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World Motor Vehicle Demand

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16. Abstract

This report discusses the level and nature of world motor vehicle demand for the period 1980-1990. A general understanding of the structure of motor vehicle demand is developed. Published demand forecasts, varying widely, are gathered and their discrepancies explained. Based on analyses of individual nation motor vehicle registrations, sales data, economic variables, and energy situations, together with the general determinants of vehicle demand, sub-regional and regional demand forecasts are developed into a "most likely forecast range."

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PREFACE

This report was prepared for the National Highway Traffic Safety Administration in response to PPA HS-272, "Motor Vehicle Economics, Market Demand and Usage, Task 3: World Demand."

METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
in	inches	2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
	AREA			
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
	MASS (weight)			
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
	VOLUME			
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
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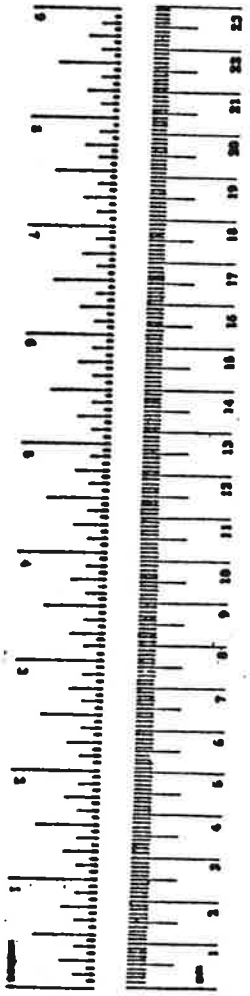
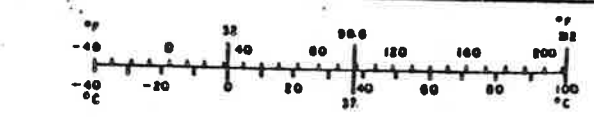


Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
	AREA			
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
	MASS (weight)			
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
	VOLUME			
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
	TEMPERATURE (exact)			
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



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EXECUTIVE SUMMARY

This report discusses the level and nature of world motor vehicle demand for the period 1980-1990. A general understanding of motor vehicle demand begins with the recognition that vehicle demand is a derived demand for mobility, representing a desire for access to spatially separated goods and services. The prevalence of traditional (e.g., public transit and bicycles) or nontraditional (e.g., electric vehicles) alternatives impacts new vehicle demand. Without an infrastructure, motor vehicles and alternatives would be impotent. The cost and availability of energy is an equally critical determinant of motor vehicle demand. The nature of economy (planned vs. market) has important implications for the level and composition of vehicle demand. Government policy can be the dominant force in shaping demand, because of its potential control over energy, infrastructure, and the economy. Finally, economic variables (e.g., income and unemployment) cannot be ignored.

World motor vehicle demand peaked in 1978, and since has declined or stagnated in all regions of the world. A survey of published forecasts yields the following sales ranges:

New Car Sales (millions)

	1978*	1980*	1985	1990
North America	12.3	9.9	9.9-12	8 -17.7
Western Europe	10.3	10.0	10-12	9 -15.6
Japan	2.9	2.9	2.5- 3.5	2 - 5.8
Rest of World	5.7	5.5	5.5-16	5.5-27
Total	31.2	28.3	27.9-43.5	24.5-66.1

*Actual Sales

New Truck Sales (millions)

	1978*	1980*	1985	1990
North America	4.4	2.8	2 - 3	1.5- 6.4
Western Europe	1.2	1.3	1 - 1.3	0.9- 2.1
Japan	1.8	2.1	1.6- 2.1	1 - 3.1
Rest of World	3.1	3.3	3.3- 8	3.3-15
Total	10.5	9.5	7.9-14.4	6.7-26.6

*Actual Sales

The variations between these forecasts are great, ranging up to 400%. In general, forecast uncertainty is greater for the truck forecasts, for the 1990 forecasts, and especially for the "rest of world" forecasts. These forecasts differ greatly because some forecasters ignore the demand limitations to be found within a general understanding of the nature of motor vehicle demand (e.g., alternatives, derived demand, infrastructure, energy, nature of economy, and government policy), and overemphasize macro-economic and trend variables. This approach leads to unrealisticly high forecasts.

This report analyzes individual nation vehicle registrations, sales data, economic variables, and energy situations together with the general considerations outlined above. Individual nation forecasts are developed, and then sub-regional and regional forecasts are formulated. A summary of the conclusions is:

North America

1980 Sales: 9.9 million cars, 2.8 million trucks

- o United States is major market (90%)

Analysis:

- o Energy future uncertain
- o Infrastructure deteriorating
- o Limited economic growth
- o Increasing prevalence of motor vehicle alternatives

Most Likely Forecast Range: 9.5-12 million cars, 3-4 million trucks

Western Europe

1980 Sales: 10.0 million cars, 1.3 million trucks

Analysis:

- o West Germany, France, Italy, and United Kingdom are major markets
- o With exception of United Kingdom, Western European countries in vulnerable oil positions
- o Infrastructure less developed than in North America
- o Limited economic growth
- o High usage of vehicle alternatives
- o Little recreational usage of trucks

Most Likely Forecast Range: 9.5-12 million cars, 1-1.5 million trucks

Japan

1980 Sales: 2.9 million cars, 2.1 million trucks

Analysis:

- o Very vulnerable to oil shocks (85%+ imported)
- o Economic success story already fading, though forecasted income growth is still relatively high
- o Increasing worldwide trend of protectionism will limit Japanese export growth
- o Because of mountainous terrain, Japan is densely populated in crowded urban clusters (physical constraints on parking)
- o Tremendous usage of the motorcycle alternative (2.4 million sales in 1980)
- o Industrial sector truck usage is already near a maximum

Most Likely Forecast Range: 2.5-3.0 million cars, 2-2.5 million trucks

REST OF WORLD:

Oceania

1980 Sales: 0.5 million cars, 0.15 million trucks

Analysis:

- o Australia and New Zealand are major markets
- o Oceania market closely resembles those of the developed countries of North America and Western Europe
- o Very high registration levels indicate the market is mature

Most Likely Forecast Range: 0.5-0.6 million cars, 0.15-0.20 million trucks

Eastern Europe

1980 Sales: 2.1 million cars, 1.2 million trucks

Analysis:

- o Soviet Union is major market (40% of cars and 70% of trucks)
- o Planned economies deemphasize private automobile transportation and emphasize truck production for industrial sector
- o Poor infrastructure and related services
- o Eastern European economies are weak, highlighted by recurrent crop failures

Most Likely Forecast Range: 2.1-2.3 million cars, 1.1-1.4 million trucks

Latin America

1980 Sales: 1.6 million cars, 0.6 million trucks

Analysis:

- o Brazil, Mexico, Argentina, and Venezuela are major markets
- o Hyper-inflation and political instability have traumatized economic confidence
- o Economic future clouded because of energy costs and crop vulnerability (notably coffee beans), though Venezuela and Mexico (with their oil reserves) could be exception
- o Infrastructure inadequate, and its development will be hindered in this large and geographically diverse area

Most Likely Forecast Range: 1.6-1.9 million cars, 0.6-0.8 million trucks

Africa - Mideast

1980 Sales: 1.0 million cars, 0.75 million trucks

Analysis:

- o Rep. of South Africa and Saudi Arabia are major markets
- o Economic outlook bright for some (OPEC members), but dismal for much of area, largely due to energy costs
- o Infrastructure needs to be developed - who will pay?

Most Likely Forecast Range: 1.0-1.2 million cars, 0.7-1.0 million trucks

Asia (Excluding Japan)

1980 Sales: 0.4 million cars, 0.5 million trucks

Analysis:

- o Malaysia, Taiwan, South Korea, and Indonesia are major car markets; China and India are major truck markets
- o Area lacks an infrastructure, and the resources and predisposition to develop one
- o Existing demand emphasizes heavy-duty trucks
- o Area of greatest long term potential (if one looks only at population), but if affluence is also considered this does not look like a substantial market for years to come

Most Likely Forecast Range: 0.4-0.5 million cars, 0.5-0.6 million trucks

These individual region and sub-region forecast ranges can be summarized into a world "most likely forecast range." This represents the most likely course of world demand for the period 1985-1990.

Most Likely Forecast Range of 1985-1990 Demand (millions)

	Cars	Trucks	Total
North America	9.5-12	3 - 4	12.5 -16
Western Europe	9.5-12	1 - 1.5	10.5 -13.5
Japan	2.5- 3	2 - 2.5	4.5 - 5.5
Rest of World:			
Oceania	0.5- 0.6	0.15- 0.20	0.65- 0.8
Eastern Europe	2.1- 2.3	1.1 - 1.4	3.2 - 3.7
Latin America	1.6- 1.9	0.6 - 0.8	2.2 - 2.7
Africa-Mideast	1.0- 1.2	0.7 - 1.0	1.7 - 2.2
Asia (Excl. Japan)	0.4- 0.5	0.5 - 0.6	0.9 - 1.1
Total	27.1-33.5	9.1 -12.0	36.2 -45.5

1. INTRODUCTION

The purpose of this report is to discuss the level and nature of world-wide motor vehicle demand. The scope is world-wide demand through 1990, but it is inevitable that all demand aspects in every nation of the world cannot be explored. At best, this report will serve as a basis for further research.

The report begins with a brief discussion of the general nature of motor vehicle demand. The discussion encompasses those considerations that must be taken into account when assessing and forecasting motor vehicle demand. These considerations are not unknown in the literature, yet they are not frequently stated in forecasting, especially when an econometric methodology is used. This discussion will highlight these considerations so that the reader may assess the following demand forecasts against the backdrop of the structure of motor vehicle demand.

Section 3 is a summary of published world-wide motor vehicle demand forecasts for the period through 1990. A short discussion of why these forecasts differ is included.

Section 4 is an analysis of world-wide motor vehicle demand. The section analyzes individual nation sales and registration data, economic variables, and energy situations, together with the general considerations (Section 2 above) relevant to each market.

Based on the analyses of Section 4, individual nation forecasts are formulated into sub-region and region forecasts in Section 5. This section also contains a summary of the analysis leading to each forecast.

Section 6 is a summary of the sources and methodologies of the published forecasts in this report.

2. GENERAL CONSIDERATIONS

This section presents a brief discussion of the nature of motor vehicle demand. These considerations are always present, whether a forecaster explicitly, tacitly, or not at all acknowledges their relevance to motor vehicle demand. All forecasts should be read and assessed against this backdrop.

2.1 DERIVED DEMAND

At its most general level, motor vehicle demand is nothing more than a derived demand for mobility.[1]* Other than pleasure driving, motor vehicle demand represents a desire for access to spatially separated goods and services. The derived nature of motor vehicle demand is generally understood in the commercial sector, where transportation is typically viewed as one factor input to the production process, but this relationship is usually ignored in the household sector.

To the extent that economic agents become more widely dispersed, this derived demand should increase. Thus, the motor vehicle demand growth of the 1960s and 70s was intimately linked to the development of the suburban rings.[2] Correspondingly, the process of gentrification, all else remaining unchanged, should lead to lessened demand. As far back as Adam Smith, the importance of distinguishing the derived "use" of transportation from the physical media of transportation has been recognized.[3,4] Hence, forecast research focusing on a physical medium (e.g., the motor vehicle) implicitly ignores alternative means for satisfying the derived demand for mobility. This insight has serious implications for the soundness of any forecasting methodology that fails to consider alternative modes of transportation.

*Superscripts refer to references given in the Reference section at the end of this report.

2.2 ALTERNATIVES

Motor vehicle alternatives can be classified generally as either traditional or non-traditional. Traditional alternatives to the new automobile include the used car, public transit, bicycles, motorcycles, mopeds, and even perambulation. For intercity travel, airplanes, passenger rail, and buses are traditional alternatives. Truck alternatives, for industrial purposes, include rail and waterway transport.

Obviously, the prevalence of any of these alternatives varies greatly among countries and even within a country, and is strongly related to an individual country's cultural orientation. For example, public transportation usage in the United States declined steadily from 1940 through 1977 (though it has since risen),[5] while public transit usage in European countries and Japan has traditionally stayed high.[6]

The used vehicle alternative to a new motor vehicle is almost always available to a consumer, and is frequently the primary market for less affluent consumers. The used vehicle alternative has implications for the cyclical nature of new vehicle demand in mature markets. In 1980, there were more than 18.6 million used car sales in the United States, making the used market twice as large as the new market.[7]

The bicycle is the best example of an alternative mode of transportation whose usage varies tremendously across nations. In the United States, its usage for work-related trips is minimal. Yet in China, the bicycle is so pervasive in the total transportation scheme that it can hardly be termed an alternative.[8] This illustrates well the role of cultural orientation in determining travel modes, though it is probably also related to a relatively low level of income in China.

Motorcycle and moped transportation have met only a small segment of United States transportation demand to date. Many marketing experts expect this to change in an environment of high-priced cars and gasoline. To this end, there is a growing

tendency for American dealers to offer motorcycles and mopeds alongside their new motor vehicles, which has long been common practice in other parts of the world. As one motorcycle executive says: "Our scooters are really sub-compacts - two-wheeled cars, a natural development in the downsizing scheme."[9]

Non-traditional alternatives to motor vehicle transportation include new technologies and radical lifestyle changes. Electric vehicles, although not truly constituting a "new" technology, are included here because improvements, especially battery upgrading, are expected to make this alternative more practicable. Current United States demand for battery-operated cars is less than 2,000 units per year. Predicasts[10] forecasts that this will jump to 100,000 units by 1990, and further grow to 900,000 units by 1995. Predicasts attributes this growth to the cost and availability of energy, and to financial incentives for producers.

Other forecasts[11] are even more optimistic. DOE pegs today's potential electric vehicle annual market at 600,000 units. Arthur Andersen and Co. places 1990 demand at 600,000 to 625,000 vehicles. Reinheimer Nordberg, Inc. expects the electric vehicle market of the late 1980s to be from 1 to 5 million units a year. Were even a portion of this growth to be realized, electric vehicles could account for a significant share of total United States demand by 1990. The potential for the electric alternative in other economies is probably much lower, mainly because electric vehicles are more practical for two- and three-vehicle households which would use their electric vehicle for short-range driving.

A lifestyle change can be considered an alternative to motor vehicle transportation if it reduces job-related travel. Thus, as satellite-based communications systems improve, making it possible for some workers to be physically absent from the office while still performing their jobs, employment-related transportation demand will lessen. It is an open question whether such a development would decrease total transportation demand, because it could be compensated for by increased pleasure and other travel.

The growth in any of these alternatives depends on a myriad of factors, including relative costs, convenience, utility, available infrastructure and social acceptance. Predicting the growth in any one alternative is extremely difficult, perhaps impossible, but recognizing that the entire package of alternatives could exert downward pressure on motor vehicle demand is possible and necessary. Forecasters are obligated to do at least this much.

2.3 INFRASTRUCTURE

Motor vehicles and alternatives are impotent in a vacuum. Motor vehicles and alternatives can only provide transportation service in the context of the appropriate infrastructure. The requisite infrastructure might be as simple as a bicycle rack, or as complicated as the network of highways, streets, roads, bridges, parking facilities, service facilities, and land use configurations needed by motor vehicles. The development of an infrastructure is intimately linked to motor vehicle demand. Most of the motor vehicle infrastructure can only be provided through collective, i.e., governmental, action. Thus, motor vehicle demand growth involves both individual consumer choice and broad public policy decisions that are made by the individuals, collectively, through their representatives in government. When government is unwilling or unable to act, motor vehicle demand growth will be limited.

The importance of an infrastructure can be seen by examining the United States historical experience. The U.S. currently has the highest level of motor vehicle ownership in the world, and the most highly developed vehicle infrastructure. Since 1900, growth in United States demand has been paralleled by a concomitant increase in the level and quality of the motor vehicle infrastructure. Elliott Sclar,[1] in a paper written for the Transportation Systems Center, traces the development of motor vehicle demand in the United States as it relates to the American infrastructure. Sclar concludes that the existence of a motor vehicle infrastructure is one of two principal determinants of future world motor vehicle demand growth, the other being the price of fuel.

A motor vehicle infrastructure is expensive, but the costs must be incurred if a motor vehicle-based society is to develop. The infrastructure is the first step in an economy's movement toward the motor vehicle as the primary mode of personal transportation. Currently, a number of the less-developed countries are beginning to develop a motor vehicle infrastructure as motor vehicle demand grows in their nations. These expenditures are being financed to a large extent by outside agencies. For example, millions of dollars in World Bank loans and International Development Agency credits have been approved recently for road and highway development in countries such as Morocco, Papua New Guinea, Ivory Coast, Pakistan, Senegal, and others.[12]

Infrastructure expenditures are not a one-shot deal. Many millions of dollars are required each year for maintenance and repair. This is especially evident with a mature infrastructure, as in the United States. Some analysts feel that the United States has more roads and bridges than it can afford to maintain. "In future years, damage inflicted by deteriorating streets and highways could rival high gasoline prices as a cause of spiraling car-ownership costs."[13]

The gist of this infrastructure discussion is that for forecasting purpose it is not enough to consider only individual motor vehicle demand. There must be a corresponding recognition of how the individual's choice relates to a broader societal predisposition for creating the necessary infrastructure. A public policy against development or maintenance of the motor vehicle infrastructure can depress motor vehicle demand just as surely as individual choice or high vehicle and gasoline prices.

2.4 ENERGY

The cost and availability of energy is an equally critical determinant of motor vehicle demand. Oil prices have two distinct effects, one being microeconomic and the other macroeconomic. As oil prices rise, the pump price of gasoline increases, causing an increase in the cost of vehicle operation. When ownership and

operating costs rise relative to the general price level, consumers cut back on vehicle consumption.

Perhaps more importantly, oil prices have a second, macroeconomic, effect as well. Developed industrial market economies have a very broad-based reliance on oil as a source of energy. Oil, or another energy source, is a factor input to virtually every production process, and is also required in conjunction with supplying most services. As oil prices rise, there are economy-wide increases in the costs of goods production and supplying services. When the price increases are steady and predictable, no major disruptions occur, and managers can switch from oil to alternative energy sources when and if a switch becomes economically rational. But when oil price increases are sharp and unforeseen, managers cannot quickly switch to other energy sources. Nor can managers, in the short run, redesign each production process to use relatively less energy and relatively more of, say, labor. The result is greatly increased supply costs, leading to inflation and unemployment.

When an economy imports a substantial fraction of its petroleum needs, rising oil costs can lead to burgeoning trade deficits. In this instance the governmental response can mitigate or exacerbate the imbalance and associated hardships. For example, the Japanese response was to increase exports and restore trade balance (see Section 4.4.1). On the other hand, the North American response was to induce internal deflation (see Section 4.2.1). In the developing countries, costly energy can be even more traumatic: entire economies may be disrupted or even destroyed (see Section 6.6).

2.5 NATURE OF ECONOMY

There are important distinctions between the structure of motor vehicle demand in planned and market economies. To a large extent, demand in planned economies is dictated by a central planning agency, and is not responsive to individual consumer demand. In these economies, resources tend to be directed toward

public modes of transportation and heavier, work-related vehicles. This is usually accompanied by an under-investment in motor vehicle infrastructure, resulting in poor road quality and availability.

Personalized transportation--the motor vehicle--is more compatible with market-oriented economies in which consumer choice is the keystone of the economic decision process. To the extent that market economies tend to be more affluent than planned economies, they are also more able to pay the high infrastructural costs required by the motor vehicle. For the forecaster, the implication is that, to the extent that developing countries evolve as planned economies rather than market economies, lower levels of motor vehicle ownership and growth can be expected for any given level of income and other variables.

2.6 GOVERNMENT POLICY

Government policy probably plays the single most important role in motor vehicle demand because of its ability to determine oil prices and infrastructural development. As already mentioned, concerted government action is required to develop an adequate infrastructure. Government policy can largely determine the price of gasoline, through deregulation, price controls or taxes. Fiscal and monetary policies impact demand, most obviously through the level of interest rates and the degree of general economic prosperity. Safety, emissions, and fuel economy regulations can have an indirect effect on vehicle cost and hence demand. In addition, trade barriers and regulation play an important role in determining both in the level of motor vehicle demand and the composition (import/domestic) of demand. Government policy is at its most important in the planned economies, where government manipulation of economic agents can affect vehicle demand in spite of market forces. Ironically, the most important factor in vehicle demand, government policy, is the most difficult to predict, because future government policy will depend on future market conditions and the political/bureaucratic response to those market conditions.

2.7 FORECASTING

It is an ardouous if not impossible task to build all the foregoing considerations into a forecasting methodology. Many are not objectively measurable, or require assessments of collective predisposition. Even when a condition is obviously present, such as an explicit trade barrier, reasonable persons can disagree as to its effect on current and future demand. Faced with these difficulties, most traditional forecasters have chosen to concentrate on several easily quantifiable factors as the prime determinants of motor vehicle demand. These typically include an income variable, some demographics (such as number of households, or driving age population), cost data, and perhaps an energy price variable. The methodology can be vastly more sophisticated--the Wharton model includes more than 400 variables and 600 equations--but the emphasis usually remains on income, costs, and population.

These variables surely have an impact on the level of motor vehicle demand, but to what extent? Sclar[1] found that, in general, motor vehicle demand is more highly correlated with income per capita than with population. This is especially true for those countries having a population in excess of 30 million persons. Thus, the standard econometric models are to some degree vindicated. Sclar cautions, however, that this "...illustrates at once the strength and weakness of the principal variables used to forecast motor vehicle demand. Their strength rests upon the fact that singly, or more usually together, they can explain a great deal of variation [in registration levels between countries]. However, in terms of building a model capable of forecasting the intermediate to long-term, they leave too much 'unexplained.'"[1]

Sclar found also that income per capita does not explain truck demand as well as it does car demand. Higher truck demand seems to be associated with two very different scenarios: light truck demand is primarily associated with recreational activities and light-duty work chores, while heavy duty truck demand is more

readily fostered in planned economies, which emphasize common carrier capabilities and the production rather than the consumption side of the economy.

This Section has discussed the general nature of motor vehicle demand and the factors that every forecaster must consider. If one or more of these factors is ignored by forecasters, they are implicitly assuming that the factor(s) will exert the same influence on future demand as has historically been the case. Starkly presented, most forecasters probably would feel uncomfortable with this realization (see Section 6.7).

3. SUMMARY OF PUBLISHED FORECASTS

3.1 NEW CAR DEMAND

The peak year for world new car demand was 1978, and between then and 1980 car demand has declined or stagnated in all regions of the world (Table 3-1). The largest loser has been North America, but no region has escaped unscathed from the world demand erosion. For the developed countries, this was to some extent expected, as markets matured and demand became more cyclical. But for the "rest of the world," comprised largely of developing nations and those countries with planned economies, this demand decline was unexpected. For these countries, staggering energy price increases and general economic recessions seem to have stifled new car demand growth in the past three years.

Table 3-1 summarizes by year and region the entire range of published new car demand projections. The specific projections and sources from which this range was drawn are shown Table 3-2. By 1990, world demand is projected to total between 24.5 million and 66.1 million units. Projections for 1985 range from a low of 27.9 million to a high of 43.5 million units.

Table 3-3 summarizes, by region, the "uncertainty" within each of these ranges. The tremendous variance in the total demand projections is largely due to great uncertainty about future demand in the "rest of the world." With stagnation in this region there is virtually no growth for the automobile industry. With strong growth in this region a major expansion of the world automobile industry is a necessity.

In general, forecasters during the past year have revised downward their world car demand projections. Table 3-4 shows how one forecasting service, Economic Models, Ltd., has lowered its 1985 world demand projections in the past year. Projections for each region have been lowered by between 11 and 17 percent, with the world total down by 13 percent.

TABLE 3-1. SUMMARY OF LOW AND HIGH WORLD NEW CAR DEMAND AND PUBLISHED FORECASTS, 1978-1990 (IN MILLIONS)

Region	1978*	1980*	1985	1990
North America	12.3	9.9	9.9-12	8-17.7
Western Europe	10.3	10.0	10-12	9-15.6
Japan	2.9	2.9	2.5-3.5	2-5.8
Rest of World	5.7	5.5	5.5-16	5.5-27
Total	31.2	28.3	27.9-43.5	24.5-66.1

*Estimated actual sales.

Source: See Table 3-2.

TABLE 3-2. ACTUAL AND FORECASTED WORLD NEW CAR DEMAND, 1978-1990 (IN MILLIONS)

	Year Projected												
	1978	1980	1985				1990						
REGION	(1)	(1)	(2)	(3)	(4)	(9)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
North America	12.3	9.9	12.0	27-28	11-12	9.9	28-29	8.0-13.5	13.7-14.4	12.9	15.6	13.4-17.7	9.9
Western Europe	10.3	10.0	11.1		10-12	10.0		9.0-13.5	12.6-14.6	17.5	14.0	11.7-15.6	10.0
Japan	2.9	2.9	3.2		2.5-3.5	2.9		2.0-3.8	4.2- 5.8		5.3	3.7-5.0	2.9
Rest of World	5.7	5.5	7.6	8-10	9-16	5.5	12-14	15-27	10.3-14.2	6.4	15.5	9.0-17.8	5.5
Total	31.2	28.3	33.9	35-38	32.5-43.5	28.3	40-43	34-57.8	40.8-50.0	36.8	50.4	37.8-56.0	28.3

	Annual Growth Rates											
	1980/1978	1985/1980				1990/1980						
REGION	(1)	(2)	(3)	(4)	(9)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
North America	-10.3	3.9	3.4-4.2	2.1-3.9	0	2.1-2.4	-2.1-3.2	3.3-3.8	2.7	4.7	0.7-3.1	0
Western Europe	- 1.5	2.1		0-3.7	0		-1.1-3.1	2.3-3.9	3.1	3.4	1.1-3.5	0
Japan	0	2.0		-2.9-3.8	0		-3.7-2.7	3.8-7.2		6.2	2.1-4.7	0
Rest of World	- 1.8	6.7	7.8-12.7	10.4-23.8	0	8.1-9.8	10.6-17.3	6.5-10.0	1.5	10.9	3.9-9.9	0
Total	- 4.8	3.7	4.3-6.1	2.8-9.0	0	3.5-4.3	1.9-7.4	3.7-5.9	2.7	5.9	1.6-5.0	0

Sources:
(1) Estimated Actual Sales.
(2) Economic Models, Ltd., World Auto Forecasts Report, April 1981.
(3) Euro Finance, European Car Industry Report, 1980.
(4) Krish Bhaskar, The Future of the World Motor Industry, (New York: Kogan Page, and London: Nichols Publishing Company, 1980).
(5) "Industry" Projections.
(6) A. Gary Shilling and Company
(7) Predicasts, Inc., World Motor Vehicles, May 1978.
(8) Chase Econometrics, Automotive Division, reported in MVMA World Motor Vehicle Data, 1981 edition.
(9) "No-Growth" Projections.

NOTE: See Section 6, Sources and Methodologies of Published Forecasts

TABLE 3-3. WORLD NEW CAR DEMAND FORECAST "UNCERTAINTY"*

REGION	1985	1990
North America	21%	121%
Western Europe	20%	73%
Japan	40%	190%
Rest of World	191%	391%
Total	56%	170%

*Defined as the difference between the low and high forecasts from Table 3-1 divided by the low forecast -- $\frac{\text{High-Low}}{\text{Low}}$ -- and then expressed as a percentage.

TABLE 3-4. REVISED FORECASTS OF 1985 WORLD NEW CAR DEMAND (IN MILLIONS)

	March 1980 Forecast	April 1981 Forecast	Percent Change
North America	13.5	12.0	-11%
Western Europe	13.0	11.1	-12%
Japan	3.8	3.2	-17%
Rest of World	8.8	7.6	-12%
Total	39.1	33.9	-13%

Source: Economic Models, Ltd, World Auto Forecasts Report, March 1980 and April 1981.

By contrast, forecasts of United States demand for passenger cars have been increased during the past year (Table 3-5). In particular, the lower bound estimates for the mid- to late-1980s have been increased sharply. These more recent forecasts show a greater awareness of the current sales recession, but seem to have compensated for lowered 1981-82 sales forecasts by simply increasing all later year forecasts. The implication is that the forecasting services are not yet acknowledging a structural decrease in demand.

3.2 NEW TRUCK DEMAND

There are few published new truck demand forecasts. Sources of new car demand forecasts usually do not furnish truck forecasts. When forecasts are made, they are frequently vague generalizations, e.g., "the soft heavy-duty market."[14] This is probably because much less resources have been devoted to the study of new truck demand than to new car demand.

The peak year for new truck demand in North America was 1978 (Table 3-6). Since then, North American demand has plummeted by more than one-third, largely due to erosion in light truck demand (see Section 4.2.2). This 37 percent decline compares with a 17 percent decrease in North American new car demand during the same period. Unlike North America, however, every other world region experienced an increase from 1978 to 1980 in new truck demand. This underscores the fact that truck demand is less well correlated with economic prosperity than is new car demand (see Section 2.7).

Table 3-6 summarizes, by year and region, the entire range of published new truck demand projections. The specific projections and sources from which this range was drawn are shown in Table 3-7. By 1990, world demand is projected to total between 6.7 million and 26.6 million units. Projections for 1985 range from a low of 7.9 million to a high of 14.4 million units.

TABLE 3-5. REVISED FORECASTS OF 1981-1990 UNITED STATES NEW CAR DEMAND (IN MILLIONS)

Year	DATE OF PROJECTION					
	Spring 1980		Summer 1981		Percent Change	
	Lowest Value	Highest Value	Lowest Value	Highest Value	Lower	Upper
1981	9.4	10.5	9.1	9.5	- 3	-10
1982	10.1	11.4	10.0	10.7	- 1	- 6
83	10.6	11.7	10.5	12.9	- 1	+10
84	10.7	12.0	10.7	12.1	0	+ 1
85	9.1	11.9	10.6	12.9	+16	+ 8
86	8.9	12.1	10.8	13.3	+21	+10
87	10.5	12.3	10.9	13.2	+ 4	+ 7
88	11.3	12.8	11.4	13.3	+ 1	+ 4
89	10.2	13.0	11.8	13.8	+16	+ 6
1990	9.9	13.3	11.9	13.7	+20	+ 3

Source: Composite of Evans, Chase, DRI, WEFA's Long Range Econometric Projections of the U.S. Economy.

TABLE 3-6. SUMMARY OF LOW AND HIGH WORLD NEW TRUCK DEMAND AND PUBLISHED PROJECTIONS, 1978-1990 (IN MILLIONS)

REGION	1978*	1980*	1985	1990
North America	4.4	2.8	2-3	1.5-6.4
Western Europe	1.2	1.3	1-1.3	0.9-2.1
Japan	1.8	2.1	1.6-2.1	1-3.1
Rest of World	3.1	3.3	3.3-8	3.3-15
Total	10.5	9.5	7.9-14.4	6.7-26.6

*Estimated actual sales.

Source: See Table 3-7.

TABLE 3-7. ACTUAL AND FORECASTED WORLD NEW TRUCK DEMAND, 1978-1990 (IN MILLIONS)

REGION	YEAR PROJECTED							
	1978	1980	1985		1990			
	(1)	(1)	(2)	(5)	(2)	(3)	(4)	(5)
North America	4.4	2.8	2-3	2.8	1.5-3	4.4	4.8-6.4	2.8
Western Europe	1.2	1.3	1-1.3	1.3	0.9-1.4	2.1	1.4-1.6	1.3
Japan	1.8	2.1	1.6-2.1	2.1	1-2	2.7	2.3-3.1	2.1
Rest of World	3.1	3.3	4.2-8	3.3	7-15	6.4	4.2-7.5	3.3
Total	10.5	9.5	8.8-14.4	9.5	10.4-21.4	15.6	12.7-18.9	9.5

ANNUAL GROWTH RATES

REGION		1980/1978	1985/1980		1990/1980			
		(1)	(2)	(5)	(2)	(3)	(4)	(5)
North America		-20.2	-6.5-1.4	0	-6.1-0.7	4.6	0.7-3.1	0
Western Europe	N/A	4.1	-5.1-0	0	-3.6-0.7	4.9	1.1-3.5	0
Japan		8.0	-5.3-0	0	-7.2--0.5	2.5	2.1-4.7	0
Rest of World		3.2	4.9-19.4	0	7.8-16.4	6.9	2.6-7.7	0
Total		-4.9	-1.5-8.7	0	0.9-8.5	5.1	1.6-5.0	0

Sources: (1) Estimated Actual Sales.
(2) Krish Bhasker, The Future of the World Motor Industry, (New York: Kogan Page, and London: Nichols Publishing Company, 1980).
(3) Predicasts, Inc., World Motor Vehicles, May 1978.
(4) Chase Econometrics, as reported in MVMA, World Motor Vehicle Data, 1981 edition.
(5) "No-Growth" projections.

NOTE: Section 6, Sources and Methodologies of Published Forecasts

Table 3-8 summarizes by region the "uncertainty" within each of these ranges. As was the case with new car demand (Table 3-3), the tremendous variance in total new truck demand is mostly attributable to uncertainty about the course of future demand in the "rest of the world."

Although comparable data for world truck demand are not available, forecasters of United States truck demand have significantly lowered their projections during the past year. Table 3-9 shows how Data Resources, Inc. (DRI), the only forecasting service that regularly makes new truck demand forecasts, has lowered its United States forecasts "across the board" during the past year. Projections for each year have been lowered by an average of 23 percent, with some individual years being lowered by as much as 37 percent. These substantial reductions seem to reflect DRI's belief that the eroding truck market of the past three years indicates a structural, i.e., permanent decrease in demand.

3.3 WHY THESE FORECASTS DIFFER

These published forecasts (Tables 3-1, 3-2, 3-6 and 3-7) differ greatly. Why is this? The time frame of these forecasts -- 10 years -- is relatively long. As the time horizon of a forecast expands, the number of factors that must be built into a forecast increases. This can be seen by analogy to production theory. In the short run, some factors of production can be manipulated (labor), but others are fixed (plant size). In the long run, however, all factors are variable, and none can be taken as fixed. Within the context of motor vehicle demand, this might mean that for short-term forecasting (two to four quarters), energy and vehicle prices are variable, but an economy's infrastructure and cultural orientation are essentially fixed. Expand the forecasting horizon to ten years, and all these factors are variable. Hence, the forecaster has more variable factors to consider, and it becomes more likely that different forecasters will assess these factors differently.

TABLE 3-8. WORLD NEW TRUCK DEMAND FORECAST "UNCERTAINTY"*

REGION	1985	1990
North America	50%	327%
Western Europe	30%	133%
Japan	31%	210%
Rest of World	142%	355%
Total	82%	261%

*Defined as the difference between the low and high forecasts from Table 3-7 divided by the low forecast -- $\frac{\text{High-Low}}{\text{Low}}$ -- and then expressed as a percentage.

TABLE 3-9. REVISED FORECASTS OF 1981-1990 UNITED STATES NEW TRUCK DEMAND (IN MILLIONS)

Year Projected	DATE OF PROJECTION				Percent Change	
	Summer 1980		Summer 1981			
	Lowest Value	Highest Value	Lowest Value	Highest Value	Lower	Upper
1981	2.90	2.99	2.18	2.18	-33	-37
1982	3.11	3.52	2.98	2.98	- 4	-18
83	3.33	3.76	3.16	3.16	- 5	-19
84	4.06	4.16	3.41	3.45	-19	-21
85	4.32	4.34	3.51	3.65	-23	-19
86	3.69	4.39	3.16	3.66	-17	-20
87	4.10	4.53	3.23	3.73	-27	-21
88	4.63	4.76	3.44	3.75	-35	-27
89	4.50	4.92	3.56	3.75	-26	-31
1990	4.02	4.99	3.53	3.69	-14	-35

Source: Data Resources, Inc.

As mentioned in Section 2.7, traditional forecasting methods usually concentrate on the easily quantifiable variables. Forecasters tend to ignore the broader nature of motor vehicle demand (Sections 2.1 - 2.6), which has the implicit effect of assuming these considerations will not change in the future. Forecasters tend not to differ in their population and cost assumptions. They do, however, differ greatly in their assessment of other demand determinants:

a. Energy Environment

Simply put, higher gasoline prices increase operating costs and tend to depress new vehicle sales. The highest demand projections assume a favorable petroleum climate, i.e., steady supply and constant or slowly rising real prices. The lowest demand projections generally assume sharply rising prices and intermittent supply interruptions.

Gasoline prices are only part of the energy picture, however. Rising energy costs can wreak economic havoc in entire economies, and eventually bring about structural change. There is evidence that this is occurring in parts of the world (see Section 6.6). Forecasters do not seem to acknowledge this.

b. Economic Environment

A growth in vehicle demand requires an environment of economic growth. Many forecasters doubt that appreciable real income growth will occur during the 1980s, in particular they doubt that substantial growth will occur in the non-oil producing third world nations (see Section 6.6). This lack of growth is frequently coupled with steadily rising food costs, partially due to the increased cost of petrochemical fertilizers and partially due to the drought conditions that have plagued much of Africa, Asia, and North America.[15] Other forecasters, however, implicitly assume that the growth rates of the 1960s and 1970s will continue.

c. Socio/Political Environment

Economic growth does not necessarily imply growth in new vehicle demand. Government policy may try to discourage private automobile ownership because of the requisite parallel expenditures for a transportation infrastructure, or because of concern for urban congestion and pollution. In some countries, ideological compulsion or economic necessity may require an emphasis on mass transit or truck demand for the industrial sector. Forecasters differ in their implicit assessment of the government's posture toward motor vehicle usage.

4. WORLD MOTOR VEHICLE DEMAND

This section presents an analysis of world-wide motor vehicle demand. Published forecasts are summarized and their implications discussed in Section 4.1. The remainder of this Section analyzes individual nation sales data, vehicle registrations, economic variables, and energy situations, together with the general considerations (Section 2 above) relevant to each market.

4.1 TOTAL WORLD DEMAND

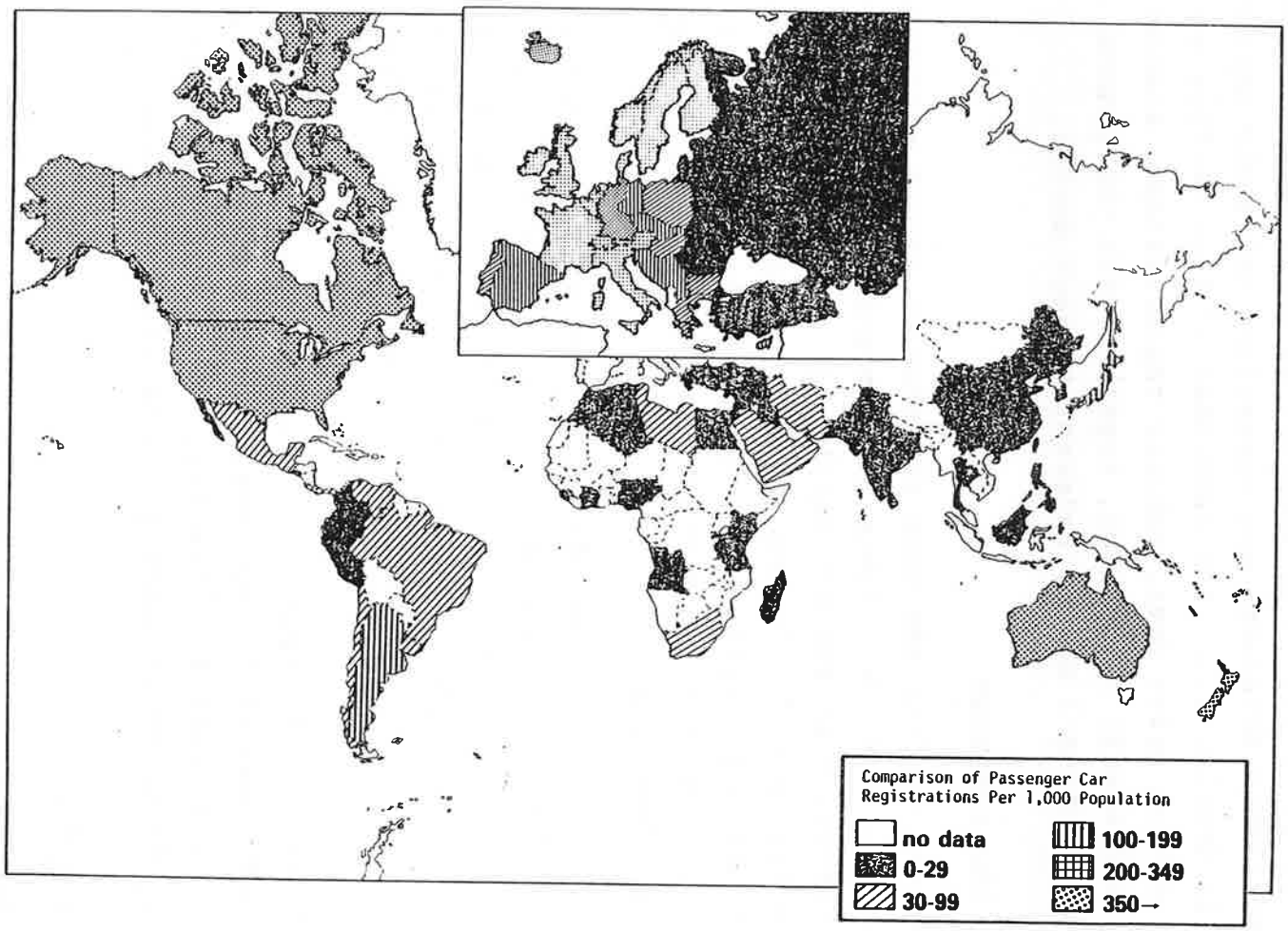
Figure 4-1 depicts the vast differences in car registration levels between countries. Table 4-1 summarizes, by region, the total car registration and per capita car registration data depicted in Figure 4-1. Figure 4-2 displays the equally diverse levels of truck registrations between countries. Table 4-2 summarizes, by region, the total truck registration and per capita truck registration data.

As we have seen, income and population are important though not exclusive determinants of motor vehicle demand. Table 4-3 summarizes, by region, current and projected real per capita gross domestic product. Table 4-4 summarizes, by region, current and projected population. The data from Tables 4-3 and 4-4 are shown in more detail in Figures 4-3 and 4-4.

As discussed in Sections 2.1 to 2.6, there are a number of other considerations that shape motor vehicle demand. These factors will be discussed in the regional discussions (Sections 4.2 to 4.5), but no world summary can be attempted here.

4.1.1 New Car Demand

World demand for new cars totaled roughly 28.3 million units in 1980, based on estimated actual sales (Table 3-1). Of this, North America (9.9 million) and Western Europe (10.0 million) accounted for more than two-thirds. Japanese new car demand was



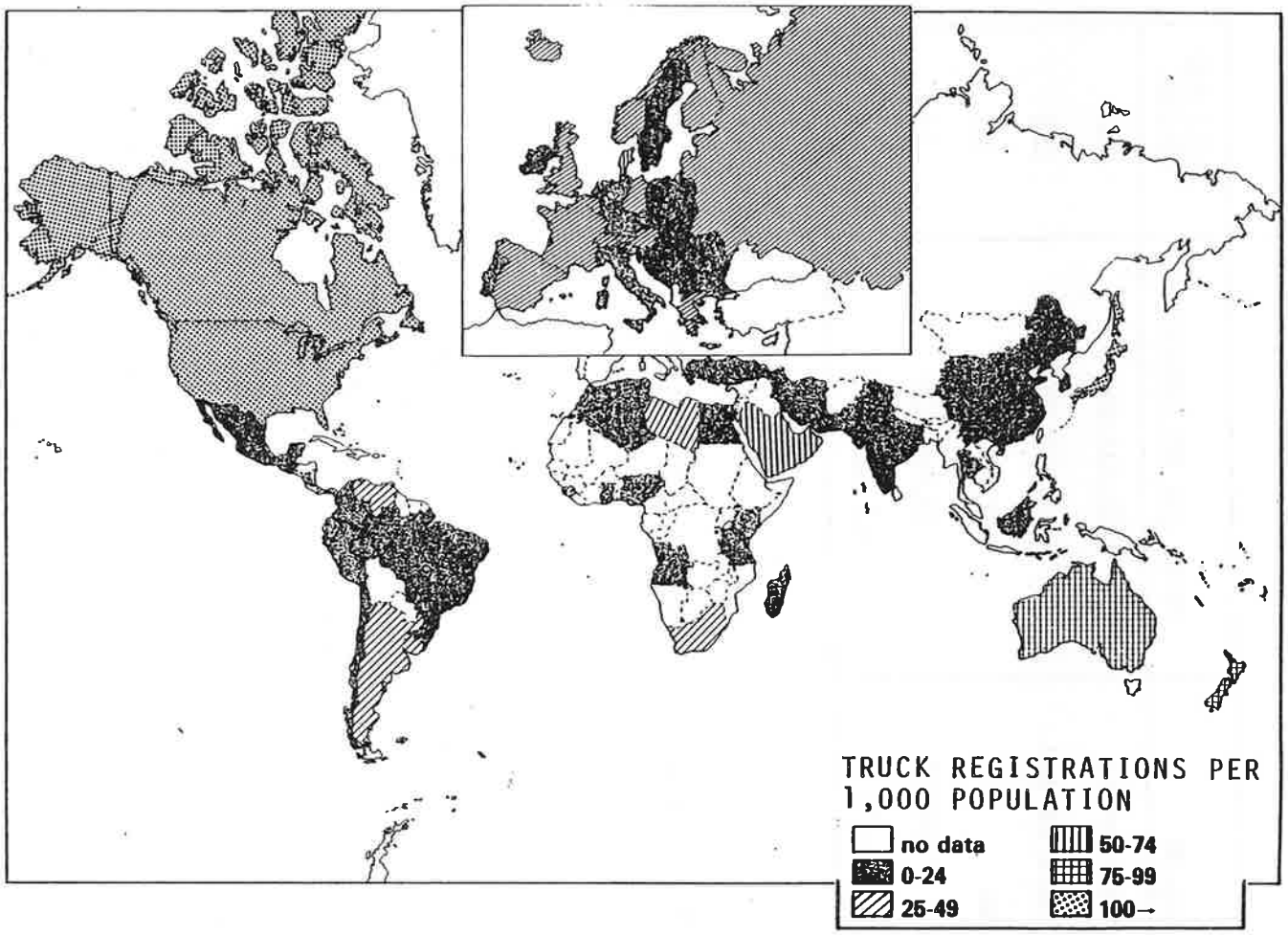
SOURCE: MVMA, WORLD MOTOR VEHICLE DATA, 1981

FIGURE 4-1. COMPARISON OF PASSENGER CAR REGISTRATIONS, PER 1,000 POPULATION

TABLE 4-1. TOTAL AND PER CAPITA CAR REGISTRATIONS, BY REGION (1979)

REGION	TOTAL CAR REGISTRATIONS	CARS/1000 PERSONS
North America	130,233,000	530
Western Europe	101,171,000	290
Japan	22,667,000	196
Rest of World	55,596,000	15
Total World	309,667,000	72

Source: MVMA, World Motor Vehicle Data, 1981 edition



SOURCE: MVMA, WORLD MOTOR VEHICLE DATA, 1981

FIGURE 4-2. COMPARISON OF TRUCK REGISTRATIONS PER 1,000 POPULATION

TABLE 4-2. TOTAL AND PER CAPITA TRUCK REGISTRATIONS, BY REGION (1979)

REGION	TOTAL TRUCK REGISTRATIONS	TRUCKS/1000 PERSONS
North America	36,777,000	150
Western Europe	11,000,000	31
Japan	13,564,000	117
Rest of World	25,074,000	7
Total World	86,415,000	20

Source: MVMA, World Motor Vehicle Data, 1981 edition

TABLE 4-3. CURRENT AND PROJECTED REAL PER CAPITA GROSS DOMESTIC PRODUCT, BY REGION, 1980-1990

REGION	YEAR			ANNUAL GROWTH RATE
	1980	1985	1990	1990/80
North America	8,161	9,354	10,479	2.5%
Western Europe	5,774	6,797	7,970	3.3
Japan	5,663	7,227	8,986	4.7
Rest of World	850	983	1,135	2.9
Total World	1,771	2,010	2,259	2.5

Source: Predicasts, Inc., World Product Casts, Issue P-1, May 29, 1981.

TABLE 4-4. CURRENT AND PROJECTED POPULATION, BY REGION, 1979-1990 (MILLIONS)

REGION	YEAR			ANNUAL GROWTH RATE
	1979	1985	1990	1990/1979
North America	244.3	258.4	270.3	0.9
Western Europe	348.3	352.5	357.0	0.2
Japan	115.9	119.7	122.8	0.5
Rest of World	3,697.8	4,099.2	4,525.2	1.9
Total World	4,406.3	4,829.8	5,275.3	1.7

Source: U.S. Statistical Abstract, 1981 edition

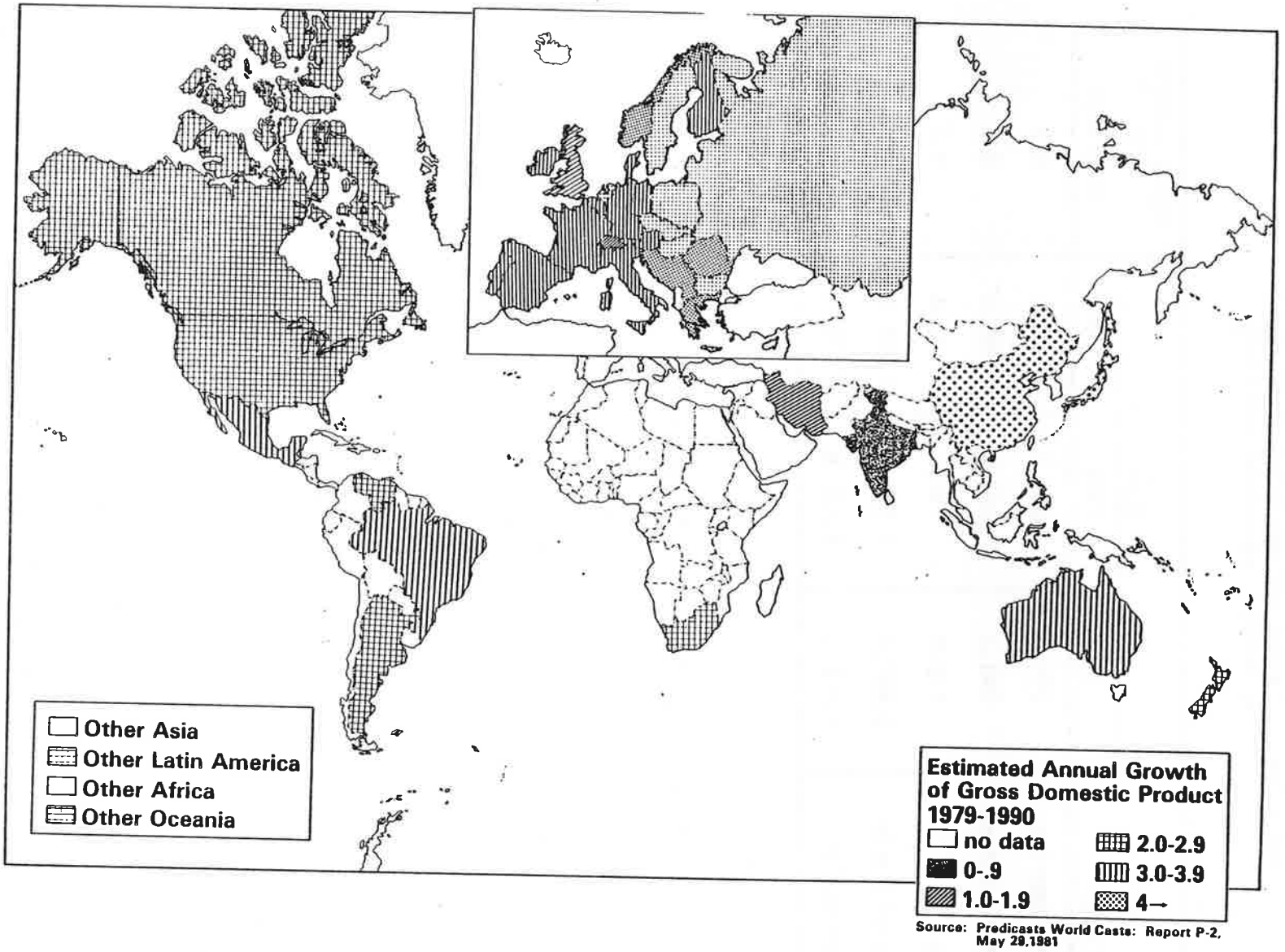


FIGURE 4-3. ESTIMATED ANNUAL GROWTH OF GROSS DOMESTIC PRODUCT, 1979-1990

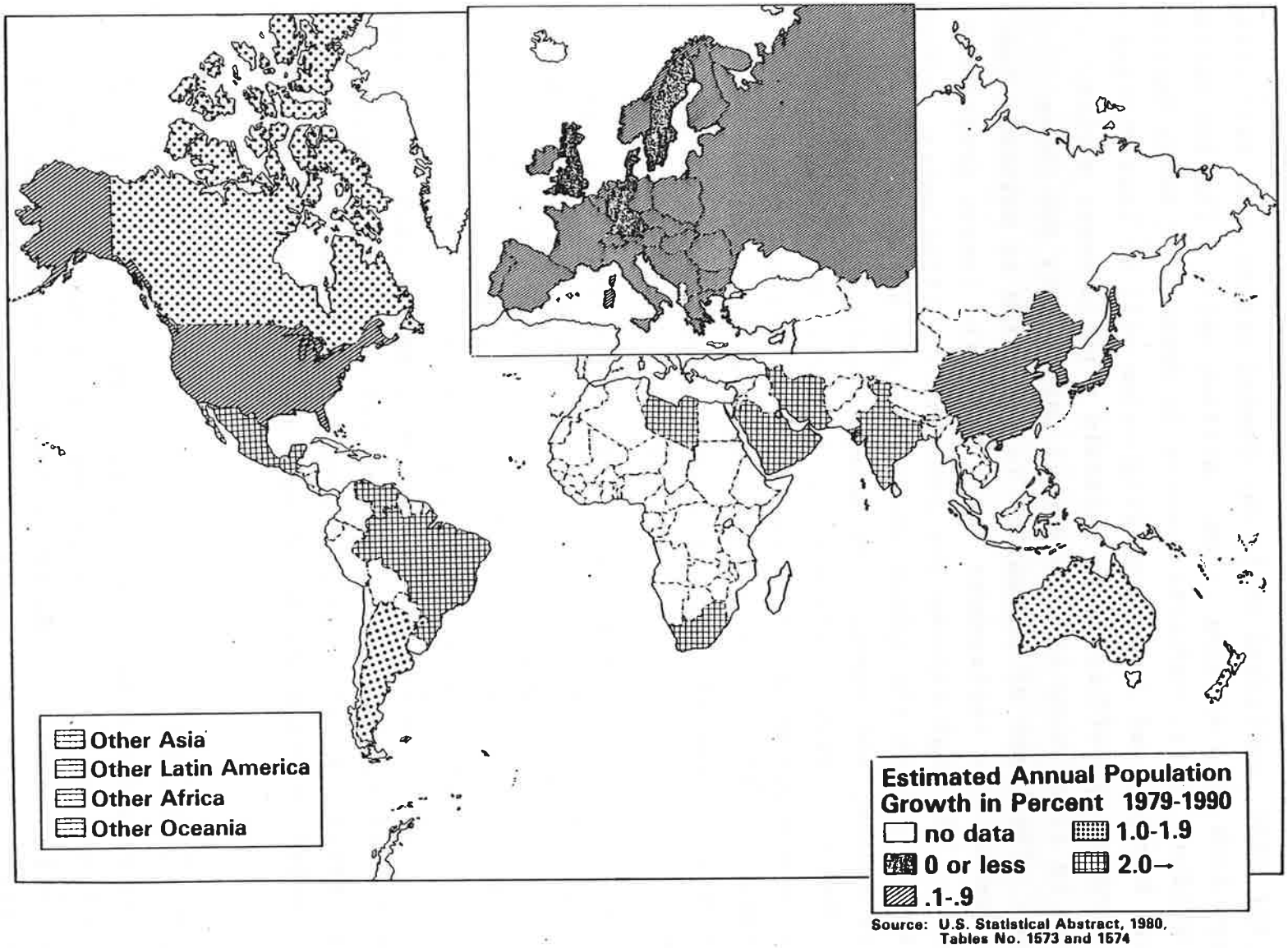


FIGURE 4-4. ESTIMATED ANNUAL POPULATION GROWTH, 1979-1990 (PERCENT)

2.9 million units. Demand in the "rest of the world" was 5.5 million units.

For 1990, published world car demand projections fall within a range from 24.5 million to 66.1 million units. The low extreme, 24.5 million units, reflects erosion in demand for North America, Western Europe, and Japan, implying sales will be insufficient or only marginally sufficient to maintain a replacement market. Decline in fleet size is a very real possibility for these regions. The "rest of the world" is projected to maintain constant demand at a replacement level under the lowest projection scenario. The high extreme for 1990, 66.1 million units, reflects very strong growth throughout the decade for North America, Western Europe, and Japan, with demand reaching all-time highs by 1990. For the "rest of the world," demand is projected to literally explode with annual increases of nearly 17 percent throughout the 1980s. Under this scenario, the "rest of the world" would become the largest single market in the world, accounting for 43 percent of total demand by 1990.

For 1985, published world car demand projections range from 27.9 million to 43.5 million units. The low extreme, 27.9 million units, reflects constant sales at a replacement level for North America, Western Europe, and the "rest of the world." Japanese demand is projected to decrease at an annual rate of 2.9 percent, although still remaining at a replacement market level. The high extreme for 1985, 43.5 million units, reflects strong growth from current levels for all regions, although North American demand is not projected to reach its historical peak (12.4 million units in 1973).

4.1.2 New Truck Demand

World demand for new trucks totaled roughly 9.5 million units in 1980 (Table 3-6). North America, which had accounted for the largest share of new truck demand as recently as 1978 (4.4 million), suffered a demand erosion to only 2.8 million units

in 1980. The "rest of the world" had new truck demand of 3.3 million units in 1980. Japanese demand was 2.1 million units. New truck demand in Western Europe was 1.3 million units.

For 1990, published world truck demand projections fall within a range from 6.7 million to 26.6 million units. The low extreme, 6.7 million units, would represent a decimation of the new truck markets in North America, Western Europe, and Japan. Such an occurence would lead to a decline in fleet sizes and severely weaken the truck manufacturers. Under this scenario, only the "rest of the world" would maintain a replacement market sales level. The high end of the 1990 range, 26.6 million units, indicates record sales years for North America, Western Europe, and Japan, with the latter two enjoying especially large increases. In addition, the "rest of the world" would experience a spectacular, fivefold increase in demand, were the high projections to be realized.

For 1985, published world truck demand projections are from 7.9 million to 14.4 million units. The low projection, 7.9 million units, would represent nearly as dire a new truck market for North America, Western Europe, and Japan as the low end of the 1990 projection. Such a sales level could not support the number of existing truck manufacturers. The high extreme, 14.4 million units, would occur if North America, Western Europe, and Japan maintain the 1980 replacement market sales levels, and the "rest of the world" experiences annual growth of about 20 percent.

4.2 NORTH AMERICA

North America, defined as the United States and Canada, traditionally has been the world's largest market for new cars and trucks. As of 1980, this was no longer true (Tables 3-1 and 3-6), though North America continues to lead in total and per capita car and truck registrations (Tables 4-1 and 4-2). North American registration, income, and population data are summarized in Table 4-5.

TABLE 4-5. NORTH AMERICA

	TOTAL CAR REGISTRATIONS AS OF 1979 (THOUSANDS) (1)	CARS/1000 PERSONS (1)	TOTAL TRUCK REGISTRATIONS AS OF 1979 (2)	TRUCKS/1000 PERSONS (2)	1980 PER CAPITA INCOME (1975 DOLLARS) (3)	PROJECTED ANNUAL REAL PER CAPITA INCOME GROWTH 1990/1980 (PERCENT) (3)	HISTORICAL REAL PER CAPITAL INCOME GROWTH 1980/1970 (PERCENT) (3)	1979 POPULATION (MILLIONS) (4)	PROJECTED ANNUAL POPULATION GROWTH 1990/1979 (PERCENT) (4)
United States	120,248	542	33,870	153	8,185	2.5	2.1	220.6	0.9
Canada	9,985	422	2,907	123	7,932	2.8	2.6	23.7	1.1
Total North America	130,233	530	36,777	150	8,161	2.5	2.1	244.3	0.9

Source:

(1) MVMA, World Motor Vehicle Data, 1981 edition

(2) MVMA, World Motor Vehicle Data, 1981 edition

(3) Predicasts, Inc., World Product Casts, Issue P-1, May 29, 1981.

(4) U.S. Statistical Abstract, 1981 edition

4.2.1 New Car Demand

North American new car demand was 9.9 million units in 1980, down 24 percent from a near-record 12.3 million sales in 1978, and they fell another 5 percent in 1981. Table 4-6 lists North American new car sales, by country, for the past twenty years.

According to Sclar,[1] the two most important determinants of future motor vehicle demand are oil prices and infrastructural development and maintenance. As was already discussed (Section 2.4), oil prices have both microeconomic and macroeconomic impacts. At the micro economic level, increased gasoline pump prices increase operating costs and tend to depress demand. From 1978 to 1980 car sales in the United States fell by 21 percent; during this time the cost of operating a car increased by nearly 50 percent in current dollars and 19 percent in real terms. A study done at TSC[16] indicates that two-thirds of this increase was due to increased oil costs. A similar pattern evolved during 1973-75 after the Arab oil embargo and resultant quadrupling of oil prices. In the interim period (1976-78), vehicle sales were very strong as real gasoline prices held steady and then declined. Table 4-7 lists real gasoline prices in the United States for the period 1968-81. When this table is juxtaposed with Table 4-6 it is clear that historical experience in the United States lends credence to the expected negative relationship between gasoline prices and car sales. Future car demand obviously will be impacted by future gasoline prices.

Gasoline price forecasts are volatile, and usually seem to reflect the current petroleum climate. For example, Table 4-8 shows how Data Resources, Inc. (DRI) has changed its forecasts over the past two years. In March 1980, shortly after the Iranian crisis, DRI forecast a 5.0 percent annual increase in the real price of gasoline. This outlook was nearly as pessimistic as the 5.6 percent annual real increase of 1979/73. In March 1981, DRI lowered its forecast to a 3.3 percent annual increase. In December 1981, after much talk about an oil "glut," DRI

TABLE 4-6. NORTH AMERICAN NEW CAR SALES, 1961-1981 (MILLIONS)

	UNITED STATES	CANADA	TOTAL
1981	8.53	0.90	9.43
1980	8.98	0.93	9.91
1979	10.67	1.00	11.67
1978	11.31	0.99	12.30
1977	11.19	0.99	12.18
1976	10.11	0.95	11.06
1975	8.64	0.90	9.54
1974	8.87	0.94	9.81
1973	11.44	0.97	12.41
1972	10.95	0.86	11.81
1971	10.25	0.78	11.03
1970	8.41	0.64	9.05
1969	9.58	0.76	10.34
1968	9.66	0.74	10.40
1967	8.34	0.67	9.01
1966	9.01	0.68	9.69
1965	9.33	0.69	10.02
1964	8.07	0.61	8.67
1963	7.56	0.54	8.10
1962	6.94	0.50	7.44
1961	5.86	0.44	6.30

Sources: MVMA, World Motor Vehicle Data; Automotive News; and Statistics Canada.(various issues)

TABLE 4-7. AVERAGE GASOLINE PRICES IN THE UNITED STATES, 1968-1981

	PRICE (1980 DOLLARS)	CHANGE FROM PREVIOUS YEAR (PERCENT)
1981	1.223	-0.6
1980	1.230	+23.4
1979	.997	+22.0
1978	.817	-3.2
1977	.844	-1.2
1976	.854	-0.8
1975	.861	-2.3
1974	.881	+22.2
1973	.721	+ 3.1
1972	.699	-2.1
1971	.714	-3.3
1970	.738	-4.8
1969	.775	-2.0
1968	.791	

Source: Exxon Corp.

Note: Based on mid-year regular grade gasoline prices.

TABLE 4-8. UNITED STATES REAL GASOLINE PRICE FORECASTS
(ALL PRICES IN 1980 DOLLARS)

DATE MADE	DECEMBER 1981	MARCH 1981	MARCH 1980
Base Year of Forecast	1981	1980	1979
Base Gas Price	1.223	1.230	.997
Forecast Year	1990	1990	1990
Forecast Gas Price	1.51	1.69	1.70
Annual Increase	2.4%	3.3%	5.0%

Source: Data Resources, Inc., various publications

lowered its forecast further to a relatively optimistic 2.4 percent annual increase in real gasoline prices. These forecast changes underscore the fact that we face an uncertain gasoline price future.

Sheik Ahmed Zaki Yamani is more optimistic. The Saudi Arabian oil minister forecasts declining real oil prices through 1985,[17] and then no real increases until the end of this decade or the early 1990s.[18]

At the macroeconomic level, the rising cost of oil imports has strained the North American economy. Inflation and unemployment ("stagflation") have appeared in unprecedented combinations. During the 1970s, the North American policy response to the two oil shocks and resultant trade imbalances was internal demand deflation,[19] unlike the highly successful Japanese effort to finance oil imports through export expansion (see Section 4.4).

North American production peaked in 1970, when imports accounted for less than one quarter of total North American petroleum needs. By 1975 this dependence had increased to 35 percent, and by 1980, 45 percent. DRI expects oil imports to drop to about one-third of North American consumption by 1990, but the region remains vulnerable. If and when the next oil price shock arrives, the North American policy response will be a crucial factor in the level of new car demand.

North America has the most sophisticated and highly developed motor vehicle infrastructure in the world. Many analysts believe, however, that the infrastructure is deteriorating.[20] Costly repairs are needed. Officials at DOT estimate that it will cost 65 billion dollars to complete the final 5 percent of the interstate highway system, and another 17 billion dollars in the next decade just to maintain this one highway system. Maintenance of state and local roads would be in addition. On these roads, the cost of just fixing obsolete and deficient bridges is 41 billion dollars.[13] Maintenance decisions of this magnitude require the

same collective predisposition as the original decisions to develop an infrastructure. Given the currently strong sentiment for shrinking the public sector, and an era of austere budgets, it seems questionable whether there will be a public commitment to incur these maintenance expenses in the near future.

Alternatives to private automobile transportation in North America are becoming more popular. Public transit usage has recently increased.[5] There is some evidence that work-related bicycle trips are on the rise. Motorcycles and mopeds increasingly are being marketed as alternatives to the mini-compact cars.[9] The electric vehicle will be a viable alternative by the end of the coming decade.[10,11] Rather than predicting future levels of usage for any of these alternatives, which is nearly an impossible task, let it suffice to say that this entire package of alternatives will probably exert at least some downward pressure on new car demand.

North American real income growth is expected to increase at a 2.5 percent annual rate throughout the 1980s (Table 4-5). Considering that last decade's income growth rate in North America was 2.1 percent, this forecast would seem to be rather optimistic.

It does not seem unreasonable that with an uncertain oil future, a deteriorating infrastructure, probable increasing prevalence of automobile alternatives, and real income growth rate forecasts that may not be attained (based on last decade's experience), that North American new car demand growth will be limited.

Reinforcing this conclusion is evidence of disinvestment in personal automobile transportation in the United States. Luxury car sales historically have been fairly consistent, i.e., not susceptible to cyclical fluctuations, credit restrictions, energy concerns, and general economic conditions, evidently because some luxury car consumers were purchasing an investment good as well as transportation. This behavior implies a constant sales level and an increasing market share when total car sales decline. This

was generally the case from 1950-78. Since then, however, luxury car sales have declined in number (by 35 percent) and in market share (23 percent), indicating that a trend of disinvestment in personal automobile transportation is emerging. Another indication of this trend is the fact that constant dollar per capita personal consumption expenditures for user-operated transportation peaked in 1978, and have declined nearly 14 percent since.[21]

If the low end North American new car demand forecasts are realized, sales will be insufficient to maintain a replacement market. Total fleet size would decline. At this point auto manufacturers, labor, and aftermarket interests undoubtedly would seek governmental relief through trade restrictions, tax concessions, or individual consumer tax credit incentives for purchasing a new domestic automobile.

4.2.2 New Truck Demand

North American demand for new trucks was 2.8 million units in 1980, down 37 percent from a record 4.4 million sales in 1978, and have fallen another 10 percent in the past year. Table 4-9 lists North American new truck sales, by country, for the past twelve years.

In the United States, nearly 94 percent of the decline in new truck sales from 1978 to 1980 is attributable to diminished light truck sales (Table 4-10).* In percentage terms, light truck sales fell 40 percent during this period, while medium and heavy truck sales fell 27 percent. This trend continued in 1981 with light truck sales down another 9 percent and medium and heavy trucks off by an additional 15 percent. Light truck sales in 1981 were the lowest since 1971, and medium and heavy truck sales were the worst since some time before 1967.

*Based on U.S. truck sales only. United States sales generally account for about 90 percent of North American truck sales. Comparable Canadian data are not available.

TABLE 4-9. NORTH AMERICAN NEW TRUCK SALES, 1970-1981 (MILLIONS)

	UNITED STATES	CANADA	TOTAL
1981	2.25	0.29	2.54
1980	2.49	0.33	2.82
1979	3.48	0.39	3.87
1978	4.08	0.37	4.45
1977	3.68	0.35	4.03
1976	3.18	0.34	3.52
1975	2.48	0.33	2.81
1974	2.69	0.31	3.00
1973	3.15	0.26	3.41
1972	2.63	0.21	2.84
1971	2.10	0.16	2.26
1970	1.81	0.13	1.94

Sources: MVMA, World Motor Vehicle Data; Automotive News; and Statistics Canada (various issues)

TABLE 4-10. UNITED STATES TRUCK SALES, 1967-1981, BY SIZE CLASS (MILLIONS)

	LIGHT TRUCKS	HEAVY AND MEDIUM TRUCKS	TOTAL TRUCKS
1981	2.03	0.23	2.25
1980	2.22	0.27	2.49
1979	3.11	0.37	3.48
1978	3.71	0.37	4.08
1977	3.34	0.34	3.68
1976	2.90	0.28	3.18
1975	2.21	0.27	2.48
1974	2.28	0.41	2.69
1973	2.71	0.45	3.15
1972	2.24	0.39	2.63
1971	1.77	0.33	2.10
1970	1.47	0.33	1.81
1969	1.59	0.38	1.97
1968	1.49	0.34	1.83
1967	1.22	0.33	1.55

Source: DRI Historical Tables, Winter 1981-82.

Data Resources, Inc. (DRI) is the only econometric forecasting service to regularly make new truck demand forecasts. These forecasts are for the United States, and not for North America, but are enlightening nonetheless. Table 4-11 lists these forecasts, segmented by truck size, for the period 1982-1990.* DRI forecasts steady growth in both light truck and medium-heavy truck sales throughout the decade, with total 1990 sales reaching the record levels first reached in 1978.

The determinants of new truck demand, tending to be less well correlated with income, are not the same as the determinants of new car demand (see Section 2.7). Evolving usage patterns and cultural considerations make North American truck demand forecasting more difficult than car demand forecasting.

4.2.2.1 Light Truck Demand - The light truck sales peak in 1978 was the culmination of a run-up that began in the mid-1960s and was only temporarily slowed in 1971 and 1975 (Table 4-10). The 1978 sales peak coincided with the cheapest gasoline prices of the 1974-1981 period (Table 4-7), as well as a peak period for personal use of the light truck. Econometric analysts regard this peak as unique, and not likely to be surpassed before the end of the decade (Table 4-11). Factors that will impact light truck demand in the 1980s include:

a. The cost differential between light trucks and large cars, assuming they are to some degree substitutes. A cost differential favorable to light trucks would tend

*These forecasts are not incorporated into the truck demand forecast range of Table 3-6 because they are not part of a comprehensive set of world forecasts.

TABLE 4-11. UNITED STATES NEW TRUCK DEMAND FORECASTS, 1982-1990, BY TRUCK SIZE (MILLIONS)

	LIGHT TRUCKS	MEDIUM AND HEAVY TRUCKS	TOTAL TRUCKS
1980*	2.22	0.27	2.49
1982	2.19	0.25	2.44
1983	2.64	0.30	2.94
1984	2.78	0.33	3.11
1985	2.87-3.10	0.35	3.22-3.45
1986	3.12-3.61	0.37-0.38	3.49-3.99
1987	2.63-3.35	0.36-0.39	2.99-3.74
1988	2.99-3.60	0.37-0.40	3.36-4.00
1989	3.49-3.74	0.38-0.40	3.87-4.14
1990	3.72-3.76	0.39-0.40	4.11-4.16

*Actual sales

Source: Data Resources, Inc., U.S. Long-Term Review, Winter 1981-82. Composite of Trendlong 1281 and Cyclelong 1281 Forecasts.

to increase light truck demand at the expense of large car demand.

b. The availability, or lack thereof, of delivery service for oversized purchases affects the demand for carrying capacity in excess of what an automobile can offer.

c. Level of usage in the agricultural and self-employed sectors of the economy.

d. The general level of affluence and leisure time and the cultural inclination to invest them in the recreational segment of the light truck market.

4.2.2.2 Medium and Heavy Truck Demand

Demand for medium and heavy trucks is primarily industrial. Peaking at 0.45 million units in 1973 (Table 4-10), demand has declined substantially since. Econometric analysts do not expect this sales record to be challenged in the coming decade (Table 4-11). Factors that will impact medium and heavy truck demand in the 1980s include:

a. The general level of economic prosperity and the corresponding level of new business formation.

b. Managerial tendency to use trucking as the transportation input to the production process, which is affected in turn by:

c. The relative costs of trucking vis-à-vis rail and waterway transport.

d. Infrastructural quality, especially highway conditions.

4.3 WESTERN EUROPE

For the purposes of this report, the term "Western Europe" embraces countries within the European Economic Community (EEC) and other countries with close economic ties to Western European markets. These countries are listed in Table 4-12. It should be noted that although forecasts frequently treat Western Europe as

TABLE 4-12. WESTERN EUROPE

COUNTRY	TOTAL CAR REGISTRATIONS AS OF 1979 (THOUSANDS) (1)	CARS/ 1000 PERSONS (1)	TOTAL TRUCK REGISTRATIONS AS OF 1979 (THOUSANDS) (2)	TRUCKS/ 1000 PERSONS (2)	1980 PER CAPITA INCOME (1975 DOLLARS) (3)	PROJECTED ANNUAL REAL PER CAPITA INCOME GROWTH 1990/80 (3) (percent)	HISTORICAL REAL PER CAPITAL INCOME GROWTH 1980/1970 (3) (percent)	1979 POPULATION (MILLIONS) (4)	PROJECTED ANNUAL POPULATION GROWTH 1990/79 (4) (percent)
West Germany	22,614	369	1,490	24	8,171	3.7	2.8	61.3	-0.3
France	18,525	346	2,525	47	7,425	3.6	3.1	53.5	0.3
Italy	17,125	301	1,235	22	4,046	3.7	2.6	56.9	0.3
United Kingdom	14,927	267	1,940	35	4,426	2.2	1.6	55.9	0
Spain	7,058	190	1,304	35	3,089	3.3	2.8	37.1	0.8
Netherlands	4,200	299	337	24	7,766	3.1	2.1	14.0	0.4
Belgium	3,036	308	310	31	7,086	3.9	2.9	9.8	0.5
Sweden	2,868	346	191	23	8,930	2.9	1.5	8.3	0
Switzerland	2,154	340	172	27	9,064	1.8	0.8	6.3	0
Austria	2,139	285	195	26	6,037	4.0	3.7	7.5	0
Denmark	1,441	281	278	54	8,462	3.2	2.1	5.1	0
Norway	1,190	292	163	40	8,468	4.3	3.8	4.1	0.2
Finland	1,170	245	152	32	6,684	3.1	3.8	4.8	0.4
Portugal	912	93	233	24	1,859	3.7	3.6	9.8	0.8
Greece	839	89	367	39	2,665	4.4	3.7	9.4	0.5
Ireland	683	203	67	20	2,861	3.8	2.3	3.4	0.8
Luxembourg	163	455	12	32	7,110	3.2	1.8	0.36	0
Other Western Europe	127	163	29	37	3,170	4.7	4.3	0.78	0.5
Total Western Europe	101,171	290	11,000	31	5,774	3.3	2.5	348.3	0.2

Source:

(1) MVMA, World Motor Vehicle Data, 1981 edition

(2) MVMA, World Motor Vehicle Data, 1981 edition

(3) Predicasts, Inc., World Product Casts, Issue P-1, May 29, 1981.

(4) U.S. Statistical Abstract, 1981 edition

a single market, its historical development has been as a group of differentiated markets.[6] The Western European market is much less homogeneous than the markets of North America or Japan. The trend seems to be, however, toward greater participation in the EEC and collective trade agreements, foretelling an integrated Western European market in the future.

Western European historically has been the second largest new car market (trailing North America), but the smallest new truck market. In 1980, Western Europe became the largest car market while still lagging behind in truck sales (see Tables 3-1 and 3-6). On a per capita basis, Western European car ownership is second only to North America's, but truck ownership lags far behind that in North America and Japan (Tables 4-1 and 4-2). Western European registration, income, and population data are summarized by country in Table 4-12. Car and truck registration data are depicted separately in Figures 4-1 and 4-2.

4.3.1 New Car Demand

Western European demand for new cars was 10.0 million units in 1980, down 6 percent from a year earlier and 3 percent from 1978. Nearly complete data indicate that this downward trend was continued into 1981. Table 4-13 lists new car sales by country for the years 1977-1981. As is evident from Table 4-13, not every Western European country has experienced the same pattern of demand shifts. West Germany, France, Spain, Belgium, and The Netherlands have suffered steady erosion in demand. Bucking this trend is Italy, which has enjoyed a growth rate unmatched among Western European nations for the past four years. Demand in the United Kingdom has been cyclical for this period, with current sales at a level more than 10 percent below the peak of 1979. Sales in Switzerland and Sweden have been fairly steady. Austrian demand appears to have jumped by nearly 50 percent from 1978 to 1980, but the 1978 sales figure (158,000) is an aberration compared to 1977 sales (296,000).

TABLE 4-13. WESTERN EUROPEAN NEW CAR SALES, 1977-1981, BY COUNTRY (MILLIONS)

	1977	1978	1979	1980	1981
West Germany	2.56	2.66	2.62	2.43	2.33
France	1.91	1.95	1.98	1.87	1.83
Italy	1.23	1.22	1.44	1.72	1.81
United Kingdom	1.32	1.59	1.72	1.51	1.48
Spain	0.66	0.65	0.57	0.52	0.47
Netherlands	0.55	0.59	0.57	0.45	0.39
Belgium	0.43	0.42	0.42	0.40	0.35
Switzerland	0.23	0.27	0.28	0.29	NA
Austria	0.30	0.16	0.21	0.22	0.19
Sweden	0.24	0.20	0.22	0.19	0.19
Other Western Europe	0.6	0.6	0.5	0.4	0.4
Total	10.1	10.3	10.5	10.0	9.8

Sources: Automotive News and Motorstat Express (various issues)

Section 4.2 pointed out the probable limiting effect of infrastructural condition and oil prices on future North American demand. It seems likely that these factors will also operate to restrain Western European new car demand through 1990.

As a general statement, the Western European road system is far short of the North American system.[6] This is due to lower levels of vehicle ownership, smaller physical size of the major markets, and less of a public policy commitment to private motor vehicle transportation as the primary mode of personal transportation. Although it is arguable which way the causation operates, it is clear that the less developed Western European infrastructures militate against sales and ownership levels rivaling those reached in North America.

As already discussed (Section 2.4), oil price increases have both microeconomic and macroeconomic impacts. At the microeconomic level, gas prices in Western Europe historically have been much higher than in North America because consumers paid the unregulated market price, and because gas taxes were higher. Thus, the oil price shocks of 1973-74 and 1978-79 resulted in smaller pump price increases (in percentage terms) for Western European car drivers (Tables 4-7 and 4-14). This implies as well that Western European consumers long ago adjusted their purchasing and driving behavior to expensive gasoline. One well known result has been the generally smaller size and higher fuel efficiency of Western European vehicles. For forecasting purposes, the bottom line is that future gas price increases, if equivalent across regions, will have a smaller impact on Western European demand than North American demand, simply because the base case oil situations differ so greatly. DRI's gasoline price forecasts for Western Europe are shown in Table 4-15.

At the macroeconomic level, Western European nations have suffered from oil price increases as severly as North America. With the exception of the United Kingdom, the Western European

TABLE 4-14. AVERAGE GASOLINE PRICES IN WESTERN EUROPE, 1967-1981

	PRICE (1980 DOLLARS)	CHANGE FROM PREVIOUS YEAR (PERCENT)
1981	2.66	- 0.7
1980	2.68	+ 8.1
1979	2.48	+13.8
1978	2.18	+ 3.3
1977	2.11	+ 1.9
1976	2.07	- 1.9
1975	2.11	+ 2.4
1974	2.06	+13.2
1973	1.82	+14.5
1972	1.59	+ 6.7
1971	1.49	+ 5.7
1970	1.41	- 4.1
1969	1.47	- 4.5
1968	1.54	- 5.5
1967	1.63	

Source: Exxon Corp.

NOTE: Based on mid-year regular grade gasoline prices for West Germany, Sweden, France, Italy, and the United Kingdom.

TABLE 4-15. WESTERN EUROPEAN REAL GASOLINE PRICE FORECASTS, 1980-1985

	Price (1980 Dollars)	Change From Previous Year (Percent)
1980*	2.68	
1981*	2.66	-0.7
1982	2.67	+0.4
1983	2.69	+0.7
1984	2.73	+1.5
1985	2.76	+1.1

Source: Economic Models, Ltd., World Auto Forecasts Report, April 1981.

*Actual prices. Others are forecasts.

countries are in an oil importing position roughly comparable to that of North America. Countries of both regions experienced sudden and rapid deterioration in their balance of payments after each oil shock. Western European countries, like their North American counterparts, generally chose to remedy this imbalance by absorbing the oil price increases through reduction of internal demand. The critical question is how the Western European oil importing countries will respond in the future to oil price increases. Will oil import-induced trade imbalances be financed by internal deflation, as in the past, or by export expansion, as the Japanese have done successfully? (See Section 4.4.)

An additional factor must be considered when assessing Western European new car demand. Alternatives to private automobile transportation, mainly public transit for intraurban commuting and passenger trains for intercity travel, are more fully developed and more frequently used than in North America. These could be even further expanded, especially if physical constraints (e.g., lack of parking spaces) come into play. The suburban sprawl which crippled North American public transportation has only limited Western European equivalents, indicating that public transit should remain a more viable alternative to automobile transportation in Western Europe.

A recent study concludes that intercity mass transit in Western Europe will continue to gain ground, and that the rail alternative for intracity transport will witness a further "resurgence."[22]

4.3.2 New Truck Demand

Western European demand for new trucks reached a record 1.34 million units in 1980, continuing a cyclical pattern which had previously peaked in 1976 (1.34 million) and locally bottomed in 1978 (1.18 million units). Demand fell further in

1981, though not nearly as precipitously as the North American demand. Table 4-16 lists Western European new truck demand, by country, over the past four years. France continues to constitute the largest new truck market, almost entirely due to its light truck demand.[23] The volatile West German demand was strong in 1980, on account of healty demand for medium and heavy trucks, but was considerably down in 1981.[23] United Kingdom truck demand has been steady, in contrast to the UK fluctuating new car demand. Italy's truck demand growth rivals its impressive car demand growth of the past four years.

Western European truck market shares for 1978 and 1980 are shown in Table 4-17. These data indicate that, on a regional basis, medium truck demand has increased at the expense of heavy truck demand. The literature suggests that this trend will continue.[6]

The most striking feature of Western European new truck demand is its relatively low level. On a per capita basis, truck ownership is only one-fifth as high as in North America (Table 4-2). Within the weak truck market of Western Europe, demand in West Germany and Italy is the weakest. Even the strongest truck market within Western Europe, France, has an ownership level less than one-third that of North America (Tables 4-2 and 4-12).

Relatively low truck ownership and demand in Western Europe seems to have a twofold explanation. At the lighter end, truck demand derives primarily from recreational use and light duty job-related work. Recreational demand at North American levels is unlikely to ever be achieved in Western Europe because of the obvious facts of lack of space and the generally lower level of affluence. The latter fact might change by 1990, but the former never can. At the heavier end of the truck market. lower levels of truck ownership probably reflect better access to alternative forms of transport, principally by rail or water networks.[6]

TABLE 4-16. WESTERN EUROPEAN NEW TRUCK SALES, 1976-1981, BY COUNTRY (MILLIONS)

	1976	1978	1979	1980	1981
France	0.29	0.30	0.32	0.32	0.33
West Germany	0.14	0.16	0.17	0.24	0.15
United Kingom	0.22	0.26	0.31	0.23	0.22
Italy	0.10	0.10	0.13	0.13	0.14
Spain	NA	0.10	0.10	0.10	0.09
Other Western Europe	NA	0.26	0.25	0.32	0.28
Total	1.34	1.18	1.28	1.34	1.21

Sources: Automotive News and Motorstat Express (various issues)

TABLE 4-17. SIZE DISTRIBUTION OF WESTERN EUROPEAN NEW TRUCK SALES, 1978 AND 1980

	1978		1980	
SIZE	SALES (MILLIONS)	PERCENT	SALES (MILLIONS)	PERCENT
Light	0.30	25	0.34	25
Medium	0.56	47	0.68	51
Heavy	0.32	28	0.32	24
	1.18	100	1.34	100

Source: Krish Bhaskar, The Future of the World Motor Industry, and Automotive News, April 27, 1981

Forecasters recognize these limitations on Western European new truck demand. The region is not expected to see significant growth in demand. With the exception of an older (1978) Predicasts forecast, no published projection pegs demand to exceed 1.4 million units by 1990. (See Table 3-7.)

4.4 JAPAN

Unlike North America and especially Western Europe, Japan is a single compact market with one set of national loyalties. Japan is considered a separate forecasting region because it is logically and geographically distinct from the other regions. Japanese registration, income, and population data are shown in Table 4-18.

As a region, Japan represents the smallest new motor vehicle market, but as an individual nation, Japanese demand is exceeded only by demand in the United States. Tables 4-1 and 4-2 indicate that Japanese car registration levels are relatively low, but that truck registration levels are relatively high. Taken together, these two statements mean that the Japanese have the highest truck/car registration ratio in the world. In Japan, one truck is registered for every 1.67 cars. Comparable data are: North America, 3.54; Western Europe, 9.20; and the rest of the world, 2.22. This phenomenon will be discussed in more detail below.

4.4.1 New Car Demand

Japanese demand for new cars was 2.9 million units in 1980, down 6 percent from the sales record set in 1979. Sales in 1981 were unchanged. Published projections for 1985 range from 2.5 to 3.5 million units; 1990 projections range from a low of 2 million to an unbelievable high of 5.8 million units (Table 3-1). There is good evidence to believe that actual demand will tend toward the lower end of these ranges. Table 4-19 shows that demand increased sharply from the mid-60s through 1973, but has been

TABLE 4-18. JAPAN

TOTAL CAR REGISTRATIONS AS OF 1979 (THOUSANDS) (1)	CARS/ 1000 PERSONS (1)	TOTAL TRUCK REGISTRATIONS AS OF 1979 (THOUSANDS) (2)	TRUCKS/ 1000 PERSONS (2)	TOTAL MOTORCYCLE REGISTRATIONS AS OF 1979 (THOUSANDS) (3)	MOTOR-CYCLES/ 1000 PERSONS (3)	1980 PER CAPITAL INCOME (1975 DOLLARS) (4)	PROJECTED ANNUAL REAL PER CAPITA INCOME GROWTH 1990/1980 (4) (percent)	1979 POPULATION (MILLIONS) (5)	PROJECTED ANNUAL POPULATION GROWTH 1990/79 (PERCENT) (5) (percent)
22,667	196	13,564	117	10,901	94	5,663	4.7	115.9	0.5

Source:

(1) MVMA, World Motor Vehicle Data, 1981 edition

(2) MVMA, World Motor Vehicle Data, 1981 edition

(3) Japan Automobile Manufacturers Association, Inc. Based on factory domestic sales (no imports included).

(4) Predicasts, Inc., World Product Casts, Issue P-1, May 29, 1981.

(5) U.S. Statistical Abstract, 1981 edition

TABLE 4-19. JAPANESE NEW CAR SALES, 1964-1981 (MILLIONS)

1981	2.86
1980	2.85
1979	3.04
1978	2.86
1977	2.50
1976	2.45
1975	2.74
1974	2.29
1973	2.93
1972	2.63
1971	2.40
1970	2.38
1969	2.04
1968	1.57
1967	1.13
1966	0.74
1965	0.59
1964	0.49

Source: Japan Automobile Dealers Association, Inc.

very cyclical since. Sales during the past four years seem to indicate that new car demand in Japan will continue to fluctuate in the 2.8 to 3.1 million units range, a level that was first reached in 1973.

Japanese new car demand soared from the mid-1960s through 1973, fueled in large part by an 8.7 annual real income growth rate.* Demand has become cyclical since then, as the market matured, with real income growth slowing to a 3.6 percent annual rate.** Analysts who forecast strong growth in Japanese car demand implicitly assume a return to the Japanese growth boom of the late 1960's and early 1970s. Other sources expect more modest income growth, e.g., 4.7 percent as shown in Table 4-18, but even this seems optimistic in light of recent past experience.

The Japanese import more than 85 percent of their petroleum needs.[25] This makes Japan theoretically much more vulnerable to supply shutoffs and price hikes than either North America or Western Europe. Despite this, Japan has sustained higher income growth and avoided less car demand erosion during the oil price shocks of 1973-74 and 1978-79. The Japanese have accomplished this through conservation and by increasing their exports of all goods to pay for their increasingly expensive oil imports. The Japanese strategy was clearly stated by Nihachiro Hanamura, president of the Japan Institute for Social and Economic Affairs:

> "We have to export manufactured goods to pay for our oil imports. If we are unable to export to the oil producing countries as much as we import from them, there is no other alternative but to increase exports to other countries. Without this, the Japanese economy cannot survive."[25]

Thus, where North America and Western Europe deflated their economies to stifle internal demand, Japan accommodated oil price increases by expanding its export sector. For forecasting

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*1973/1964 annual growth rate.[24]

**1980/1973 annual growth rate.[24]

purposes, the key question is whether Japan will be able to continue along this course. If oil import bills continue to rise it seems questionable whether the Japanese, considering that their trade surplus is already high* and a worldwide trend toward protectionism has emerged,[25] will remain as successful at financing their oil imports through export expansion. Even if we assume for the sake of argument that trade protectionism will not impede Japanese exports, it is unlikely that Japan could maintain economic prosperity in the context of a worldwide economic slowdown: How can a country so integrated in the world economy maintain export-induced income growth when its trade partners cannot afford to import?

Another factor that militates against new car demand growth in Japan is the two-wheeled alternative. Motorcycle** demand in Japan is large and growing. In the developmental stage of Japanese car demand, the motorcycle was the predominant mode of personal transportation (Table 4-20). As car demand grew (Table 4-19), motorcycle demand fell. Motorcycle sales bottomed out in 1975. Then, as car demand leveled off and gas prices rose (Table 4-21), motorcycle demand increased once again. In the past five years motorcycle demand has more than doubled, increasing at the spectacular annual rate of 16 percent. The Japanese motorcycle fleet is now nearly as large as its truck fleet (Table 4-18). If this trend were to continue, or if motorcycle demand simply levels off at an annual level of 2.4 million units, little or no new car demand growth may be realized. Future gasoline prices, which will impact motorcycle and car sales, are forecasted in Table 4-22.

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*In 1981, Japan had a trade surplus of $13.41 billion with the United States, and a worldwide trade surplus of $8.89 billion.[26]

**Includes mopeds.

TABLE 4-20. JAPANESE NEW MOTORCYCLE SALES, 1961-1980 (MILLIONS)

1980	2.36
1979	1.91
1978	2.03
1977	1.63
1976	1.33
1975	1.12
1974	1.16
1973	1.18
1972	1.08
1971	1.12
1970	1.19
1969	1.25
1968	1.24
1967	1.34
1966	1.42
1965	1.29
1964	1.51
1963	1.52
1962	1.49
1961	1.72

Source: Japan Automobile Manufacturers Association, Inc. Based on factory domestic sales (no imports included).

TABLE 4-21. JAPANESE GASOLINE PRICES, 1967-1981

	PRICE (1980 DOLLARS)	CHANGE FROM PREVIOUS YEAR (PERCENT)
1981	2.31	- 1.5
1980	2.35	- 4.5
1979	2.46	+16.0
1978	2.12	+9.8
1977	1.93	+ 2.7
1976	1.88	- 4.6
1975	1.97	- 5.7
1974	2.09	+43.2
1973	1.46	+19.7
1972	1.22	+27.1
1971	0.96	- 5.9
1970	1.02	- 5.6
1969	1.08	- 5.3
1968	1.14	- 3.4
1967	1.18	

Source: Exxon Corp.

NOTE: Based on mid-year regular grade gasoline prices.

TABLE 4-22. JAPANESE REAL GASOLINE PRICE FORECASTS, 1980-1985

	Price (1980 Dollars)	Change From Previous Year (Percent)
1980*	2.35	
1981*	2.31	-1.5
1982	2.35	+1.7
1983	2.39	+1.7
1984	2.44	+2.1
1985	2.49	+2.0

Source: Economic Models, Ltd., World Auto Forecasts Report, April 1981.

*Actual Prices. Others are forecasts.

Japanese demand for motorcycles is at least partially due to Japan's geographics. Japan is not a large country, and because of the mountainous terrain only about one-third of the land mass is suitable for habitation. The result is a densely populated country with large population clusters in crowded urban areas. There is relatively little land allocated for road networks and parking. Thus, maneuverability in heavy traffic congestion and ease of parking in constricted spaces make the motorcycle a very attractive option to the Japanese. These same factors probably imply that the Japanese car market will become or has become saturated at much lower registration levels than in North America.[27]

4.4.2 New Truck Demand

Japanese demand for new trucks reached a record 2.14 million units in 1980. Though car sales stagnated (Table 4-19), a new truck sales record in excess of 2.26 million units was set during 1981 (Table 4-23). Japanese truck demand has followed a curious pattern: from 1961 through 1969 demand increased steadily, from 1970 through 1974 demand went cyclical, and then from 1975 to date demand increased steadily once again. All-time sales records have been set during each of the past three years.

Japanese truck ownership levels are very high, exceeded only in the more mature North American market with its highly developed recreational vehicle (light truck) market. Japanese truck demand is almost entirely for mini- and light trucks (only 9 percent of 1979 sales were in the medium and heavy truck range). Unlike demand in North America, however, Japanese demand for light trucks is derived from industrial and not recreational use. The bulk of goods transportation in the congested urban areas of Japan is done by means of car-derived vans with small carrying capacities.[6] Therefore, although truck registration levels in Japan and North America are not dissimilar, the composition of the respective truck fleets is entirely different.

TABLE 4-23. JAPANESE NEW TRUCK SALES, 1961-1981 (MILLIONS)

1981	2.26
1980	2.14
1979	2.09
1978	1.80
1977	1.67
1976	1.63
1975	1.55
1974	1.54
1973	1.96
1972	1.72
1971	1.60
1970	1.69
1969	1.77
1968	1.71
1967	1.56
1966	1.30
1965	1.07
1974	0.99
1963	0.83
1962	0.66
1961	0.50

Source: Japan Automobile Dealers Association, Inc.

The very strength of current Japanese truck demand tends to indicate that the limit for truck demand may be reached soon. More than 98 percent of all goods movement in Japan in the 1-100 kilometer range is done by truck transport; the comparable figure for greater distances is over 80 percent.[6] Furthermore, trucks are still increasing their share of the freight transportation market, at the expense of rail and water transport. Once these latter alternatives have been eclipsed in all feasible circumstances, further growth in truck demand could only increase with the general level of economic activity. This point is likely to be reached very soon.

4.5 REST OF THE WORLD

The "rest of the world" region is a polyglot of diverse nations, peoples, and economies. The region includes several developed nations (in the Oceania sub-region), planned economies (Eastern Europe), developing countries (Latin America), some of the poorest and most underdeveloped countries (in Asia), and some fabulously wealthy nations (Kuwait in the Africa-Mideast sub-region).

Though tremendously heterogenous, the "rest of the world" is treated as a single forecasting region by most published forecasts of world demand (see Table 3-2). This is unfortunate because, for example, there is very little commonality between Kuwait and China. To alleviate this gross aggregation, this Section identifies five distinct sub-regions within the "rest of the world" region. After an opening discussion concerning the entire region, this Section will confine analysis to a sub-region framework.

The "rest of the world" is the largest region in the world with 84 percent of the world's population. This region's expected rate of population growth is also the highest of any region

(Table 4-4). The "rest of the world" is the poorest of the forecasting regions, and its forecasted income growth is lower than that of every other region except North America (Table 4-3). Car and truck ownership levels are the lowest in the world (Tables 4-1 and 4-2). These regional statistics mask important differences between sub-regions within the "rest of the world" region. Table 4-24 lists registration, income, and population data for each sub-region.

New car demand in the "rest of the world" was 5.5 million units in 1980. Table 4-25 shows how new car demand in the "rest of the world" was distributed between sub-regions. Published projections for 1985 range from 5.5 million to 16 million units; 1990 projections range from 5.5 to 27 million units (Table 3-1). These forecasts represent the greatest degree of "uncertainty" among all published car demand forecasts (Table 3-3).

These projections are based on the aggregate "rest of the world" forecasts made by forecasters of worldwide demand; these forecasters do not disclose how they expect this demand to be distributed between sub-regions. These forecast ranges encompass both the plausible and the wildly unrealistic.

As an initial means of assessing the credibility of the higher end of these published car demand forecast ranges, an attempt has been made to develop forecast ranges for each sub-region within the "rest of the world." A thorough literature search uncovered car demand growth rate forecasts from a number of sources and for each sub-region. These were assembled in a way to preserve the most optimistic forecast for each sub-region. The resulting individual sub-region forecasts ranges are shown in Table 4-26. From this exercise, it appears that 1990 car demand of between 11 million and 12 million units for the "rest of the world" region is the upper boundary of plausibility. Even this range may seem high in light of other factors operating within each sub-region (see below).

TABLE 4-24. "REST OF WORLD" DATA BY SUB-REGION

SUB-REGION	TOTAL CAR REGISTRATIONS AS OF 1979 (THOUSANDS) (1)	CARS/1000 PERSONS (1)	TOTAL TRUCKS REGISTRATIONS AS OF 1979 (THOUSANDS) (2)	TRUCKS/1000 PERSONS (2)	1980 PER CAPITA INCOME (1975 DOLLARS) (3)	PROJECTED ANNUAL REAL INCOME GROWTH 1990/1980 (PERCENT) (3)	HISTORICAL REAL PER CAPITAL INCOME GROWTH 1990/1980 (PERCENT) (3)	1979 POPULATION (MILLIONS) (4)	PROJECTED ANNUAL POPULATION GROWTH 1990/1979 (PERCENT) (4)
Oceania	7,093	326	1,730	79	5,259	2.8	1.6	22.4	1.4
Eastern Europe	17,610	45	8,965	23	3,236	2.9	2.8	397.0	0.9
Latin America	17,025	29	6,376	19	1,258	3.2	3.1	352.8	2.8
Africa-Mideast	9,366	17	4,286	8	800	3.3	3.5	576.0	2.9
Asia (excl. Japan)	4,501	2.0	3,717	1.6	321	3.9	4.1	2,349.6	1.6
Total for "Rest of World"	55,596	15	25,074	7	850	2.9	2.9	3,697.8	1.9

Source:

(1) MVMA, World Motor Vehicle Data, 1981 edition

(2) MVMA, World Motor Vehicle Data, 1981 edition

(3) Predicasts, Inc., World Product Casts, Issue P-1, May 29, 1981.

(4) U.S. Statistical Abstract, 1981 edition

TABLE 4-25. "REST OF WORLD" NEW CAR SALES, 1980 BY SUB-REGION (MILLIONS)

Oceania	0.5
Eastern Europe	2.1
Latin America	1.6
Africa-Mideast	1.0
Asia (excl. Japan)	0.4
Total	5.5

Source: See Tables 4-29, 4-32, 4-35, 4-38 and 4-41.

TABLE 4-26. "REST OF WORLD" NEW CAR DEMAND FORECASTS, 1980-1990, BY SUB-REGION (MILLIONS)

	1980*	1985	1990	ANNUAL GROWTH RATE (PERCENT)
Oceania	0.5	0.6-0.7	0.7-0.9	3-6
Eastern Europe	2.1	2.4-2.6	2.8-3.1	3-4
Latin America	1.6	2.1-2.6	2.9-4.1	6-10
Africa-Mideast	1.0	1.3-1.6	1.6-2.6	5-10
Asia (excl. Japan)	0.4	0.4-0.5	0.5-0.7	3-6
Total	5.5	6.8-8.0	8.5-11.4	4.3-7.6

*Estimated actual sales

Sources: Iron Age, June 2, 1980; Ward's Auto World, March 1981 and September 1981; Asian Wall St. Journal, August 24, 1981; Transports, March 1981; Automotive News, April 6, 1981 (A. Gary Shilling & Co.), May 25, 1981 (Sage Associates), December 8, 1980 (Frost & Sullivan).

New truck demand in the "rest of the world" was 3.3 million units in 1980. Table 4-27 shows how this new truck demand was distributed among sub-regions. Published projections for 1985 range from 3.3 million to 8 million units; 1990 projections range from 3.3 million to 15 million units (Table 3-6). The upper end of these forecasts represent annual growth rates of 16 to 19 percent, which is four times greater than the forecasted growth rate for any other region (see Table 3-7). The lower end of these truck forecasts describe a replacement market with no net growth. Taken together, these two statements explain why this region's published truck demand forecasts contain the greatest amount of "uncertainty" of all the truck demand forecasts (Table 3-8).

4.5.1 Oceania

Oceania includes the countries of Australia and New Zealand. Registration, income, and population data for each country are shown in Table 4-28. Car and truck sales for 1980 are shown in Tables 4-29 and 4-30.

Oceania closely resembles the developed countries of North America and Western Europe in registration levels and income. The very high registration levels indicate the market is mature. Growth potential in this market is quite limited, and probably will be confined to population growth levels. In light of this, the Oceania demand forecasts of Table 4-26 seem unrealistically high.

4.5.2 Eastern Europe

Eastern Europe is defined as the Communist bloc nations of Comecon plus Yugoslavia. With the exception of Oceania, the Eastern European sub-region is the most affluent and has the highest ownership levels of cars and trucks (Table 4-24). Individual nation data for Eastern Europe are given in Table 4-31. Estimated 1980 car and truck sales for each country are shown in Tables 4-32 and 4-33. It is clear that the Soviet Union dominates Eastern Europe in terms of total vehicle registrations and demand, though lagging behind in per capita rates.

TABLE 4-27. "REST OF WORLD" NEW TRUCK SALES, 1980, by SUB-REGION (MILLIONS)

Oceania	0.15
Eastern Europe	1.2
Latin America	0.6
Africa-Mideast	0.75
Asia (excl. Japan)	0.5
Total	3.3

Source: See Tables 4-30, 4-33, 4-36, 4-39 and 4-42.

TABLE 4-28. OCEANIA

COUNTRY	TOTAL CAR REGISTRATIONS AS OF 1979 (THOUSANDS) (1)	CARS/ 1000 PERSONS (1)	TOTAL TRUCK REGISTRATIONS AS OF 1979 (THOUSANDS) (2)	TRUCKS/ 1000 PERSONS (2)	1980 PER CAPITA INCOME (1975 DOLLARS) (3)	PROJECTED ANNUAL REAL PER CAPITA INCOME GROWTH 1990/1980 (PERCENT) (3)	HISTORICAL REAL PER CAPITA INCOME GROWTH 1980/1970 (PERCENT) (3)	1979 POPULATION (MILLIONS) (4)	PREDICTED ANNUAL POPULATION GROWTH 1990/1979 PERCENT (4)
Australia	5,657	392	1,413	98	6,863	3.1	1.9	14.4	1.0
New Zealand	1,274	410	249	80	4,629	2.4	1.2	3.1	1.6
Other Oceania	162	38	68	16	1,010	2.6	1.9	4.9	2.5
Total Oceania	7,093	326	1,730	79	5,259	2.8	1.6	22.4	1.4

Source:

(1) MVMA, World Motor Vehicle Data, 1981 edition

(2) MVMA, World Motor Vehicle Data, 1981 edition

(3) Predicasts, Inc., World Product Casts, Issue P-1, May 29, 1981.

(4) U.S. Statistical Abstract, 1981 edition

TABLE 4-29. OCEANIA NEW CAR SALES, 1980, BY COUNTRY

Australia	462,000
New Zealand	76,000
Other	10,000
Total Oceania	0.5 million

Source: Economic Models, Ltd., World Auto Forecasts Report, April 1981; and MVMA, World Motor Vehicle Data, 1981 edition.

TABLE 4-30. OCEANIA NEW TRUCK SALES, 1980, BY COUNTRY

Australia	110,000
New Zealand	21,000
Other	5,000
Total Oceania	0.15 million

Source: Economic Models, Ltd., World Auto Forecasts Report, April 1981; and MVMA, World Motor Vehicle Data, 1981 edition.

TABLE 4-31. EASTERN EUROPE

COUNTRY	TOTAL CAR REGISTRATIONS AS OF 1979 (THOUSANDS) (1)	CARS/ 1000 PERSONS (1)	TOTAL TRUCK REGISTRATIONS AS OF 1979 (THOUSANDS) (2)	TRUCKS/ 1000 PERSONS (2)	1980 PER CAPITA INCOME (1975 DOLLARS) (3)	PROJECTED ANNUAL REAL PER CAPITA INCOME GROWTH 1990/1980 (PERCENT) (3)	HISTORICAL REAL PER CAPITA INCOME GROWTH (1980/1970 (PERCENT) (3)	1979 POPULATION (MILLIONS) (4)	PROJECTED ANNUAL POPULATION GROWTH 1990/1979 (PERCENT) (4)
Soviet Union	7,000	27	6,500	25	3,430	2.6	2.6	263.4	0.9
East Germany	2,500	149	645	38	4,426	3.1	3.3	16.8	0.1
Yugoslavia	2,285	103	317	14	1,982	4.6	4.9	22.2	0.7
Czechoslovakia	2,133	140	354	23	4,026	2.3	2.1	15.2	0.6
Poland	2,117	60	649	18	2,555	3.1	2.8	35.2	0.9
Hungary	820	77	255	24	2,577	2.7	2.2	10.7	0.3
Bulgaria	520	58	120	13	2,452	3.6	3.2	8.8	0.6
Romania	235	11	125	6	2,758	5.1	4.7	22.1	0.8
Total Eastern Europe	17,610	45	8,965	23	3,236	2.9	2.8	397.0	0.9

NOTE: Excludes Albania because of insufficient data.

Source:

(1) MVMA, World Motor Vehicle Data, 1981 edition

(2) MVMA, World Motor Vehicle Data, 1981 edition

(3) Predicasts, Inc., World Product Casts, Issue P-1, May 29, 1981.

(4) U.S. Statistical Abstract, 1981 edition

TABLE 4-32. EASTERN EUROPEAN NEW CAR SALES, 1980, BY COUNTRY

Soviet Union	870,000
East Germany	239,000
Yugoslavia	256,000
Czechoslovakia	186,000
Poland	384,000
Hungary	90,000
Bulgaria	40,000
Romania	20,000
Total Eastern Europe	2.1 million

Source: Economic Models, Ltd., World Auto Forecasts Report, April 1981; "Behind the Iron Curtain: Vehicle Production Rises," Automotive Industries, February 1980, and TSC analysis of MVMA sales and registration data.

TABLE 4-33. EASTERN EUROPEAN NEW TRUCK SALES, 1980, BY COUNTRY

Soviet Union	860,000
East Germany	75,000
Yugoslavia	40,000
Czechoslovakia	40,000
Poland	80,000
Hungary	25,000
Bulgaria	20,000
Romania	25,000
Total Eastern Europe	1.2 million

Source: Economic Models, Ltd., World Auto Forecasts Report, April 1981; "Behind the Iron Curtain: Vehicle Production Rises," Automotive Industries, February 1980, pp. 91-95, and TSC analysis of MVMA sales and registration data.

Eastern European economies are planned. As a general rule, vehicle "demand" in this sub-region is equal to production.* Eastern European production is dictated by five year state plans which decree the models and volumes to be produced, largely irrespective of consumer demand. Most cars are built for government or military officials, or are used as inducements to lure workers to otherwise unpopular jobs and to reward particularly productive workers. The general public has virtually no access to new cars through official channels - Moscow has only two "dealerships" and the waiting list is four years and longer. As a consequence, there exists tremendous latent demand for cars that has fueled a thriving black and gray market for used cars, usually supplied by officials' clandestine resales. In this fashion, automobile ownership has diffused somewhat into the civilian population, the result being merely to whet consumer demand.[30] It is interesting to note that car ownership levels in Eastern Europe are highest in those countries (East Germany, Czechoslovakia, Yugoslavia) which border Western nations (see Table 4-31).

Perhaps in recognition of burgeoning consumer demand, current five-year plans in Eastern Europe call for expanded car and truck production.[28] In addition, analysts view this areas as one of moderate demand growth (Table 4-26). But putting too great a reliance on these expectations would be to contradict the current realities.

First and foremost, Eastern Europe lacks the infrastructure and related services to support increased vehicle ownership. There are fewer miles of paved roads in the Soviet Union than in

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*The exception to this statement is the relatively insubstantial level of vehicle trade outside this sub-region. In 1978, about 225,000 vehicles (7 percent) were exported. Imports accounted for 82,000 sales (about 2.5 percent).[28] Recent data indicate, however, that the level of Eastern European motor vehicle trade with other countries and regions is on the upswing.[29]

the entire state of Pennsylvania. Vast areas of rural Russia lack even graded dirt roads; those that exist are impassable at least one-third of each year. Even in Moscow, the streets are dotted with bone-jarring (and axle-snapping) potholes. Furthermore, Soviet vehicle production plans have not been accompanied by funding for infrastructural improvements. Road signs are nonexistent or inaccurate. Gasoline stations are few and far between. Roadside cafes and motels are only a dream. Repair facilities are rare and extremely slow, and consequently the driver must be part mechanic.[28] Because of a lack of driver training programs, half of all cars in Moscow are involved in accidents each year.[30] Many of these infrastructural shortcomings are traceable to an ideological commitment to favor the collective good (mass transit) over private automobile transportation. As a corollary, there is greater emphasis on truck production (especially medium and heavy) for the industrial sector. Further sustained growth in this sector is expected, to the detriment of the privately owned automobile. These government "policies" are and will continue to be the most pervasive determinants of Eastern European vehicle demand.

There are other factors inhibiting demand growth in Eastern Europe. To date, the Soviet Union has been able to supply Eastern bloc petroleum needs, with the excess exported to other nations. Oil exports have been a very valuable source of hard currency. Soviet production has peaked, however, and oil exports cannot be expected to provide as much revenue in the future. Soviet aid to its satellites is becoming increasingly expensive (more than $10 billion to Poland alone in 1981), exacerbating cash flow problems.[31] The 1981 Soviet wheat harvest was more than one-third below expectations, requiring costly imports. Soviet President Brezhnev has acknowledged that "the food problem is, economically and politically, the central problem of the five-year plan."[32] To raise money, the Soviet Union has been selling gold and diamonds in quantities sufficient to depress world market prices. Communist loans from Western banks have

more than doubled in the past four years, reaching a total of mo: than $80 billion in 1981. Many analysts believe these loans wil: never be paid off. The Siberian-Western European gas pipeline, which the Soviets expect to provide 50 percent of their future hard currency reserves, will be of paramount importance to the future viability of the Soviet economy.[33] Without it, some analysts fear the economic collapse of Eastern Europe.[31] The gravam of this paragraph is that in addition to the lack of an adequate infrastructure in Eastern Europe, the area does not seem a likely candidate for economic prosperity, making vehicle demand growth even less likely.

4.5.3 Latin America

The Latin American sub-region includes the nations of Central and South America. Though vehicle ownership is not nearly as widespread as in North America, Western Europe, Japan, and Eastern Europe, the Latin American sub-region is widely viewed as the growth market of the 1980s (Table 4-26). As will be discussed below, significant obstacles will need to be overcome for this optimistic scenario to be realized. Table 4-34 lists registration, income, and population data for the latin American countries. Estimated car and truck sales for each country are included in Tables 4-35 and 4-36.

Latin American new car demand totaled 1.6 million units in 1980; new truck demand was 0.6 million units. Brazil, Mexico, Argentina, and Venezuela are the major markets; together they account for 80-90 percent of all vehicle registrations and new vehicle sales.

Latin America includes nations that are relatively affluent (Venezuela) as well as some that are particularly poor (Colombia). As a sub-region, Latin America is considerably less wealthy than Eastern Europe. Only Brazil has enjoyed sustained and strong income growth during the past decade, although Venezuela and Mexico with their oil reserves could be exceptions in the future. Elsewhere, hyper-inflation and political instability have severely traumatized economic confidence. Increased energy costs have exacted a heavy toll, and crop failures (especially coffee

TABLE 4-34. LATIN AMERICA

COUNTRY	TOTAL CAR REGISTRATIONS AS OF 1979 (THOUSANDS) (1)	CARS/ 1000 PERSONS (1)	TOTAL TRUCK REGISTRATIONS AS OF 1979 (THOUSANDS) (2)	TRUCKS/ 1000 PERSONS (2)	1980 PER CAPITA INCOME (1975 DOLLARS) (3)	PROJECTED ANNUAL REAL PER CAPITA INCOME GROWTH 1990/1980 (PERCENT) (3)	HISTORICAL REAL PER CAPITA INCOME GROWTH 1980/1970 (PERCENT) (3)	1979 POPULATION (MILLIONS) (4)	PROJECTED ANNUAL POPULATION A GROWTH 1990/1979 (PERCENT) (4)
Brazil	7,250	61	1,950	16	1,376	3.8	5.4	119.2	3.0
Mexico	3,323	51	1,412	21	1,441	3.3	1.9	65.8	3.7
Argentina	2,784	102	1,193	44	1,502	2.8	1.5	27.2	1.0
Venezuela	1,270	87	551	38	2,789	2.1	2.3	14.5	3.1
Colombia	490	19	139	5	640	2.5	3.0	26.2	2.5
Chile	336	31	193	18	1,058	3.6	1.1	10.8	1.8
Peru	318	19	164	10	834	1.7	0.8	17.2	2.8
Other Latin America	1,254	22	774	13	871	2.4	1.6	71.9	2.5
Total Latin America	17,025	29	6,376	19	1,258	3.2	3.1	352.8	2.8

Source:

(1) MVMA, World Motor Vehicle Data, 1981 edition

(2) MVMA, World Motor Vehicle Data, 1981 edition

(3) Predicasts, Inc., World Product Casts, Issue P-1, May 29, 1981.

(4) U.S. Statistical Abstract, 1981 edition

TABLE 4-35. LATIN AMERICAN NEW CAR SALES, 1980, BY COUNTRY

Brazil	818,000
Mexico	286,000
Argentina	240,000
Venezuela	140,000
Colombia	32,000
Chile	25,000
Peru	13,000
Other	75,000
Total Latin America	1.6 million

Source: Economic Models, Ltd., World Auto Forecasts Report, April 1981; Krish Bhaskar, The Future of the World Motor Industry; Automotive News, (various issues); and TSC analysis of MVMA sales and registration data.

TABLE 4-36. LATIN AMERICAN NEW TRUCK SALES, 1980, BY COUNTRY

Brazil	180,000
Mexico	177,000
Argentina	100,000
Venezuela	50,000
Colombia	10,000
Chile	12,000
Peru	13,000
Other	50,000
Total Latin America	0.6 million

Source: Economic Models, Ltd., World Auto Forecasts Report, April 1981; Krish Bhaskar, The Future of the World Motor Industry; Automotive News, (various issues); and TSC analysis of MVMA sales and registration data.

beans) have highlighted the vulnerability of most of the Latin American economies.[6]

In the past year economic stagnation has driven Argentinian car demand down 30 percent.[34] Brazil, the dominant Latin American market, suffered a 38 percent decline in new car sales in the first seven months of 1981.[35] Though declines of this magnitude are probably temporary, the long term outlook for Latin American demand is clouded.

The greatest obstacle to demand growth in Latin America is the lack of an adequate infrastructure. Even if consumers have sufficient purchasing power, car sales will be inhibited by inferior road networks. Development of road systems, assuming the finances and predisposition are present, will be problematic in such a large and geographically diverse sub-region.

The inadequate road infrastructure will mean that truck demand will be concentrated on smaller trucks and four-wheel drive vehicles suitable for the rough terrain. Truck demand does not face serious competition from either rail or water networks in Latin America because the latter are impractical for the large, sparsely populated areas of much of the sub-region. With the exception of Venezuela, Mexico, and Chile, Latin America is heavily dependent on oil imports. Brazil has taken positive steps with its alcohol fueled and alcohol/gasoline fueled cars, but the area as a whole remains vulnerable. Future oil import bills for these countries will go a long way toward determining relative affluence, and in turn, vehicle demand.

4.5.4 Africa-Mideast

The Africa-Mideast sub-region, as a whole, is relatively poor. Income growth over the past ten years has been strong, however, and is expected to continue. This sub-region is also expected to have the greatest rate of population growth (Table 4-24). For these reasons, forecasters expect this to be the second great growth market of the 1980s (Table 4-26),

trailing only demand growth in Latin America. Individual country data for the Africa-Mideast sub-region are shown in Table 4-37. Africa-Mideast had car sales of 1.0 million units and truck sales of 750,000 units in 1980. Tables 4-38 and 4-39 give 1980 car and truck sales for each nation.

Forecasters believe car sales for Africa-Mideast could reach between 1.6 and 2.6 million units by 1990 (Table 4-26). This will be realized only if the currently inadequate infrastructure is developed. The wealthier Mideast nations (especially OPEC members) can afford this; most of the African nations cannot. Consequently, a number of the African countries have sought external financing for road development from agencies such as the World Bank (see Section 2.3). Whether support will continue for further infrastructural development is an open question.

General economic prosperity will also be needed if vehicle demand is to be fostered. With the exception of South Africa, the African nations are poor. Income growth is expected, but is highly dependent on moderating oil prices. Some African economies have been severely strained by the oil price hikes of 1978-79; recurrence could decimate entire economies (see Section 6.6). Another crucial piece in the economic picture for these nations is food prices, which are subject to the whims of nature and highly unpredictable.[15]

The economic future is much more optimistic for the OPEC countries of the Mideast and Nothern Africa. These countries, notably Saudi Arabia, Kuwait, and Libya, have very high per capita income levels and well-developed demand for motor vehicles. Saudia Arabia is already the third largest new car market and the largest new truck market in the Africa-Mideast sub-region. Kuwait has a car registration level nearly as high as that of Western Europe. Some analysts believe the OPEC countries, because of their wealth and petroleum reserves, will be the single greatest future growth market.[36] Already high registration levels and an underdeveloped infrastructure make this less than a certainty.

TABLE 4-37. AFRICA - MIDEAST

COUNTRY	TOTAL CAR REGISTRATIONS AS OF 1979 (THOUSANDS) (1)	CARS/ 1000 PERSONS (1)	TOTAL TRUCK REGISTRATIONS AS OF 1979 (THOUSANDS) (2)	TRUCKS/ 1000 PERSONS (2)	1980 PER CAPITA INCOME (1975 DOLLARS) (3)	PROJECTED ANNUAL REAL PER CAPITA INCOME GROWTH 1990/1980 (PERCENT) (3)	HISTORICAL REAL PER CAPITA INCOME GROWTH 1980/1970 (PERCENT) (3)	1979 POPULATION (MILLIONS) (4)	PROJECTED ANNUAL POPULATION A GROWTH 1990/1979 (PERCENT) (4)
Rep. of South Africa	2,331	84	897	32	1,431	2.0	0.7	27.8	2.9
Iran	1,400	37	200	5	1,007	4.1	-1.1	37.4	2.9
Turkey	659	15	401	9	997	2.7	3.2	44.6	2.3
Saudi Arabia	507	55	505	54	7,653	3.9	8.6	9.3	2.0
Nigeria	461	6	304	4	571	3.9	3.9	74.6	3.4
Egypt	379	9	115	3	433	3.4	3.6	41.0	2.3
Kuwait	363	284	133	104	14,800(est.)	5.0	4.5	1.3	5.8
Israel	334	88	115	30	3,718	3.3	2.6	3.8	2.2
Libya	313	107	72	25	6,100(est.)	5.0	4.0	2.9	3.7
Iraq	180	14	82	6	1,400(est.)	2.0	1.8	12.9	3.2
Other Africa-Mideast	2,439	8	1,462	5	460	2.7	3.4	320.4	2.9
Total Africa-Mideast	9,366	17	4,286	8	800	3.3	3.5	576.0	2.9

Source:

(1) MVMA, World Motor Vehicle Data, 1981 edition

(2) MVMA, World Motor Vehicle Data, 1981 edition

(3) Predicasts, Inc., World Product Casts, Issue P-1, May 29, 1981.

(4) U.S. Statistical Abstract, 1981 edition

TABLE 4-38. AFRICA-MIDEAST NEW CAR SALES, 1980, BY COUNTRY

Rep. of South Africa	277,000
Iran	120,000
Turkey	27,000
Saudia Arabia	171,000
Nigeria	60,000
Egypt	18,000
Kuwait	43,000
Israel	35,000
Libya	18,000
Irac	46,000
Oman	37,000
Algeria	21,000
Other	130,000
Total Africa-Mideast	1.0 million

Source: Automotive News, May 25, 1981, and November 2, 1981; TSC Analysis of MVMA sales and registration data.

TABLE 4-39. AFRICA-MIDEAST NEW TRUCK SALES, 1980, BY COUNTRY

Rep. of South Africa	128,000
Iran	35,000
Turkey	25,000
Saudia Arabia	197,000
Nigeria	40,000
Egypt	30,000
Kuwait	27,000
Israel	10,000
Libya	49,000
Iran	67,000
Oman	38,000
Algeria	11,000
Other	100,000
Total Africa-Mideast	0.75 million

Source: Automotive News, May 25, 1981, and November 2, 1981; TSC Analysis of MVMA sales and registration data.

4.5.5 Asia (excluding Japan)

This area is the sub-region of extremes. It has the largest population, the lowest income, the highest expected income growth rate, the fewest cars, and the lowest car and truck registration levels (Table 4-24). Individual nation data are shown in Table 4-40. Asia (excluding Japan) car sales totaled roughly 400,000 units in 1980 (Table 4-41); truck sales were about 500,000 (Table 4-42).

This is the sub-region with the greatest long term potential demand if one considers only population, but if one also considers affluence, this area does not look like a substantial market for years to come. Furthermore, Asia (except for Japan) lacks a motor vehicle infrastructure and the resources and predisposition to develop one. The likeliest candidates for motor vehicle demand growth in Asia, again except for Japan, are South Korea and Taiwan, with their emerging industrial sectors, and Indonesia and Malaysia, with their petroleum revenues. In addition, some analysts pinpoint the Philippines as a major growth market.[37] China, despite car manufacturers' hopes,[38] will not soon be a major market, though it is the largest truck market in this sub-region (see Table 4-42).

TABLE 4-40. ASIA (EXCLUDING JAPAN)

COUNTRY	TOTAL CAR REGISTRATIONS AS OF 1979 (THOUSANDS) (1)	CARS/ 1000 PERSONS (1)	TOTAL TRUCK REGISTRATIONS AS OF 1979 (THOUSANDS) (2)	TRUCKS/ 1000 PERSONS (2)	1980 PER CAPITA INCOME (1975 DOLLARS) (3)	PROJECTED ANNUAL REAL PER CAPITA INCOME GROWTH 1990/1980 (PERCENT) (3)	HISTORICAL REAL PER CAPITA INCOME GROWTH 1980/1970 (PERCENT) (3)	1979 POPULATIONS (MILLIONS) (4)	PROJECTED ANNUAL POPULATION GROWTH 1990/1979 (PERCENT) (4)
India	860	1.3	516	0.8	143	1.3	0.3	667.3	2.4
Indonesia	577	4	453	3	280	4.0	4.8	148.1	2.2
Malaysia	567	41	145	11	1,007	4.8	4.7	13.7	2.0
Philippines	550	12	508	11	431	3.5	3.1	47.7	3.2
Thailand	396	8	390	8	457	4.3	4.8	46.7	2.6
Taiwan	325	19	70	4	1,400	5.2	7.3	17.5	1.4
South Korea	241	6	253	6	835	4.9	7.5	39.1	1.2
Pakistan	210	2.5	100	1.2	179	1.9	1.2	84.1	2.6
China	50	0.05	850	0.8	419	4.9	5.3	1,012.2	0.6
Other Asia	725	3	432	1.6	239	3.9	2.5	273.2	2.2
Total Asia (excluding Japan)	4,501	2.0	3,717	1.6	321	3.9	4.1	2,349.6	1.6

Source:

(1) MVMA, World Motor Vehicle Data, 1981 edition

(2) MVMA, World Motor Vehicle Data, 1981 edition

(3) Predicasts, Inc., World Product Casts, Issue P-1, May 29, 1981.

(4) U.S. Statistical Abstract, 1981 edition

TABLE 4-41. ASIA (EXCL. JAPAN) NEW CAR SALES, 1980, BY COUNTRY

India	31,000
Indonesia	40,000
Malaysia	75,000
Philippines	30,000
Thailand	20,000
Taiwan	74,000
South Korea	46,000
Pakistan	10,000
China	5,000
Hong Kong	34,000
Other	50,000
Total Asia (excl. Japan)	0.4 million

Source: Economic Models, Ltd., World Auto Forecasts Report, April 1981; Nachrichten fur Aussenhandel, May 5, 1981; and TSC analysis of MVMA sales and registration data.

TABLE 4-42. ASIA (EXCL. JAPAN) NEW TRUCK SALES, 1980, BY COUNTRY

India	110,000
Indonesia	25,000
Malaysia	17,000
Philippines	11,000
Thailand	22,000
Taiwan	18,000
South Korea	44,000
Pakistan	7,000
China	190,000
Hong Kong	15,000
Other	35,000
Total Asia (Excl. Japan)	0.5 million

Source: Economic Models, Ltd., World Auto Forecasts Report, April 1981; Nachrichten fur Aussenhandel, May 5, 1981; and TSC analysis of MVMA sales and registration data.

5. MOST LIKELY FORECAST RANGE, 1985-1990

The published forecasts discussed in Section 3 differ greatly. This is because some (overly optimistic) forecasters ignore the demand limitations to be found within a general understanding of the nature of motor vehicle demand. These include the derived demand nature of vehicle demand, alternatives, infrastructure needs, energy considerations, the nature of the economy and its implications, and the pervasive influence of government policy. These same forecasters tend to over-emphasize macroeconomic and trend variables, leading to unrealistically high forecasts. The goal of this Section is to develop realistic forecasts within the framework of demand outlined in Section 2.

Based on the analyses of Section 4, individual nation forecasts are formulated into sub-region and region forecasts in this Section. The analyses leading to these "most likely forecast ranges" are also summarized here.

North America

1980 Sales: 9.9 million cars, 2.8 million trucks

- o United States is major market (90%)

Analysis:

- o Energy future uncertain
- o Infrastructure deteriorating
- o Limited economic growth
- o Increasing prevalence of motor vehicle alternatives

Most Likely Forecast Range: 9.5-12 million cars, 3-4 million trucks

Western Europe

1980 Sales: 10.0 million cars, 1.3 million trucks

Analysis:

- o West Germany, France, Italy, and United Kingdom are major markets
- o With exception of United Kingdom, Western European countries in vulnerable oil positions
- o Infrastructure less developed than in North America
- o Limited economic growth
- o High usage of vehicle alternatives
- o Little recreational usage of trucks

Most Likely Forecast Range: 9.5-12 million cars, 1-1.5 million trucks

Japan

1980 Sales: 2.9 million cars, 2.1 million trucks

Analysis:

- o Very vulnerable to oil shocks (85% + imported)
- o Economic success story already fading, though forecasted income growth is still relatively high
- o Increasing worldwide trend of protectionism will limit Japanese export growth
- o Because of mountainous terrain, Japan is densely populated in croweded urban clusters (physical constraints on parking)
- o Tremendous usage of the motorcycle alternative (2.4 million sales in 1980)
- o Industrial sector truck usage is already at a maximum

Most Likely Forecast Range: 2.5-3.0 million cars, 2-2.5 million trucks

REST OF WORLD:

Oceania

1980 Sales: 0.5 million cars, 0.15 million trucks

Analysis:

- o Australia and New Zealand are major markets
- o Oceania market closely resembles those of the developed countries of North America and Western Europe
- o Very high registration levels indicate the market is mature

Most Likely Forecast Range: 0.5-0.6 million cars, 0.15-0.20 million trucks

Eastern Europe

1980 Sales: 2.1 million cars, 1.2 million trucks

Analysis:

- o Soviet Union is major market (40% of cars and 70% of trucks)
- o Planned economies deemphasize private automobile transportation and emphasize truck production for industrial sector
- o Poor infrastructure and related services
- o Eastern European economies are weak, highlighted by recurrent crop failures

Most Likely Forecast Range: 2.1-2.3 million cars, 1.1-1.4 million trucks

Latin America

1980 Sales: 1.6 million cars, 0.6 million trucks

Analysis:

- o Brazil, Mexico, Argentina, and Venezuela are major markets
- o Hyper-inflation and political instability have traumatized economic confidence
- o Economic future clouded because of energy costs and crop vulnerability (notably coffee beans), though Venezuela and Mexico (with their oil reserves) could be exception
- o Infrastructure inadequate, and its development will be hindered in this large and geographically diverse area

Most Likely Forecast Range: 1.6-1.9 million cars, 0.6-0.8 million trucks

Africa - Mideast

1980 Sales: 1.0 million cars, 0.75 million trucks

Analysis:

- o Rep. of South Africa and Saudi Arabia are major markets
- o Economic outlook bright for some (OPEC members), but dismal for much of area, largely due to energy costs
- o Infrastructure needs to be developed - who will pay?

Most Likely Forecast Range: 1.0-1.2 million cars, 0.7-1.0 million trucks

Asia (Excluding Japan)

1980 Sales: 0.4 million cars, 0.5 million trucks

Analysis:

- o Malaysia, Taiwan, South Korea, and Indonesia are major car markets; China and India are major truck markets
- o Area lacks an infrastructure, and the resources and predisposition to develop one
- o Existing demand has emphasis on heavy-duty trucks
- o Area of greatest long term potential (if one looks only at population), but if affluence is also considered this does not look like a substantial market for years to come

Most Likely Forecast Range: 0.4-0.5 million cars, 0.5-0.6 million trucks

These individual region and sub-region forecast ranges can be summarized into a world "most likely forecast range." This represents the most likely course of world demand for the period 1985-1990.

Most Likely Forecast Range of 1985-1990 Demand (millions)

	Cars	Trucks	Total
North America	9.5-12	3 - 4	12.5 -16
Western Europe	9.5-12	1 - 1.5	10.5 -13.5
Japan	2.5- 3	2 - 2.5	4.5 - 5.5
Rest of World:			
Oceania	0.5- 0.6	0.15- 0.20	0.65- 0.8
Eastern Europe	2.1- 2.3	1.1 - 1.4	3.2 - 3.7
Latin America	1.6- 1.9	0.6 - 0.8	2.2 - 2.7
Africa-Mideast	1.0- 1.2	0.7 - 1.0	1.7 - 2.2
Asia (Excl. Japan)	0.4- 0.5	0.5 - 0.6	0.9 - 1.1
Total	27.1-33.5	9.1 -12.0	36.2 -45.5

6. SOURCES AND METHODOLOGIES OF PUBLISHED FORECASTS

This section summarizes the sources and methodologies from which the published forecasts in this report are drawn. To the extent the information is ascertainable and is not proprietary, specific assumptions underlying the forecasts are highlighted. This Section concludes with some general remarks about the interpretation of economic forecasts.

6.1 ECONOMIC MODELS, LTD.

Economic Models, Ltd. (EML) makes semi-annual projections of world demand in a publication entitled World Auto Forecasts Report. The projections within this paper are from the April, 1981 Report. Since then, EML has been acquired by DRI, and their offerings have been restructured.

EML uses a stock-adjustment econometric model, with the universe of cars including only those cars up to six years old. Optimistic economic assumptions underpin EML's projections. For the period 1982-1985, EML projects annual real income growth of roughly 2-4 percent throughout the world. Petroleum prices are projected to rise at about one percent annually in real terms with, apparently, no serious supply interruptions.

6.2 EURO FINANCE

Euro Finance publishes periodic reports on selected Western European industries as part of its Industry Study Program. The projections within this paper come from Euro Finance's European Car Industry Report of 1980.

Euro Finance does not indicate the specific assumptions underlying its projections, but it does call its economic/industrial development assumptions "plausible, but some what optimistic" (p. 25). Read within the context of the entire report, this seems to imply that Euro Finance has assumed real

income growth of two to four percent per annum for the industrialized nations, with higher growth in the "rest of the world." Assumptions concerning petroleum are much less optimistic, with Euro Finance expecting oil supply and price jolts to be a feature of economic life throughout the 1980's. No specific oil price projections are given.

6.3 THE FUTURE OF THE WORLD MOTOR INDUSTRY

This book, by Professor Krish Bhaskar of the University of East Anglia (England), is a comprehensive study of global demand and supply. The book contains a large number of projections with a very wide range. The source of Bhaskar's projections (macroeconometric model, discrete choice model, educated guess, etc.) is unclear, although it seems to be a synthesis of other published projections and the author's own "subjective estimates" (p. 370).

General assumptions include higher rates of inflation, slower economic growth, and possible trade restrictions. No quantification is given for the first two assumptions. Petroleum supply and price is not considered to be an obstacle to increased demand. Bhaskar believes that as oil prices rise and supply is exhausted an alternative source of power will be found "which can be substituted for petrol" (p. 347). This belief would seem to be the driving force behind his extremely optimistic "high" projections for world demand in 1990, especially in the case of the "rest of the world."

6.4 "INDUSTRY" PROJECTIONS

The so-called "industry" projections are the composite of two sets of industry forecasts. The first set is Toyota's forecasts, as reported in the MVMA's World Motor Vehicle Data, 1981 edition. The second set of forecasts is derived from statements made by Philip Caldwell, chairman of Ford Motor Co., and Thomas Murphy, former chairman of General Motors Corp. These statements were reported in Iron Age issues of April 7 and June 2, 1980, and Wards' Auto World, January 1980.

The "industry" projections represent the best guesses of knowledgeable insiders about the likely course of future demand. Although not to be dismissed lightly, these projections may have an inherently optimistic bias in them. Other than Bhaskar's projections, the "industry" projections are the highest of the published forecasts.

Underpinning the "industry" projections are three crucial assumptions. The first is that there will be an increasing need for personal transportation throughout the world, and that the automobile will become even more firmly established as the preferred mode of personal transportation. The second is that real income growth will be adequate to finance this increased demand. The third is that greater political stability in the Middle East will ease uncertainty about the price and availability of gasoline.

6.5 A. GARY SHILLING AND COMPANY

A. Gary Shilling & Co. recently completed a study of long-term automobile demand. The results from which these projections were derived were reported in Automotive News, April 6, 1981.

Although the study's methodology and assumptions are not reported, these projections are significant because they are recent; they perhaps best reflect the impact of the 1979-80 oil price increases. These projections are the lowest of any consistent, inclusive published set (see Table 3-2). Demand in 1990 is projected to reach only 36.8 million units. Most significant is the projected distribution of this demand: most of the growth will accrue to the industrialized world, with demand in the "rest of the world" inching upward at a mere one percent annually. This is in sharp contrast to projections for the "rest of the world" made by every other published source.

6.6 "NO-GROWTH" PROJECTIONS

In general, all projections of demand growth rely on optimistic economic, industrial, and political assumptions. There is considerable evidence and feeling that this will not be realized. Hence, the "no-growth" projection is one of zero net growth in world new motor vehicle demand. Under this scenario, all markets would retain constant demand at roughly the replacement levels of 1980.

The "no-growth" projections are based on the twin possibilities of stagnating real income and oil supply price shocks. For the United States, Business Week[39] states "the golden age of the consumer is over...the big surges in consumer markets are over." Business Week goes on the predict that the American standard of living will shrink in the coming years, and that "high-priced oil lies at the heart" of the problem.

Nearly as pessimistic is an OECD[40] report that predicts that the U.S. and other industrialized countries will face "slower growth, more unemployment, rising inflation, and aggravated payment difficulties" as a result of massive oil price increases. The report warns that the OECD nations may be "condemned to a prolonged period of anemic growth by a physical shortage of oil in the world that will last at least until 1985." As a final note, the report warns that its grim forecasts may end up on the optimistic side.

The World Bank[41] predicts that economic growth rates will decline around the world in the first half of the 1980s. In their study, "World Development Report, 1980," the World Bank frequently emphasizes the importance of rising oil prices as determining these pessimistic projections. The study concludes that the world economy is going through a significant and irreversible structural change.

Non-oil producing developing countries are expected to be the most severely hurt by oil price increases. These countries, making up a large part of the "rest of the world," and previously

expected by most to be the largest growth markets for new autos, are in many cases having their economies decimated by oil import bills. The New York Times[42] reports that development plans in Asia, Africa, and Latin America "are being shelved or cut back." Throughout the third world, "oil price increases have dealt a blow to aspirations...and can be expected to increase inflation, retard growth, and strain political systems." The Nairobi Times, referenced in the New York Times' article, warns that "whole economies of several third world nations are about to be put out of business...the welfare of millions of third-world people will be at stake."

The above statements may seem somewhat dire in view of the highly publicized recent talk of an "oil glut."[43,44] It is true that world oil prices have dropped in the first quarter of 1982 and that current OPEC production of 20 million barrels daily compares to more than 30 million barrels daily in 1979, largely due to worldwide recession. These facts do not, however, mean the issue has disappeared. The very reason current oil prices have softened is the battering real incomes have taken in the past two years. With real oil prices down and as real incomes rebound, we may well experience another increase in oil demand, firming oil prices, and eventually leading to further price hikes. Even though the short term petroleum outlook seems favorable, the very benefit - lowered prices - will tend to increase demand and start the upward cycle all over.[45] This is precisely what happened during the period 1973-78.

DRI sums it up nicely: "...this is a Pyrrhic victory... relative energy prices can be expected to rise significantly after the present glut inevitably disappears..." DRI then goes on to forecast a 16 percent increase by 1990 in global oil demand, despite no growth in total demand by the developed countries.[46]

6.7 ECONOMETRIC FORECASTS

Many of the published forecasts in this paper come from econometric models. These include the forecasts from Data Resources, Inc., Chase Econometrics, Wharton, Evans, and Economic Models, Ltd. This section discusses the general nature and interpretive validity of econometric models.

Simply put, an econometric model consists of specified variables embedded in mathematical formulae (structural relations), numerical constants (parameters), and the software programmed for the computer (algorithm).

Econometric model building begins with the determination of the characteristics of a set of data. The data are not considered to have arisen accidentally, but to be germane in some general context. Their characteristics must reflect certain permanent features of the phenomenon under study.[47] Studying these data, the model-builders must then identify persistent relationships among those variables which, according to economic theory, are relevant to the incidents under examination. Model-builders seek to perceive repetitive temporal patterns and fixed spatial relationships among the data available to them. Their perception of the relationship among variables may be formalized by statistical methods, or, they may be satisfied with a non-rigorous feeling for the way the observations interrelate. If the modelers choose to explicitly (mathematically) describe their observations, they must formulate a logical framework or specification. This specification must incorporate economic theory, the essence of historical experience ("reality"), and the dynamic process by which past observations came about. The last is of paramount importance because, for purposes of prediction, an understanding of the relationship between cause and effect is crucial[48]

If simple description is the goal, it may suffice to note that two variables are correlated; but when the aim is to forecast, the model must specify a causal sequence. The terminal variables in such a sequence are the final output, or, in other words, the

endogenous variables. These "effect" variables are determined within the model. The initial variables in such a specification are the exogenous variables. These "cause" variables are determined outside the model. Historical data are statistically fitted to the model to calibrate it, yielding parameter estimates.

The algorithm by which the model is calibrated defines econometrics. These techniques of statistical inference range from the simplest least squares regression to the most esoteric inference techniques on the computational frontiers. When the dependent variable is continuous, traditional continuous multivariate regression is appropriate; the counterpart for discrete dependent variables is a discrete choice model.[49]

After calibration, the model is exercised on any set of forecasted exogenous inputs the modeler chooses. In this way, using the same functional specification, forecasts may be obtained under a multitude of future scenarios. Hence, forecasts are always made under the assumption that the functional specification is a true representation of the underlying relationships, and that these relationships will not change in the forecasted future. If the model is incorrectly specified, parameter estimates are generally biased and inconsistent.*

This is the essence of econometrics, and the most troubling aspect of econometric forecasting. Consider that most models are specified on relationships gleaned from the motor vehicle market and holdings of the mid-1970s, and calibrated on pre-1979 data. This was a period of relatively low gasoline prices and high scrappage rates. Since then, these variables have changed, and basic relationships involving these variables have necessarily also changed. Real gasoline prices fell from 1967-73, increased

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*This is true for the following types of specification errors in multiple regression: omission of a relevant explanatory variable, non-linearity of the regression function, and incorrect specification of the error term. In the case of inclusion of an irrelevant variable, least squares estimates are unbiased and consistent but not efficient.[50]

greatly during 1974, fell again from 1975-78, increased in 1979-80, and have since fallen again. Scrappage rates are at an all-time low. These changes have exacted structural change among predictive variables, making questionable the validity of any model formulated two or three years ago and forecasting ten years into the future.*

*For an expanded discussion of these issues, see References 51 and 52.

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