue that railroads are no longer in a monopolistic position. Other modes can offer the same services, frequently at similar or even lower cost. Most legislators are well educated in rail problems because of their recent efforts to draft reform and regulatory acts. They realize that railroads must be free to abandon unprofitable services or they will not have the economic strength to survive. They also know that abandonment is unacceptable to constituencies for the most part, but they have no real desire to nationalize the system. This would put rail unions directly to work for Congress and they would be in a position to use their political strength to exploit the system. However, because the rail debates preceding the passage of the reform and regulatory acts greatly improved the level of understanding of rail problems by most legislators, they know what needs to be done. Legislators are also beginning to be aware of a difference in rhetoric that could be used to explain the situation to their constituency. With the passage of Proposition 13 in California, a public mood to eliminate excessive government interference is widespread in the population. It can be argued that the railroads could solve their own problems if they could only get the government (and particularly the ICC) off their backs. A private-enterprise solution to the problem can be found in a deregulated environment, or so the argument goes. This argument just might work, and it would leave the legislators free to seek deregulation for the railroads with the public's backing. The draft of a rail deregulation bill has been released. The next step is up to Congress. Congress could act soon, but it is even more likely to do so if there is a crisis. It will probably start slowly by holding hearings. Then, if U.S. business leaders do not raise serious objections, deregulation for the railroads might just be a possibility.

Trucking deregulation, however, is quite a different matter. The ICC has already moved to ease entry. Not only are irregular-route certificates being granted almost automatically, but new guidelines proposed by the ICC would switch the burden of proof in most cases from applicants to those who protest the action. However, the trucking industry will not change instantly regardless of what is done. Entry into regular route operations is extremely difficult, expensive, and, as a practical matter, limited to those already within the industry. The principal factor is that the owner-operator still cannot solicit business without an operating certificate, usually does not have the time or the inclination to file

for it in most cases, and will not likely file in the future either. A person who continues to drive the truck rather than manage the business will not be able to do both. So, there will be no change in the truckload business until "no certificate" is needed. At that point the owner-operator will be free to solicit business. Perhaps, more to the point, the owner-operator will no longer be willing to pay the irregular-route carrier 25 percent of revenues for use of that carrier's certificate. However, the irregular-route carrier provides a number of services for that 25 percent share of the revenue. To the extent that these services are really costs to the trucking industry, somebody will have to provide them. This suggests that there will be the need for a truckload broker in the system to solicit loads, to secure the billing, and to handle the paper work. Alternatively, owner-operators may go to work for private fleets where it is currently against the law for them to work, or they might work for a contract carrier who, in a deregulated environment, might secure long-term contracts from large shippers.

The regular-route portion of the trucking industry is against deregulation because it is convinced that there will be increased competition both within their business and from the freed-up truckload operators. The two will tend to encroach on their territory and could cause rate wars and price cutting. Some services, however, are currently underpriced (i.e., small shipments), and it is expected that rates on these portions of the market will be increased rather than decreased. The net effect could be bankruptcy for the marginal carrier and an even faster concentration of the industry than currently exists.

Organized labor also plays an important role in the trucking case. The Teamsters' Union does not want deregulation and has made this point perfectly clear to the government. Alfred Kahn, President Carter's inflation expert, has suggested a possible quid pro quo in which the current administration will not push as hard for trucking deregulation if the Teamsters are willing to live with the President's 7 percent wage and price guideline.

It is quite likely that trucking deregulation will not occur right away; one wonders, if rail deregulation comes, can trucking deregulation be far behind? As deregulation in other countries has shown, industry practices initiated in one portion of an industry eventually spread to all portions of that industry. This suggests that floating rates, contract prices, and other practices typical in deregulated environments would eventually spread to the trucking industry, regardless of whether it was deregulated.

The implications of a complete deregulation of the trucking industry for the transportation industry and, in particular, the railroads are still being debated. Rail carload service and full-truckload trucking appear to be locked in a death struggle. Truckload costs are now almost equal to those for rail for all except the longest moves. Unless rail is deregulated, it cannot make the appropriate adjustments to its price-and-service offerings to be able to hold the profitable traffic. It will take bold management initiative for rail to find a winning strategy. Unless the rail industry is free to explore new initiatives for deregulation, it will probably not succeed. In fact, a winning strategy may well involve a considerable amount of withdrawal from current markets. There is a reluctance on the part of the public at large to let railroads merely go out of business. Therefore, the alternative that looms behind the failure of private enterprise to find a solution to rail's problems is nationalization of the rail system. Where nationalization has been tried in other countries, it has been a dismal failure. Japan, Germany, and Great Britain have all found that

a nationalized rail system requires enormous subsidies just to break even. Trucking deregulation does not improve the prospects for the railroads and, in my opinion, involves some risk if deregulation does go ahead in the trucking area.

One area that will require additional exploration before a possible future can be determined is in the area of intermodal operations (i.e., trailer on flat car, container on flat car, and related services). If these intermodal services are to be viable, they will probably have to exploit both multimodal ownership and operations. Because rail ownership of other modes is currently against the law, deregulation would once again seem to be required before progress can be made.

The impact that the outcome of the deregulatory question holds for the operation of the entire transport system has sweeping implications for the future of the whole U.S. transport system. Will the system have a continued, sickly, and struggling rail sector, no sector at all, a nationalized rail network, a shrunken but profitable private enterprise rail industry, or an aggressive set of multimodal transportation conglomerates? The number of possible alternatives is large, and their outcome is still too uncertain to assign much more than an equal probability to each at this point in time.

Possibilities for New Technology

Among those items that are listed as possible alternative futures for new technology, the most important seems to be the question of the price and availability of fuel. Because petroleum is a nonrenewable resource, it is clear that the world will eventually run out of oil at some point in time. When is the question. If the price in the marketplace were a true reflection of the shortage of petroleum, then as the shortage intensifies, the price would rise and the pace of development to find a substitute would quicken as a consequence. It is my feeling that at some price not too much greater than the one that exists today, a next-best solution will be found. It may be methanol from coal, hydrogen, storage batteries, or any one of a dozen other technologies now being investigated or even something that has not yet been developed.

I could be wrong, however, in which case an eventual solution might be several times more expensive than today's petroleum-based fuels. If so, the new fuel prices would dictate a new equilibrium between transport and the economy. Relevant intermediate solutions will also play a role if they can substantially reduce petroleum use in the transportation sector or in other sectors. For example, a large-scale solar solution to static power generation would release considerably more petroleum-based fuel for transportation. In fact, it would appear that over the long term there is almost complete convertibility from one type of fuel to another at an appropriate cost.

A more current threat, however, is one or more short-term interruptions in the petroleum supply. As we saw during the Arab boycott of 1973-1974, even a short-term break in oil supply can be extremely disruptive to the economy. It appears as though possible interruptions of supply will remain a problem until a more broadly-based source of supply is developed. Already, the potential for avoiding worldwide fuel shutdowns is improved from the situation that existed in 1973 when most of the supply was from the Middle East and Venezuela. Since that time, the North Sea, Alaska's North Slope, and Mexico have all come on line. Nigeria, Indonesia, and Venezuela have all expanded their output, and countless smaller fields are now producing or are under development. At the same time, the United

States has increased its dependence on imported oil, including that from the Middle East. In particular, this country appears not to have solved its current shortage of refinery capacity.

Even with a broader base of supply, short-term shortages (especially localized shortages) appear to be a fact of life that must be dealt with from time to time. Unfortunately, by the time our society learns how to cope with these kinds of shortages, we probably will be beyond the current problem. Fuel efficiency, which is terribly important in the face of steadily rising fuel costs, is of almost no use in a short-term shortage. It is important to remember that the key factor in an emergency is to keep the economy working. This means that the shortages, if there are any, should be taken in the private passenger sectors rather than in the freight sector.

Thus, I believe that new fuels, improved combustion processes, and more efficient propulsive devices are the principal products that technology research is likely to be able to provide over the next few years. If we are lucky, technology will produce some widely applicable solutions to the problems we are currently experiencing, perhaps even to the point that the problems go away. More likely, we will muddle through until the rising price of petroleum forces us to use alternative fuels for the entire transport sector.

As to other technological developments that are likely to impact the freight transportation sector, it is difficult to name what they are likely to be at this point in time. This is particularly true of components. An example of this type of possibility is the Roadrailer (the highway trailer with convertible rail wheels that can be moved in short trains by a small locomotive). Although it was tested some years back, the proper environment for its adoption did not exist. At the current time, however, the institutional barriers to its acceptance might possibly be overcome. Containerization in one form or another also appears to be likely. However, the thing that we seem most anxious not to discover is that the most ubiquitous container of this era is the highway trailer. Consolidation of trailers for economical long-distance movement by high-speed unit trains requires considerably more regulatory freedom than currently exists. Hinterlands of sufficient size are difficult to achieve under today's operating certificates.

CONCLUSIONS

In conclusion, then, the alternatives seem fairly clear. For the next 10 or 20 years, the economy will still have very much the same structure that it has today. The trends we see in the current system will probably continue. Per-capita income will continue to rise. Transport output as a percentage of GNP will decline, but overall transport output will have grown from 1.5 to 2.5 times larger than it is at the moment. Likewise, ton kilometers per dollar of output of GNP will probably continue to decline. The principal determinant will be the type of fuel that is being used and the location of its production. Different coal scenarios, for example, could have relatively large impacts on this figure. There will undoubtedly be an enormous growth in foreign trade. The cyclical and sporadic nature of this growth may even condition the U.S. transport system to be more adaptable and flexible under shocks.

The principal determinant of the modal makeup of the U.S. transportation system is the outcome of the current regulatory reform process going on in Washington. The next 10 years will probably see major changes in the regulatory scheme. The outcome will greatly condition the type of transport system that we will even-

tually have. It is difficult to say whether the system will be dramatically different in physical appearances. Chances are it will not. Statistically, however, it is likely to be quite different. It almost certainly will have more truck and less rail, but the essential questions relate to whether the components are healthy, not to their overall magnitude.

The second big unknown is the impact of fuel price and availability. The best of all possible worlds would be a steady rise in the price of petroleum until such time as new technological developments provide us with new energy sources, or new engines, or both. The range of possible outcomes is huge. It could prove to be a very exciting period for technology developers. If fuel prices rise to very high levels, it could even force a generalized reorganization of the economy. This could have major consequences for continued economic growth and would substantially alter the economic patterns of trade and development as well as life-styles. The more probable occurrence, however, is for a series of shorter-

term fuel crises. Methods for coping with these without damaging our economy must continue to be sought.

It is clear that the prospects for the future of the U.S. freight transportation system are for substantial and major changes. The future will not be boring and, although it is likely to be difficult, it is not fair to classify it as "bleak" by any means. In fact it might be characterized by Dickens' lines, "It was the best of times, it was the worst of times..."

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Passenger Transportation in the Year 2000

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Prognosticating is always a risky business. The longer the forecast period and the more dynamic the area of interest, the more caution the forecaster must exercise in developing predictions. In the absence of prescience, forecasters generally rely on extrapolation from established trends, and the best results are those that successfully weigh and incorporate the influence of emerging trends on future outcomes.

Thus, a would-be seer of the future of intercity and urban passenger transportation in 1949 would have accentuated the influence of pent-up demand for the better life that had been forestalled by war and depression. In 1959, the forecaster would likely have stressed the expected technological impact on transport from the then nascent space program. On the other hand, a predictor in 1969 would likely have emphasized the increasing importance of environmental constraints and the need for the transport sector to contribute toward achieving general social-welfare goals such as improved employment opportunities for minorities.

At first, one is tempted to note that these projections might have proved wide of the mark. Real economic growth and increased consumption of superior goods certainly characterized the 1950s and 1960s, but growth rates have slowed and, although the demand for travel is still growing, growth has been sporadic. Technology has been far from successful in solving all our transportation problems. Environmental considerations are already being accorded reduced emphasis, and many now feel that reliance on transport solutions to problems,

which are only marginally related to transportation, yields only inappropriate transport systems and unresolved social problems. Nonetheless, it is also obvious that these forecasters all correctly identified important influences on the long-run development of passenger transportation that continues to date. Economic growth, though cyclical, has continued strong, and the demand for superior goods such as travel continues to outpace other sectors of the economy. Although technology has not been a panacea, it is clear that the current passenger transport network would be unmanageable, if not impossible, without the breakthroughs of the past 20 years. One need only to travel to those regions where computerized reservation and information systems have yet to be introduced to appreciate the impact of the cybernetic revolution. Finally, although the activism of the 1960s has given way to the lowered expectation of the 1970s, the concerns of that decade introduced a new set of priorities into the transportation planning process, requiring that consideration be paid to the needs of the environment, minorities, the elderly, and others who are economically or physically disadvantaged.

Today, new forces are gathering that will help shape the future transportation environment. Obviously, all of these factors will continue to be important, and the estimates that follow are largely based on projections of economic growth and technological progress within constraints imposed by energy availability, environmental protection, and the sociopolitical system. It must be stressed that the emerging forces will not al-