Statement of

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Mr. Chairman and Members of the Committee, I am T.R. Lakshmanan, director of the Bureau of Transportation Statistics (BTS). Thank you for the opportunity to appear today to testify on the state and performance of the U.S. transportation system.

BTS, established by the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), is the newest operating entity of DOT. It is responsible for compiling, analyzing, and disseminating information on the nation's transportation systems, including intermodal transportation. BTS is also responsible for enhancing the quality and effectiveness of DOT's statistical programs through research and improvements in data acquisition and use. A better understanding of the performance of the transportation system and the potential for its improvement require both better coverage and increased quality of existing data.[1]

[1] Most of the information in this statement is taken from U.S. Department of Transportation, Bureau of Transportation Statistics, *Transportation Statistics Annual Report 1995* (Washington, DC: 1995); and U.S. Department of Transportation, Bureau of Transportation Statistics, *National Transportation Statistics 1996*, DOT-BTS-VNTSC-95-4, prepared by the Volpe National Transportation Systems Center (Washington, DC: 1996).

As I present my remarks on the transportation challenges we face, I will proceed in the following sequence. First, I will briefly review where we are with a focus on patterns of passenger and freight travel and the economic performance and other consequences of transportation. I will then proceed to a discussion of the various factors that may signify changes in the system and the implications of these changes.

WHERE WE ARE

The United States has been a pioneer in the development of transportation infrastructure. It has invested heavily in this infrastructure, as well as in the production of a variety of vehicles, and the human and organizational capital needed to create an impressive transportation system. This system, serving 258 million people, 6 million business establishments, and 86,000 units of governments, is a vast enterprise, accounting for over 4 trillion passenger-miles and 3 trillion ton-miles of domestic freight annually.

Over the years, the U.S. transportation system has played a critical role in the expansion of agriculture, resource industries, manufacturing, and urban centers. Currently, innovative intermodal logistical developments are emerging to support the American economy as its firms compete in global markets. Further, the U.S. transportation system offers its residents a very high level, indeed the highest level, of personal mobility in the world -- as measured by passenger-miles traveled per capita (see figure 1).

One way to characterize the role transportation plays in the economy is to gauge the proportion of the gross domestic product (GDP) arising from transportation-related activities. In 1994, the portion of the GDP attributed to transportation-related demand was $712.7 billion, or

10.8 percent of overall GDP. Thus, transportation is a large economic sector, broadly comparable to health (14.2 percent), education (7.2 percent), and food (12.4 percent).

Passenger Travel

Between 1970 and 1994, U.S. passenger travel increased by 87 percent -- an average growth rate of about 3 percent annually (see figure 2). Passenger-miles per capita increased from around 11,000 miles in 1970 to nearly 16,600 miles in 1994.

Air travel and passenger travel in light-duty trucks (including pickups, sport-utility vehicles, and mini-vans) more than tripled over this period. Air passengers traveled 388 billion miles in 1994, compared with 118 billion miles in 1970. This reflects an annual growth rate of about 5 percent. In terms of absolute miles traveled, the growth in automobile use overshadows all other modes, growing by over 900 billion passenger-miles between 1970 and 1994. Transit travel grew significantly in the 1970s, before leveling off in recent years. Passenger-miles traveled on commuter rail increased from around 4.5 billion in 1970 to around 7 billion today.

Passenger travel is partly related to travel to and from work. The number of jobs has increased significantly over the past 25 years due to the baby boom generation moving into the labor force and a dramatic increase in labor force participation by women. In 1970, there were about 83 million people in the civilian labor force (including the unemployed), 38 percent of whom were women. In 1994, women accounted for 46 percent of the 131 million people in the civilian labor force.

The growth in passenger travel is also related to household activities such as shopping, recreation, and taking care of children's needs. The number of households grew rapidly over the

past 25 years as the population increased and household size declined. The average household was 3.14 persons in 1970 and 2.67 in 1994. The number of households grew by 51 percent between 1970 and 1994, while the population grew by only 28 percent over the same period.

Changes in the distribution of jobs and population in metropolitan areas have contributed to increases in private vehicle use. According to decennial census data, metropolitan areas grew from 140 million in 1970 to 189 million in 1990.[2] Central city areas grew from 64 million to 72 million, but suburbs grew from 76 million to 117 million. Between 1980 and 1990, central cities lost population while suburbs grew (see figure 3). The suburban share of metropolitan population was 62 percent in 1990, compared with 54 percent in 1970. The share of jobs in the suburbs also has increased: 42 percent of jobs in 1990 were found in suburbs, up from 37 percent in 1980. In 1990, suburb-to-suburb commutes accounted for 44 percent of all metropolitan commutes while suburb-to-downtown made up only 20 percent of all metropolitan commutes. Suburb-to-suburb commutes usually are more easily accomplished in a private vehicle. As metropolitan areas have expanded and low-density suburbs have spread into the rural areas, mass transit has had difficulty providing the same level of service in suburban areas as in higher density core cities.

Transportation often spills over state boundaries. According to the 1992 Truck Inventory and Use Survey (TIUS), half the vehicle-miles of travel by trucks used in for-hire transportation occur outside the vehicle's base state. Over 10 percent of the vehicle-miles of travel by vans and minivans used for personal transportation occur outside the vehicle's base state. We do not have

[2] Figures for 1990 are calculated using 1980 metropolitan area definitions and therefore differ from figures based on current U.S. census definitions.

equivalent data for automobiles, but can assume that they are used by households in similar fashion to vans and minivans for personal travel.

The Movement of Freight

Freight transportation grew substantially between 1970 and 1994 in all land modes and air cargo. The ton-miles carried by Class I railroads increased 57 percent, while ton-miles carried by oil pipelines increased 41 percent. Using vehicle-miles of travel of combination trucks as a surrogate for ton-miles, freight transportation by truck increased 210 percent. The biggest relative growth was in air cargo ton-miles, which increased 434 percent. As shown in figure 4, this growth has been uneven in response to general fluctuations in the economy.

For the first time in nearly two decades, we are able to report on how much freight is moved by all modes in the United States, including trucking and intermodal combinations. In keeping with the mandate of section 5002 of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), BTS worked with the Bureau of the Census to conduct the Commodity Flow Survey (CFS) in 1993. Preliminary results from the CFS show that the nation's freight transportation system carried more than 12.4 billion tons of goods valued at more than $6.3 trillion for a total distance of 3.7 trillion ton-miles in 1993. As shown in figure 5, over half the weight of all freight was moved by truck, with rail and water transport accounting for most of the remaining tonnage. In terms of ton-miles, the split between truck, rail, water, and pipeline transportation is more even, given the greater distances moved by large shipments in the non-highway modes. Nearly three-quarters of the value of items transported moved by truck, followed in order of magnitude by intermodal, rail, water, and pipeline transport.

The CFS shows the importance of local transportation to the nation's commerce. Nearly 30 percent of the value and over 56 percent of the tons of all shipments represented by the CFS occur between places less than 50 miles apart. Over 38 percent of the shipments measured by value, and two-thirds of the shipments by weight, are sent less than 100 miles.

Although local transportation is important, significant quantities of goods are shipped across the entire continent. For example, for shipments originating in California, the top five destinations ranked by value were Texas, Arizona, New York, Illinois, and Florida, according to the Commodity Flow Survey.

Fast, flexible forms of transportation have emerged in recent years. Parcel, postal, and courier services account for about 9 percent of the value of all shipments. When shipments reported as being sent by more than one mode are added to moves by parcel and courier services, intermodal transportation exceeds 200 million tons valued at $660 billion. In particular, about 38 million tons, worth $83 billion, moved by the "classic" intermodal combination of truck and rail. Assuming 50,000 pounds of payload per truck, this intermodal combination would represent 1.5 million large trucks diverted from our highways for a major part of their trips.

Intermodal shipments tend to be high in value. Shipments by parcel, postal, and courier services are worth $15.08 per pound. Truck-rail intermodal shipments are worth $1.09 per pound. Although these statistics are far short of the $26.77 value per pound of air and air-truck shipments, they are significantly higher than the 35 cents per pound for truck-only shipments and the values per pound for railroads, water transport, and pipelines which are less than a dime.

Growth has been particularly dramatic in the use of trucks. According to the Census Bureau's TIUS, the number of trucks used in for-hire transportation has increased by 24 percent.

Vehicle-miles of travel grew even faster for these trucks, which traveled approximately 46,000 miles per truck in 1982 and 58,000 miles in 1992. Combination trucks with more than one trailer traveled the farthest per vehicle in 1992, averaging 79,000 miles per vehicle. The number of these multiple combination trucks doubled from 1982 to 1992 to 58,902, and their vehicle-miles of travel increased 152 percent. In comparison, there were 1,670,455 single combination trucks (most typically a 3-axle tractor with a 2-axle semi-trailer) in 1992.

The truck fleet appears to be getting heavier as well as traveling farther. Between 1982 and 1992, trucks with typical operating weights above 80,000 pounds increased in number by 180 percent and in miles traveled by 193 percent. Trucks below 33,000 pounds increased 77.5 percent in number and 120 percent in miles traveled. Relative increases for trucks in the intermediate weights were substantially less. The policy implications of these changes are under study by the Federal Highway Administration, which is expected to report its results later this year.

International trade is a basic source of growth, placing demands on the domestic transportation system for access between ports of entry and the interior. The North American Free Trade Agreement has added a north-south focus to the traditional concern with east-west freight movements for international movements. Based on information collected through the Census Bureau under contract to BTS:

- $259.3 billion in goods moved through land crossings between Canada and the United States between April 1994 and March 1995, an increase of 15 percent over the preceding 12 months. In terms of value, 76 percent of this trade was moved by truck, 20 percent by rail, and 4 percent by pipeline.

- $90.7 billion in goods moved through land crossings between Mexico and the United States between April 1994 and March 1995, an increase of 16 percent over the preceding 12 months. In terms of value, 87 percent of this trade was moved by truck and the remainder by rail.

Although transborder land crossings are important, most international trade moves in and out of the United States through ports. Seaports handled international cargo valued at $565 billion in 1994, an increase of 92 percent over the cargo handled in 1980.

Changes in the structure of the economy have had major ramifications for freight transportation. Between 1977 and 1984 -- a period of substantial economic growth and structural change -- use of highways, air and water transport, and urban transit increased. According to the Department of Commerce, industry's use of infrastructure grew faster than the economy as a whole. Industry's share of highway use climbed from 34.5 percent to 40.2 percent, partly reflecting the effects of new logistical systems, such as just-in-time methods, that rely heavily on trucking to provide rapid and frequent delivery of small shipments. Durable goods manufacturing, wholesale, and retail services, other services, and public enterprises accounted for much of the increase. These groups also increased their proportional share of air transport. The changing use of highways and air transport provide insights into the growth of higher value goods. Aside from the transport service sector, the most intensive industrial users of highways are the wholesale and retail trade, and the construction industry. While the material intensity in the overall economy may have declined -- indicating less material transport per unit output -- the rise of the new logistical systems may signify more use of highways and bridges.

Economic Performance of Transportation

The transportation share of GDP has held steady since 1980 -- a period of considerable dynamism and technological and structural change in the transportation industries and the larger economy these industries serve. Indeed, transportation for-hire industries have performed well in terms of economic productivity in the last two decades. Their labor productivity, measured by value-added per worker, is well above that of the economy as a whole (see figure 6). In 1978, transportation sector labor productivity was 9 percent higher than the economy as a whole. By 1992, the sector's labor productivity had climbed 19 percent higher than the economy as a whole, reflecting the effects of deregulation and technological change in the transportation for-hire industries.

Within the transportation sector, labor productivity increased most rapidly and is projected to continue in railroad and air transport industries. The rise of labor productivity in air transportation has been accompanied by rapid growth in the employment and industrial output. Between 1978 and 1992, employment in this industry increased 77 percent (from 418,000 to 739,000), while its value-added increased 123 percent, from about $20 billion (1987 dollars) to $45 billion (1987 dollars).

There is evidence that investments in highways and other public transport capital reduce the costs of transportation and production, and contribute to economic growth and productivity. A clear majority of recent empirical studies in the United States concludes that highway capital makes a positive contribution to total economic output, although small relative to private labor and capital inputs. Studies in Europe and Asia also find positive contributions of transportation infrastructure to national economies. (See table 1). Further, one retrospective benefit-cost study

of the U.S. federal highway system concluded that even under pessimistic assumptions, the benefits accruing to Class I trucks in the form of cost savings amount to one-third of the cost of the Interstate system alone. Under some more generous assumptions, the benefits may have been as high as three-quarters the cost of the Interstate system. The study did not include the benefits to final consumers such as households (see box 1).

The Unintended Consequences of Transportation

The U.S. transportation system provides Americans with enormous economic and societal benefits, and highly valued personal mobility. Over the last 25 years, transportation has become safer and cleaner and also somewhat more energy efficient while the amount of travel and movement of freight have increased. However, fatalities and injuries from crashes and their related costs, and environmental damage continue to affect our society, the economy, and the efficiency of our transportation system in significant ways.

The number of motor vehicle traffic fatalities has declined since 1970, when over 54,000 people died in motor vehicle crashes. Even so, in 1995, an estimated 41,700 persons lost their lives in motor vehicle traffic crashes -- about 115 people per day -- and motor vehicle crashes are the leading cause of death for Americans aged 5 to 27. Moreover, after many years of steady decline in annual highway fatalities, the number of deaths increased every year since 1992, when there were 39,250 deaths.

The annual costs of highway crashes have been estimated at $137.5 billion (1990). Part of these costs are borne by taxpayers through medical treatment (e.g., Medicare, Medicaid) and income support (e.g., Social Security Income disability). Taxpayers pay more than one-quarter of

the first-year medical costs of hospitalized crash victims and pay more than one-half of the medical costs for those injured seriously enough to be admitted to a rehabilitation hospital.

Far less air pollution is emitted from cars and other highway vehicles today than 25 years ago. This improvement, in turn, has helped to make air quality better in most metropolitan areas. Lead has been all but eliminated from gasoline, and total emissions of carbon monoxide and volatile organic compounds are much lower in absolute amounts today than in 1970. Nitrogen oxide (NO_x) emissions remain roughly the same in amount -- but are much lower if measured on the basis of emissions per mile.

One way to examine these trends is to analyze what would have happened if conditions present in the early 1970s had continued unabated. Had transportation fatality rates remained at 1972 levels, twice as many lives would have been lost in transportation accidents in 1992. At 1972 rates, the transportation sector in 1992 would have used 3.8 quadrillion Btu's more energy. It also would have produced several times as much air pollution, and would have produced 15 percent more carbon dioxide emissions.

Despite the progress, the unintended consequences of transportation continue to be significant. Moreover, while the historical record over the last 25 years is impressive on many counts, some recent developments will need to be watched closely. Data from the last two or three years show some slight increase in some emissions. Energy efficiency gains also have tapered off. It is too soon to know whether these recent developments will continue. Given the expected increase in transportation use, however, the trends in the various unintended consequences will need to be watched closely in the years to come.

FACTORS AFFECTING CHANGE IN TRANSPORTATION

Passenger Travel

The rapid growth in personal transportation that has characterized the last half century shows signs of leveling off. However, some forces of change could stimulate new growth in future travel demand, albeit not as great as in the past. Factors contributing to the demand for personal travel include the following.

Population. The growth of the U.S. population between 1980 and 1993 was 13.4 percent. Had there been no immigration, the natural increase in population would have been closer to 9 percent. The Bureau of the Census projects that the U.S. population could grow 14 percent between 1995 and year 2010. Immigration into the United States is expected to be a major component of future growth. Immigrants have a more immediate impact on travel activity than natural increases in population because most immigrants are in their twenties and thirties.

The American population is aging. The relative proportion of different age groups will change over the next 15 years as the baby boomers move into old age. The number of people aged 55 to 64 years is expected to increase by 63 percent, from 21 million to 34 million. During the same period, the number of people 65 years or older will increase by 19 percent from 33 million to 40 million.

The growing share of people over age 65 is already changing transportation needs. Should travel trends remain at 1990 levels, the total annual person-miles traveled would be expected to moderately increase across all age groups through the year 2010. For drivers between 55 and 64 years of age, however, the increase by 2010 could be as much as 63 percent over 1995 levels.

The labor force. As mentioned earlier, America had an extraordinary increase in the labor-force in the 1970s and 1980s. Although the labor force will not grow at such high rates in the foreseeable future, the absolute numbers of new participants in the labor force will continue to increase. The impact of increased employment on travel to work will be affected by telecommuting. The number of Americans who worked at home increased from 2.2 million in 1980 to 3.4 million in 1990.

Domestic migration patterns. Major changes in domestic migration patterns have changed transportation demand. During the 1970s and 1980s, almost 90 percent of U.S. population growth occurred in the South and West -- more than half of it in Texas, Florida, and California. These trends have moderated. One explanation may be that as workers age, the tendency to move long distances for job-related reasons declines, and the explosive growth of many metropolitan areas of the South and West -- along with accompanying transportation demands -- can be expected to moderate.

Immigration. During the 1980s, almost 40 percent of the U.S. population increase came from immigration, largely from Central and South America and Asia. (See figure 7.) This high level of immigration continues today. The greatest impact on transportation demand comes from young immigrants. About 80 percent of immigrants are of labor-force age, and most immigrants locate in metropolitan areas. It is expected that continued immigration at recent growth rates will have a major influence on increasing future urban travel demand.

Evolution in women's travel. Many factors have contributed to increased travel demand by women. These include a greater percentage of women in the work force and a higher proportion of licensed women drivers. In 1990, the daily number of trips by women exceeded

those by men, although the overall travel volume of men remained greater because of the longer average length of men's trips.

Growth in travel by the young and old. The growth of travel by the youngest and oldest age groups in the United States has been great. Although additional growth may occur, the rate of change has slowed. National travel demand continues to rise because today's 20 year olds make more trips than those of past generations (and young females have increased their trip-making to equal that of males), while those 65 and older likewise make more trips (and today's older females, unlike those of the past, are making nearly as many trips as older males).

Travel by persons of low income. Vehicle ownership and the propensity to travel are affected by income. Most aspects of travel increase with income -- trips, miles, and the use of a car. As vehicles have become more ubiquitous, used vehicles have become increasingly available. Moreover, as the average age of vehicles increases, used vehicles become more affordable. Although the number of those with low income may not be falling, the proportion of the U.S. population with access to a vehicle has been growing, and thus more travel by car is likely. As greater proportions of the lower income populace come to own cars, there is likely to be some decline in carpool use, in transit patronage, and in pedestrian travel. Overall, as car ownership by those with lower incomes rises, the result will be greater demand for highway travel. However, many people depend on mass transit. Households with income below $15,000 per year and those that qualify for the earned income tax credit account for 60 percent of total transit use.

Forces for Change in Freight Transportation

Freight transportation has changed in response to many factors. We are moving lighter goods, either because traditional products like automobiles are being manufactured with lighter materials, or because the economy is emphasizing light-weight products such as consumer electronics. Just-in-time logistical systems have placed new demands for faster and more reliable service to support manufacturing, wholesale, and retail. The combination of toll-free telephone numbers and overnight parcel delivery services has allowed small retail establishments to serve national and international markets, resulting in more growth for carriers specializing in small shipments.

International trade will probably continue to place increasing demands on the domestic transportation system. Although overall global economic growth rates are likely to be uneven, economic growth in regions such as Asia, the Pacific Rim, and Latin America may continue to be significant. This growth will provide new markets for U.S. products, and be the source of both imports and tourists to be carried on the domestic U.S. transportation system.

WHERE WE ARE HEADED: IMPLICATIONS FOR THE FUTURE

Our assessment of where we are headed in the next decade and a half is framed by our current perceptions of the balance of the above demographic and economic trends. The prevailing view (as indicated by DOT and Department of Energy reports[3]) is that the *pace* of this aggregate growth in the next decade and a half is likely to be more moderate than the recent past.

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[3] U.S. Department of Transportation, *1995 Status of the Nation's Surface Transportation System: Condition and Performance, Report to Congress,* FHWA-PL-96-007 (Washington, DC: 1995); U.S. Department of Energy, Energy Information Administration, *Annual Energy Outlook 1995*, DOE/EIA-0383(95) (Washington, DC: January 1995).

The personal propensity to travel will *increase*, unless constrained by environmental concerns, finances, road capacity, or the attractiveness of transportation substitutes such as telecommuting.

Personal travel, comprised largely of highway travel in automobiles and light trucks, and air travel are likely to grow in response to increasing population, GDP, and personal income. Highway travel by light-duty vehicles, which grew at 2.8 percent per year between 1970 and 1991, may increase at a more moderate rate. The growth of air travel is expected to slow, reflecting maturation of the industry.

Freight transport, driven by industrial output growth, will continue to increase in all modes. Air cargo and trucking are expected to grow faster than water and rail transport.

Characteristics of the Future Transportation System

To refer to the next decade as one of moderate growth is in many ways too bland a characterization, which conceals more than it reveals about the *vitality and dynamism* of the emerging transportation system. Underlying the aggregate demand there appears to be a diverse set of demographic processes (noted above), as well as processes of economic structural change. The latter processes, which derive from technological and logistical evolution underway in the last decade, are very dynamic and may lead to further changes in the *sectoral, structural, and spatial composition, as well as the external aspects of the emerging transportation system.* These *compositional changes* in the emerging transportation system are likely to be both significant and difficult to anticipate. They are important to consider for a variety of reasons.

Extensive technological change, restructuring, and market volatility are evident in the transport sector so that there may well be major transformations in this sector in the next decade or so. Such changes could take the form of:

Sectoral changes. Sectoral changes are occurring in the economy. One example is the relative change in the fortunes of different transport subsectors as the larger economy is "dematerializing." Dematerialization refers to the ongoing evolution from a material-intensive production system based on economies of scale (where efficiency is attained by concentrating resources in large firms) to the emerging, flexible, knowledge-intensive production system with agile firms exploiting economies of scope (where firms offer a broader range of services). Predictably, this development is favoring (and will continue to favor) the transport industries offering faster, flexible services (e.g., air, truck, and intermodal services).

Structural changes. Over the last decade, new information technologies (IT) and transport logistics produced major structural changes and, in turn, were influenced by a structural evolution in the larger economy. Not only did these technologies introduce a broad variety of products and services but a shortening of the half life of products, and a need to rush ideas to markets in ever shorter times. These developments have far-reaching impacts on both the production system and the transportation system.

On the transportation side, firms, aided by deregulation, have responded to this high level of technological uncertainty and market volatility with new logistical systems. Now, just-in-time deliveries of customized commodities at the moment they are needed require flexibility as well as information handling and prompt decisionmaking among networking firms. This restructuring of the transport sector will continue with greater use of IT.

On the production side, many manufacturing firms are responding to the changing demand for new products by becoming what might be termed "knowledge coordination centers." These firms use a wide network of other firms that are suited to the rapidly expanding technologies and the growing diversity of demand. In other words, new products (with short half lives) are made by a frequently changing coalition of firms. For the transportation industry, this means that *what is transported will frequently change*. In effect, a trend that is emerging from the use of new logistical systems is that, in growing parts of the economy, commodity flow patterns may be *variable and unpredictable*.

For such emerging production and transportation systems to continue to operate efficiently, there is a need to coordinate the wide variety of actors -- shippers, carriers, other private service providers, public actors at different governmental levels, ports, airports and others -- in large intermodal networks. A challenging problem is to lower costs and add value along an entire network, where the relevant assets are controlled by many private and public actors.

Two important points are evident. First, the ability of the different actors to effectively communicate, cooperate, or compete will require *efficient connections among different modes*. In other words, efficiency improvements in the dynamic transport industries could require improved coordination among different public and private actors -- implying the need for *institutional innovations*. Second, it is clear that the transportation system as a whole is more critical than any one part.

Spatial changes. Spatial changes are a corollary of the above-mentioned sectoral and structural changes. One of the more swift and dramatic spatial shifts in the last decade and a half is the recent east-west Pacific-oriented flows of freight in the United States. This is dramatically

illustrated by the growth of intermodal container traffic through East Coast and West Coast ports. In 1980, the Port Authority of New York and New Jersey oversaw the largest volume of container traffic in the country, double the combined traffic through the ports of Los Angeles and Long Beach. The relationship was reversed by 1993, with Los Angeles and Long Beach handling twice the traffic as New York. Given the quickening pace of changes, other spatial shifts could be expected.

External changes. In a globalizing U.S. economy where exports are increasingly important, the likely explosive growth in population, urbanization, and the consequent transportation demand in Asia and Latin America offer big opportunities for U.S. export of vehicles, engineering services, technologies, and management services. These developments may lead to more business travel and freight movement.

Implications

The transportation system at the turn of the millennium offers us fresh challenges. Although we believe there will be *sectoral, structural, spatial, and external shifts in the next decade or so,* our ability to predict their exact nature is limited. While the moderate aggregate growth forecast suggests a strategy that includes capacity expansion, the somewhat uncertain compositional changes may require flexible responses to changing situations.

The U.S. Congress anticipated this need when it enacted ISTEA, which provides for flexible, management-oriented strategies in addition to investment-oriented capacity expansion. In ISTEA, Congress emphasized consideration of technology, information, management, flexibility, and an inclusive coordinating form of decisionmaking at the state and local levels.

Congress also created BTS in order to develop the information and knowledge base necessary to support strategic decisions by key private and public transportation actors in such a distributed system of decisionmaking.

The forces and trends we describe were beginning to be evident even in 1991 as ISTEA was formulated. These forces and trends are continuing and are likely to strengthen as the technology and organizational forces play out in the future. The flexible ISTEA strategy is a good hedge against the uncertainty that is likely to confront us in the next decade and beyond.

Mr. Chairman, this concludes my prepared remarks.

Box 1: Cost Savings from Investment in the U.S. Federal Highways

Between 1950 and 1973, the stock of U.S. federal highways grew from $44.3 billion to $185.8 billion (in 1973 dollars), which, with a 12-percent interest rate and 25-year lifetime, would yield an annual capital cost of $17.8 billion. One study estimated a cost function for the Class I trucking industry over this period that yielded a cost elasticity of -0.07 for highway capital.[1] Then, with simulation techniques, they explored the value of cost savings for the entire trucking industry over this 24-year period.

If alternative assumptions are made about the price elasticity of demand for freight transport and the social discount rate for public investment in highways, the cost elasticity of the infrastructure (-0.07) implies savings in the cost per revenue ton-mile carried by the trucking industry from 0.038 cents in 1950 and to 1.93 cents by 1973. These figures represent an annual saving of 19.3 percent (or $9.73 billion) for transport (at 1973 levels) on 1950 highway infrastructure.

The table below shows the cost savings for Class I trucking firms alone from the Interstate Highway System under alternative assumptions about the price elasticity of freight transport and the social discount rate for highway investment. In the more pessimistic case, which assumes a high price elasticity (-2) for freight transport and a high social discount rate (12 percent), one-third of the cost of the Interstate system can be counted as a cost savings just to Class I trucking firms. Under the reasonable case of -1 price elasticity and a 6 percent social discount rate, 72 percent of the cost of highways can be counted as savings to the same firms. These estimates do not include the benefits to passengers or those obtained from the improved quality of freight service.

Scenarios	Assumptions	Cost savings for Class I trucking firms only
I.	"Pessimistic" case (a) High elasticity of freight carriage to be -2 (b) High social discount rate (12%) for highway investments	33% of the total capital cost of the Interstate Highway System ($5.97 billion)
II.	(a) Price elasticity of freight carriage to be -1 (b) High social discount rate (12%) for highway investments	44% of the total capital cost of the Interstate Highway System ($7.85 billion)
III.	(a) Price elasticity of freight carriage to be -1 (b) Social discount rate (6%) for highway investments	72% of the total capital cost of the Interstate Highway System ($12.84 billion)

Source: U.S. Department of Transportation, Bureau of Transportation Statistics, *Transportation Statistics Annual Report 1995* (Washington, DC: 1995), p. 169.

[1] T.E. Keeler and J.S. Ying, "Measuring the Benefits of a Large Public Investment; the Case of the U.S. Federal-Aid Highway System," *Journal of Public Economics*, vol. 36, 1988, pp. 69-85.

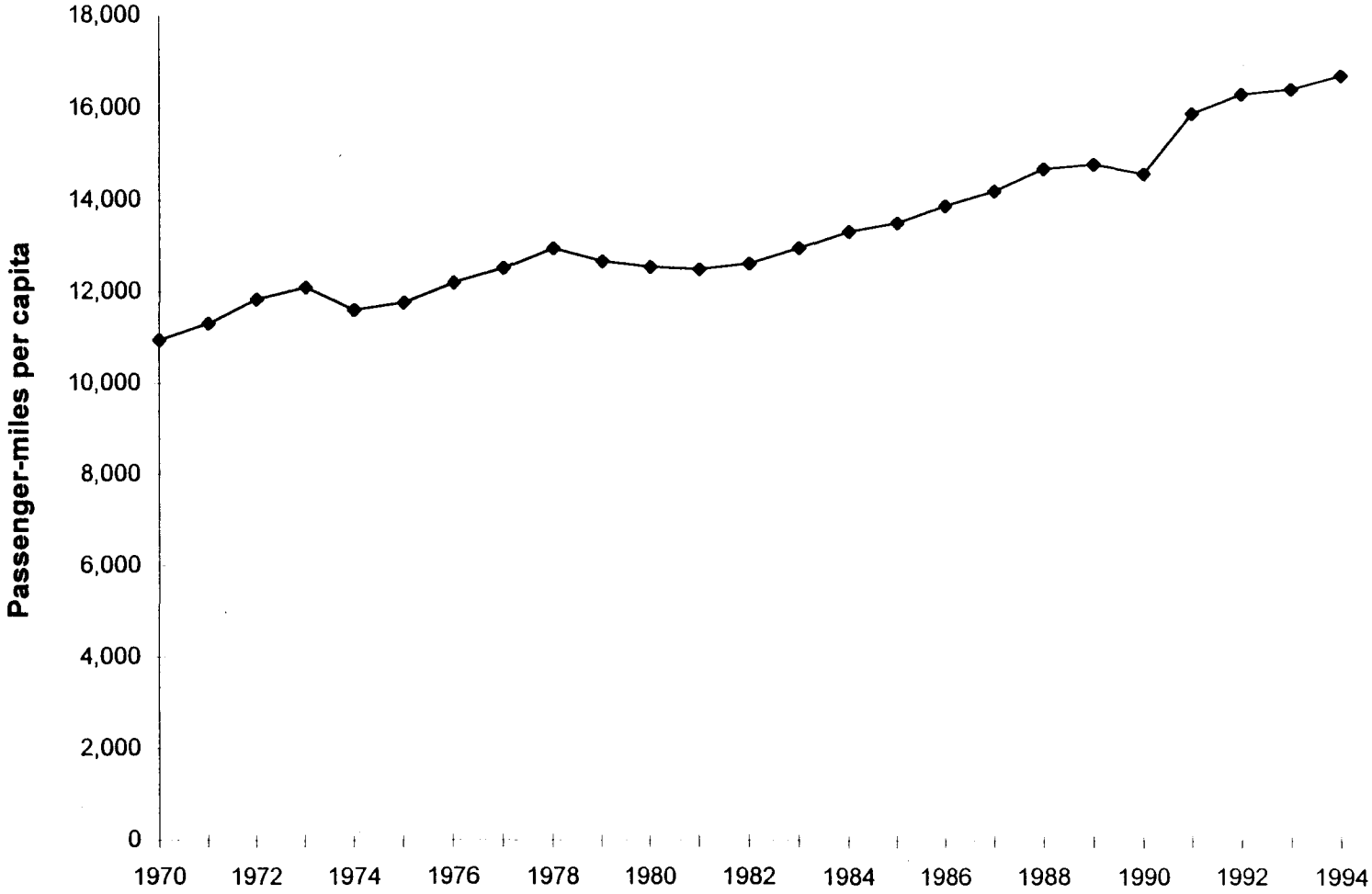
Table 1: Summary of Output and Cost Elasticities of Highway and Other Public Capital in Various Countries

Country	Sample	Infrastructure measures	Elasticity range
United States	aggregate (ts)	public capital	output: 0.05 to 0.39
	states (xs)	public capital	output: 0.19 to 0.26
	states (ts/xs)	highway capital	output: 0.04 to 0.15
	regions, trucking	highway capital	cost: -0.07
Japan	regions (ts/xs)	transportation and communication infrastructure	output: 0.35 to 0.42
United Kingdom	aggregate (ts)	public capital	cost: negative, statistically significant
France	regions (xs)	public capital	output: positive, statistically significant
Germany	industry (ts/xs)	public capital, highway capital	cost: negative, statistically significant
India	aggregate (ts), states (xs)	economic infrastructure: roads, rail, electric capacity	cost: -0.01 to -0.47

Note: ts=time series, xs=cross section

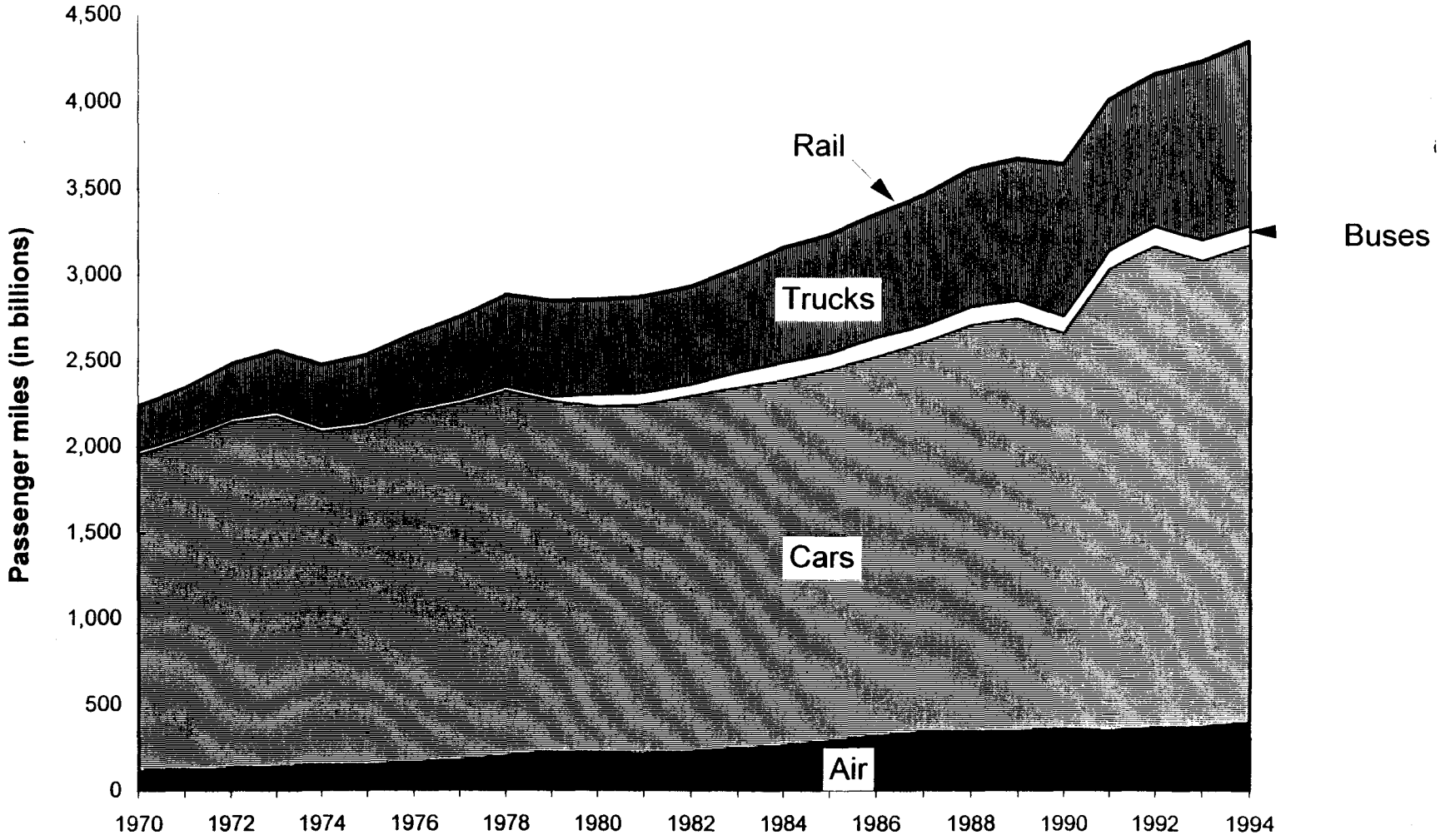
Source: U.S. Department of Transportation, Bureau of Transportation Statistics, *Transportation Statistics Annual Report 1995* (Washington, DC: 1995), p. 171.

Figure 1: Trend of passenger travel propensity in the U.S., 1970-1994



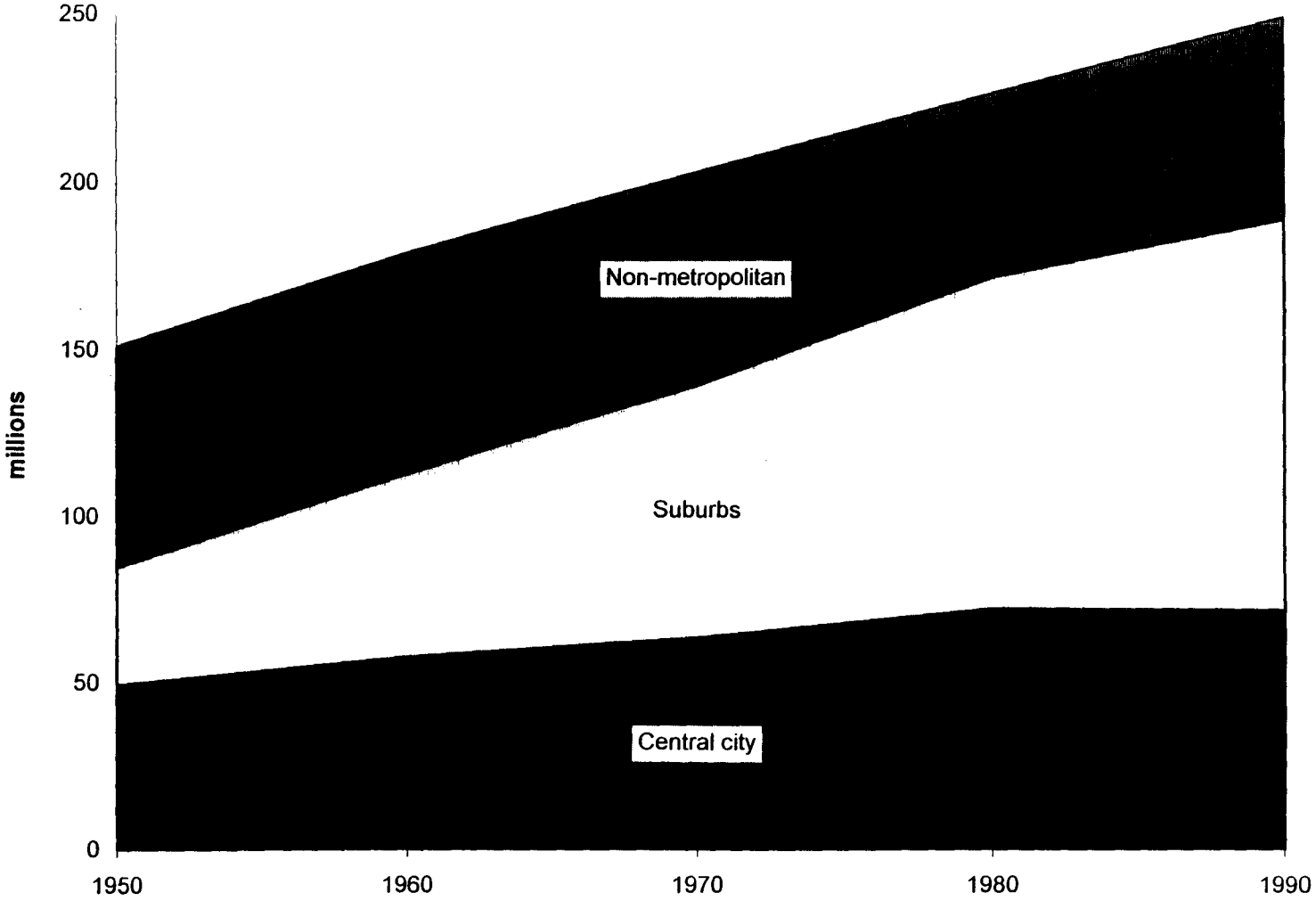
Data Source: BTS, *National Transportation Statistics, 1996*, Table 6, and Bureau of the Census, *Statistical Abstract of the United States, 1995*, Table 2.

Figure 2: U.S. passenger transportation by mode, 1970-1994



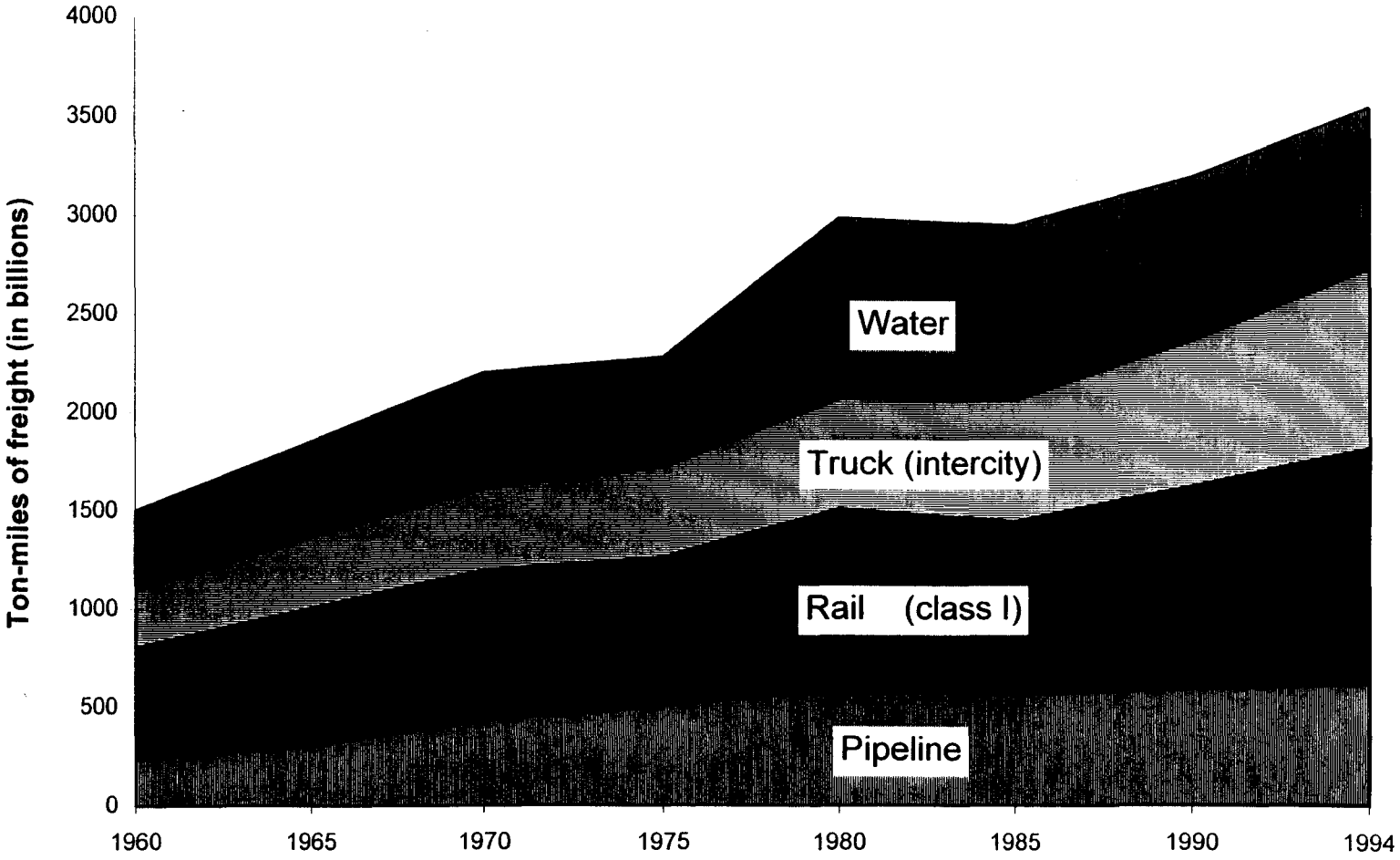
Data Source: BTS, *National Transportation Statistics, 1996*, Table 6.

Figure 3: U.S. Population by Place of Residence: 1950-1990



Source: Alan E. Pisarski, *Commuting in America*. (Washington, DC: Eno Foundation for Transportation, forthcoming)

Figure 4: U.S. freight transportation by mode, 1960-1994



*: Air freight was about 12 billion ton-miles in 1994, less than 0.4% of the total.

Data Source: BTS, *National Transportation Statistics, 1996*, Table 7.

Figure 5

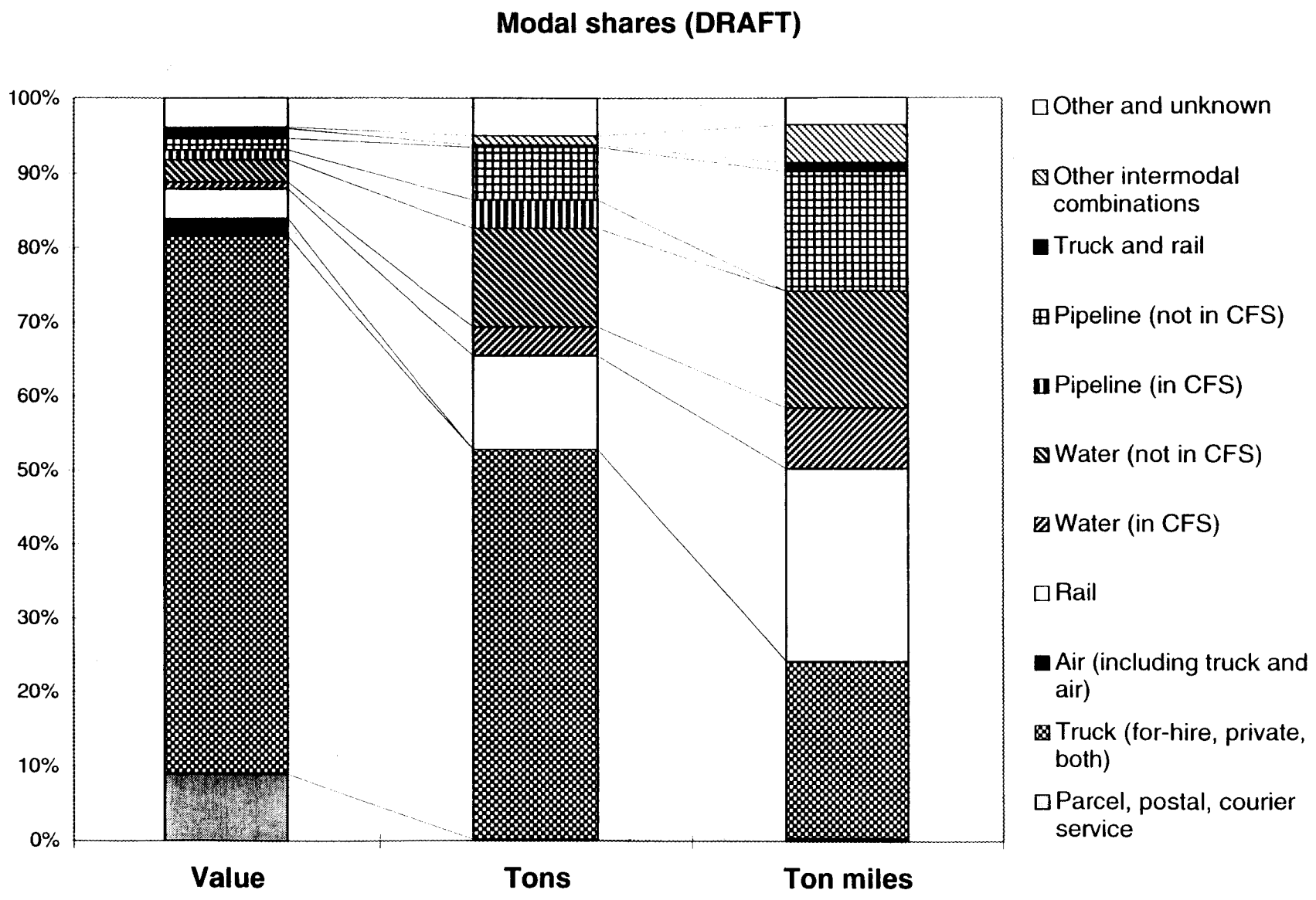

Modal shares (DRAFT)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Value
Tons
Ton miles
Other and unknown
Other intermodal combinations
Truck and rail
Pipeline (not in CFS)
Pipeline (in CFS)
Water (not in CFS)
Water (in CFS)
Rail
Air (including truck and air)
Truck (for-hire, private, both)
Parcel, postal, courier service

Figure 6: Trends of labor productivity

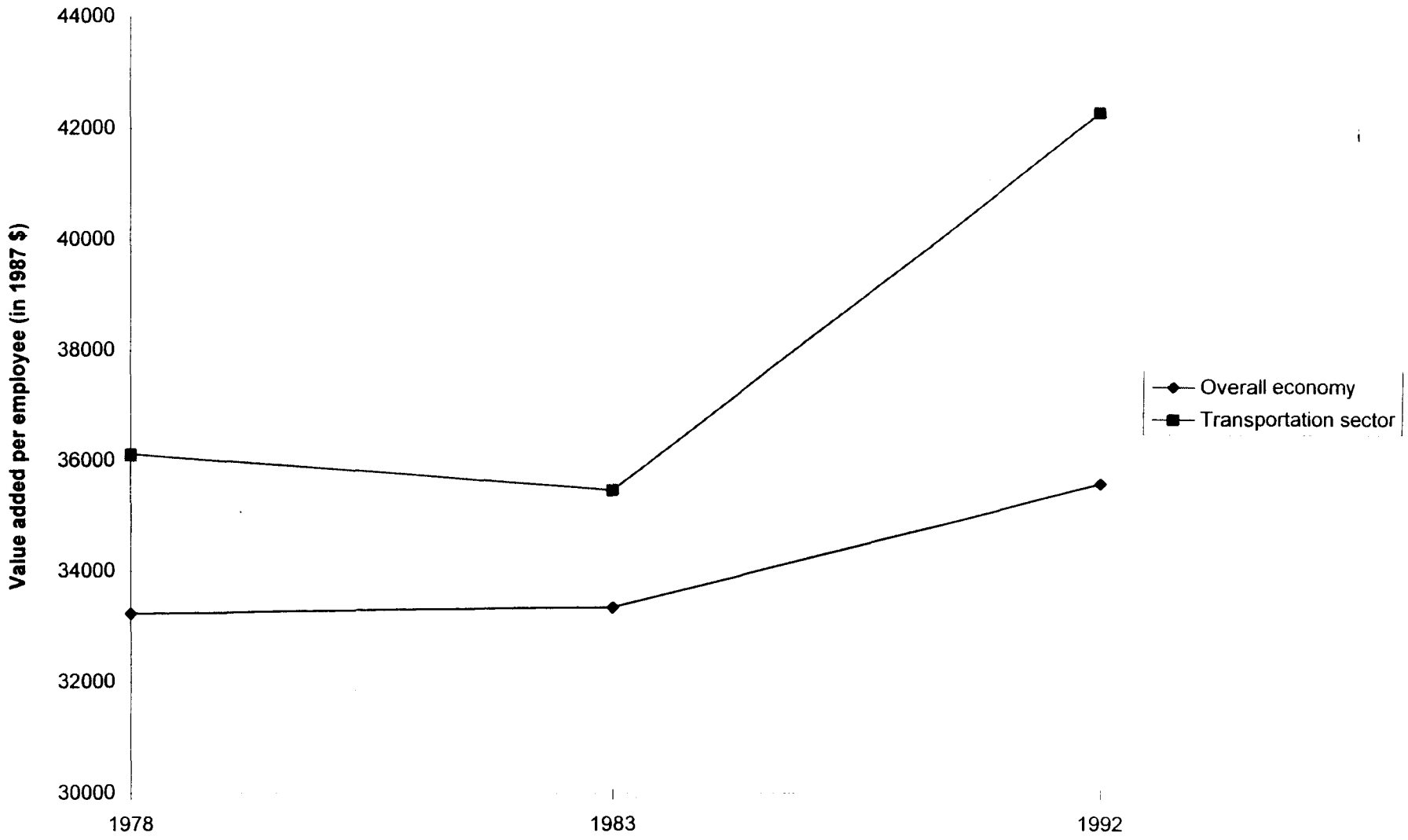
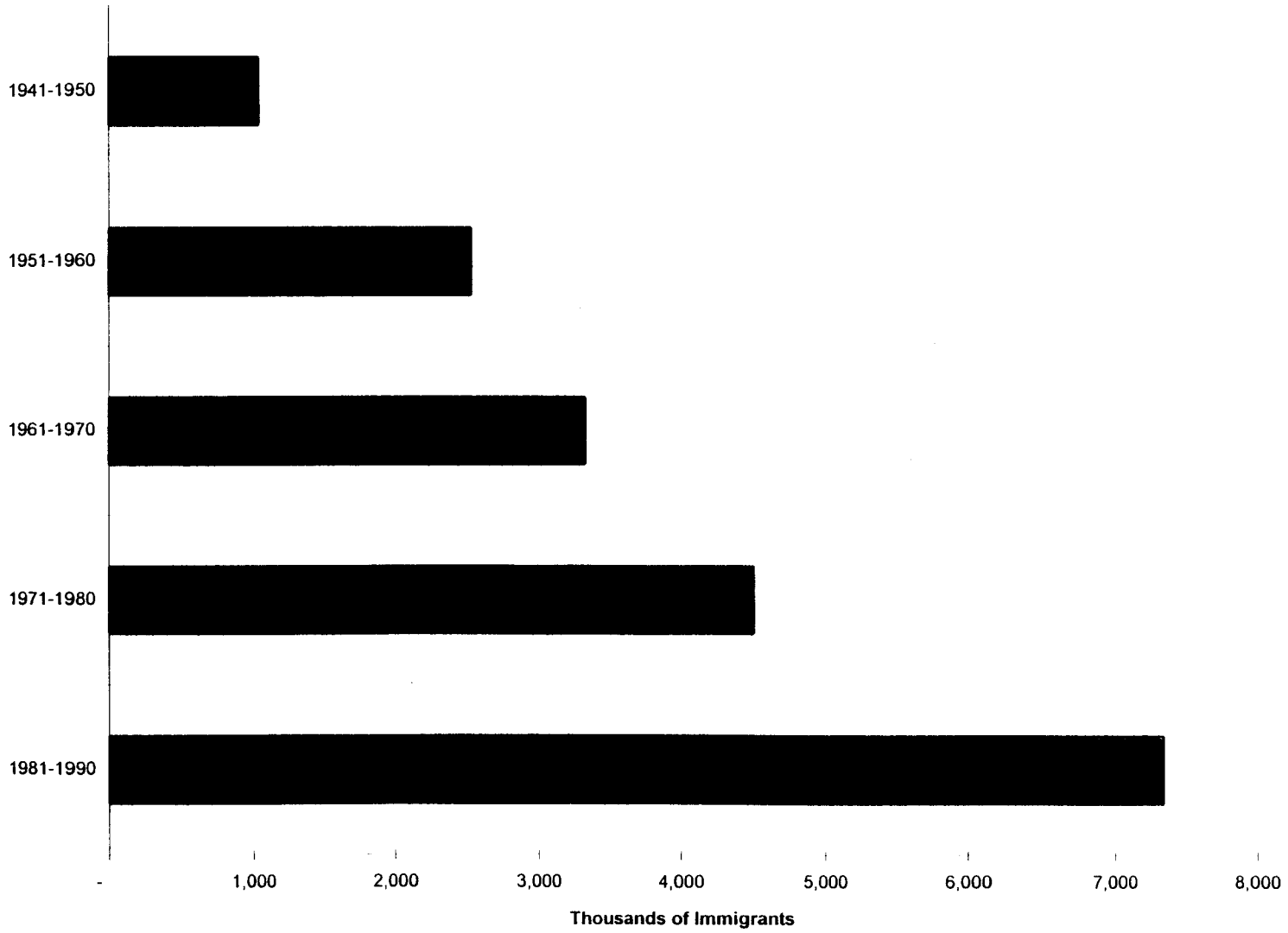



Figure 7: Foreign Immigration, 1941 - 1990