#5:

n-96-01
II-A-1105

GROWTH FORCAST BY THE DEPARTMENT OF COMMERCE, BUREAU OF INDUSTRY ECONOMICS.

U.S. INDUSTRIAL OUTLOOK 1981

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1/6/81

CHAPTER 27

Motor Vehicles

Motor vehicle sales and production fell dramatically in 1980 to the lowest unit sales level since 1975 and the lowest unit production level since 1961. A moderate recovery is expected in 1981 with sales increasing 9 percent and production 18 percent above 1980 on a unit basis.

Since the spring of 1979, sharply reduced sales and increased market penetration by imports have had a devastating impact on employment and profits in the motor vehicle industry. The sales downturn occurred in two stages. The first started in the spring of 1979 as a result of gasoline shortages and rapidly rising fuel prices. Consumer preference shifted dramatically toward smaller cars because of their fuel economy advantage. As a result, sales of imported cars spurted to a record level, to a 15 percent increase over the prior year. Sales of new domestic-make passenger cars and trucks, however, declined 13 percent from 1978 to 11.35 million units.

The second stage of the downturn occurred in the spring of 1980, following imposition of consumer credit controls in March. In contrast to the 1979 decline, which was due to a shift and a dampening in demand, the second stage reflected dampening recessionary economic conditions. The decline in domestic-make motor vehicle sales in 1980 was sharp, dropping 25 percent to an estimated 8.7 million cars and trucks—the lowest level of sales since 1963. However, sales of imported cars and trucks continued to boom in 1980, totaling an estimated 2.9 million units, 3.6 percent above the record 1979 level. The drastic downturn in sales of domestic-make motor vehicles sharply curtailed production. The number dropped to 8.2 million cars and trucks—29 and 36 percent below 1979 and 1978, respectively, and the lowest level since 1961.

The combination of a major shift in consumer demand together with a sharp recession has plunged the industry into the worst crisis in its history. The outlook for the immediate future is uncertain because it depends on the shape and depth of the current recession and subsequent recovery.

Assuming the national economy turns around in the fourth quarter of 1980 and recovers slowly but

1980 Profile

Motor Vehicles

SIC Code: 3711	
Value of industry shipments (million $)	62,600
Value added (million $)	12,500
Total employment (000)	296
Number of establishments, total (1977)	320
Number of establishments with 20 employees or more (1977)	118
Exports as a percent of product shipments	4.5
Imports as a percent of apparent consumption [1]	20.4
Compound annual rate of change, 1975–80:	
Value of product shipments [2]	6.4
Value of exports [2]	5.8
Value of imports [2]	27.7
Total employment	2.1

Major producing States: East-Central.

[1] Imports divided by product shipments plus imports minus exports.
[2] Rates of change based on current dollars.
Source: Bureau of the Census; Bureau of Labor Statistics; and Bureau of Industrial Economics estimates.

steadily during 1981, motor vehicle sales for 1981 are forecast to reach 12.6 million vehicles. About 9.6 million will be domestic-make and 3 million imported. Supporting the higher sales level, production will increase to about 9.7 million units, 18 percent above estimated 1980 output.

The downturn created much unemployment. The motor vehicle industry is the leading employer among U.S. manufacturing industries. As a result of production cutbacks, unemployment has become a critical problem. As of August 1980, 250,000 production workers and 50,000 salaried workers had been indefinitely laid off by the auto manufacturers. In addition, an estimated 650,000 employees of automotive suppliers were laid off.

Profitability also dropped sharply. Worldwide earnings of the four U.S. car companies totaled $3 billion in 1979, a decline of 38 percent from the $4.9 billion of 1978. With the sharp reduction in production, losses in 1980 have been at record levels. Wall Street analysts' forecasts of losses for the four companies range between $2.25 and $4 billion for 1980. No industry in American history has experienced losses of this magnitude in one year.

PASSENGER CARS

As noted in the introductory section, the decline in motor vehicle sales started in the spring of 1979 and reached precipitous proportions in the spring of 1980. In May and June, the new car market hit bottom with domestic-make car sales at the lowest level since 1958. With easier credit conditions, sales increased slightly during the summer months and the market continued to improve during the fourth quarter, following introduction of the 1981 models. New car sales for the year totaled an estimated 9 million units, including 6.6 million domestic make cars and 2.4 million imports. Domestic-make car sales were the lowest since 1961. In contrast, imported car sales—stimulated by consumer demand for fuel efficiency—increased to a new high, 3 percent above the 1979 record level.

Motor Vehicles: Trends and Projections 1975–81

(In millions of current dollars except as noted)

Item	1975	1976	1977	1978	1979[1]	1980[2]	Percent change 1979–80[3]	1981[4]	Percent change 1980–81[4]
Industry (SIC 3711)									
Value of shipments[5]	45,340	62,717	76,487	84,300	81,000	62,600	—22.7	82,000	31
Value added	10,441	15,844	18,672	20,100	18,700	12,500	—33.2	—	—
Value added per production worker-hour ($)	23.36	28.30	30.14	30.92	30.94	29.32	—5.2	—	—
Total employment (000)	283	324	343	376	370	296	—20.0	—	—
Production workers (000)	235	274	289	316	308	229	—25.7	—	—
Average hourly earnings (Dec.—$)	7.26	8.04	8.69	9.56	10.01	[6]10.65	—	—	—
Year-to-year percent change in average hourly earnings (Dec.–Dec.)	10.5	10.8	8.1	10.0	4.7	[6]8.2	—	—	—
Year-to-year percent change in industry price index (Dec.–Dec.)[7]	N.A.	6.4	6.7	5.9	8.1	[6]9.3	—	—	—
Capital expenditures	656	1,047	1,808	N.A.	—	—	—	—	—
Product (SIC 3711)—									
Value of shipments[5]	43,394	59,753	72,918	80,500	77,300	59,700	—22.8	78,300	31.2
Year-to-year percent change in producers price index (Dec.–Dec.)[7]	6.4	6.0	6.9	6.9	8.1	[6]8.8	—	—	—
Product classes									
Passenger cars									
Value of shipments[5]	28,833	39,746	46,813	50,300	49,400	41,300	—16.4	50,900	23.2
Quantity shipped (unit of measure)[5]	6,713	8,500	9,201	9,165	8,419	6,500	—22.8	7,300	12.3
Year-to-year percent change in producers price index (Dec.–Dec.)[7]	6.0	5.3	6.4	6.8	7.5	[6]8.2	—	—	—
Trucks & Buses									
Value of shipments[5]	12,166	16,968	21,996	26,200	24,000	15,400	—35.8	23,500	52.6
Quantity shipped (unit of measure)[5]	2,272	2,979	3,442	3,706	3,037	1,700	—44	2,400	41.2
Year-to-year percent change in producers price index (Dec.–Dec.)[7]	7.2	8.5	8.7	7.2	9.6	[6]10.4	—	—	—
Trade[8]									
Value of exports	2,247	2,227	2,153	2,501	2,972	2,700	—9.2	3,100	14.8
Value of imports	4,720	6,169	7,643	11,187	12,706	14,600	14.9	15,700	7.5

[1] Value of all products and services sold by the motor vehicle industry (SIC 3711).
[2] Estimated except for hourly earnings, price indexes, and 1979 trade data.
[3] Forecast.
[4] As of June 1980.
[5] July 1979 to July 1980. Note: Months may differ for the price and earnings indexes.
[6] December 1975 is the base period for index.
[7] Value of shipments of these products produced by all industries.
[8] Includes Canada.

Source: Bureau of the Census (industry and trade data), Bureau of Labor Statistics (hourly earnings and price indexes). Estimates and forecasts by the Bureau of Industrial Economics.

New car sales are expected to rise in 1981 to a total of 9.7 million units, including 7.2 million domestic-make cars and 2.5 million imports. Several factors underlie this forecast. Historically, firming of the used-car market has preceded recovery in the new-car market. With increasing trade-in values, transaction prices decrease and new cars become more affordable. Used car prices started increasing in late May of 1980. Further, even though growth is expected to be slow in 1981, improving general economic conditions provide a base for an upturn in the auto market. Assuming a personal income tax reduction in 1981 to approximately offset the automatic personal tax increases (social security tax and "bracket creep" due to inflation), real disposable personal income should be slightly higher than in 1980. Consumer confidence, as indicated by the Conference Board and University of Michigan surveys has been rising since May 1980. Consumer installment credit liquidations have exceeded extensions for several months, thus improving consumers' liquidity. To be sure, the economy is expected to continue to have several negative factors, such as relatively high inflation, interest, and unemployment rates, that inhibit growth in auto sales. In summary, however, the positive factors appear to outweigh slightly the negative influences and a slow, but steady recovery in car sales is projected for 1981.

Reflecting the sharp decline in domestic-make car sales, car production was drastically curtailed during 1980 with output totaling an estimated 6.5 million units, 23 and 29 percent below 1979 and 1978, respectively. The 1980 production level was the lowest since 1961. With the improved sales outlook for 1981, production is expected to increase to 7.3 million cars.

New Car Retail Sales

(thousands of vehicles)

Year	Domestic [1]	Import	Total
1967	7,568	769	8,337
1968	8,625	1,031	9,656
1969	8,465	1,118	9,583
1970	7,119	1,286	8,405
1971	8,682	1,568	10,250
1972	9,327	1,623	10,950
1973	9,676	1,763	11,439
1974	7,454	1,413	8,867
1975	7,053	1,587	8,640
1976	8,611	1,499	10,110
1977	9,109	2,076	11,185
1978	9,312	2,000	11,312
1979	8,341	2,329	10,671
1980 [2]	6,600	2,400	9,000
1981 [2]	7,200	2,500	9,700
1985 [2]	9,600	2,400	12,000

[1] Includes units built in the United States by foreign-based manufacturers.
[2] Estimates by Bureau of Industrial Economics (BIE).
Source: Motor Vehicle Manufacturers Association

Car Size Trends

Following the 1973–74 oil embargo and during the 1974–75 recession, consumer demand shifted from larger cars to small cars. In 1973, for example, compacts and subcompacts (including imports) accounted for 42.9 percent of total new-car sales. By 1975, the small-car share of the market had grown to 52.7 percent. Even more dramatic was the fall in market share of the full-size car from 29.3 percent in 1973 to 17.7 percent in 1975. However, stable oil prices and ready availability of gas soon resumed. From 1975 until early 1979, gasoline prices rose at a substantially slower rate than the Consumer Price Index. As a result of relatively low gasoline prices, consumer demand shifted back toward larger cars, with the small-car market share dropping from 52.7 percent in 1975 to 48 percent in 1976 and remaining at approximately that level through 1978. As noted in the introductory section, the market reacted to the "energy shock" of 1979 with a dramatic shift in consumer demand toward smaller cars. The small-

car share of the market, including imports, increased from 48.5 percent in 1978 to 56.5 percent in 1979 and continued the sharp rise in 1980 to 63.9 percent.

Consumer preference is not expected to switch back to larger cars, as it did soon after the oil embargo ended. The general public now seems to expect gasoline prices to increase significantly faster than the inflation rate and sees petroleum supplies as being vulnerable to political instability in several oil-producing countries. These two factors will continue to encourage demand for smaller cars.

The sudden and dramatic rise in small-car demand was not expected, and left the domestic auto industry with inadequate production capacity for newer-design, small cars and surplus capacity for large cars. The shortage of domestic small-car capacity provided Japanese car manufacturers (who at the time had excess capacity) with an excellent opportunity to increase penetration of the U.S. market.

Not much could be done by U.S. manufacturers because long lead times are required to substantially change the mix of production by car size. Conversion of assembly plants requires a minimum lead time of 2 years, and developing adequate production capacity for components may take much longer. For example, designing and tooling a new engine or transmission requires 4 to 5 years. Establishing substantial stand-by capacity for protection against sudden demand shifts is not economically feasible due to the huge capital requirements for such facilities. Thus, the industry is inherently vulnerable to unanticipated changes in demand, as the events of the last 2 years have so painfully demonstrated.

Why did the industry fail to anticipate the shift in demand that occurred in 1979 and 1980? Certainly there was no doubt about the long-term need for smaller cars to conserve energy. However, consumer acceptance of smaller cars in even greater numbers was doubtful in the absence of higher prices or short supply of gasoline. The lower demand for small cars from 1976 to 1978 tended to confirm this concern. Accordingly, with Federal Government policy holding down gasoline prices by controlling domestic crude prices, continued consumer demand for large cars was a reasonable expectation. This outlook, however, was premised on adequate petroleum supplies and did not anticipate the Iranian revolution and the accompanying supply disruptions and sharp price increases.

Subcompacts are now the largest segment of the market, accounting for an estimated 43 percent of the cars sold in 1980. With fuel economy now the dominant market force, this segment will continue to increase. Therefore, the domestic share of this segment is of particular interest. The first subcom-

pacts made in quantity in North America were introduced in the 1971 model year, quickly took 35 percent of all subcompact sales in 1971 and increased steadily to a peak of 46 percent in 1974. In 1977, however, the market share for domestic makes declined precipitously to 34 percent, but recovered sharply in 1978 to 40 percent due to the introduction of Chrysler's Omni and Horizon. The domestic makes' share increased again in 1979 to 46 percent, with domestically produced Volkswagens accounting for three-quarters of the increase. With imports selling at a record level in 1980, the domestic-makers' share declined to 43 percent. However, due to the introduction of Ford's new Escort and Lynx and General Motors new J-car, domestic makes should capture approximately 50 percent of the subcompact market in 1981.

Auto Imports and Exports

Within the industry, automobiles assembled in Canada and shipped to the United States and cars produced in the United States and transported to Canada, are not considered imports and exports because they are of similar design and enter each country duty-free. As noted earlier, retail sales of imported cars increased 3 percent in 1980 to an estimated 2.4-million units. The excellent fuel economy performance of small imported cars was a major factor in this increase. Import shipments through June 1980 totaled 1,330,000 cars, and for the year are expected to reach a new record of 2,450,000, 5 percent above the previous peak of 2,329,000 units shipped in 1979. Retail sales of imported cars are expected to increase slightly from an estimated 2.4 million in 1980 to 2.5 million units in 1981. Shipments should increase to 2.6 million units in 1981 as Japanese manufacturers build up inventories from currently depleted levels.

In 1980, imports accounted for an estimated 26.7 percent of total new-car sales, a record market share. Import penetration should decline slightly in 1981 to 25.8 percent. In future years, as domestic manufacturers compete more vigorously for the small-car segment of the market, import penetration is expected to decline to approximately 20 percent.

Japanese manufacturers increased their domination of the U.S. imported car market in 1980, accounting for an estimated 80 percent of import

sales. The Japanese producers first gained the lead position in 1974 with a 42.4 percent market share, edging out West Germany's 42.3 percent. From 1976 through 1978, Japanese-produced vehicles accounted for approximately two-thirds of total imported car sales. In 1979, the Japanese share increased to 76 percent. However, two-thirds of the increase over 1978 was due to Volkswagen's start of car production in the United States.

The U.S. deficit in automotive products trade with Japan is now huge. In 1976, it was $4.6 billion. By 1979, the deficit had almost doubled to $9.1 billion and reached an estimated $10.5 billion in 1980. For 1981, it is expected to exceed $11 billion. Our automotive trade deficit with Japan is exceeded only by our petroleum trade deficit with oil producers. The Japanese export drive, which underlies the huge deficit increase, has caused a major deterioration in U.S.-Japanese trade relations and has given substantial impetus to demands that the United States adopt protectionist measures.

The Japanese Government has been sensitive to the economic and political problems created by the huge imbalance in auto trade, and has eliminated tariffs on cars and many categories of automotive parts and simplified procedures for certifying compliance of U.S.-produced cars with Japanese safety and emission standards. These concessions, however, are unlikely to make a significant dent in the trade deficit because the Japanese automotive market is now mature and highly saturated with local products. Only Honda is committed to the construction of a car assembly plant in the United States, while Nissan has announced plans to build a truck assembly plant in this country. Toyota has been studying the feasibility of production here since 1977.

With the exception of sales to Canada, exports of U.S. cars have been very low for many years. For example, export shipments totaled only 106,000 cars in 1977, 1.2 percent of U.S. production. With the decline in the value of the dollar in 1978, domestic car manufacturers placed more emphasis on export promotion, and shipments increased to 152,000 autos in 1978 and 187,000 in 1979. During the 1977–79 period, the European Communities (EC) and the Near East were our leading growth markets, with the Near East taking 36 percent and the EC 27 percent of U.S. car exports in 1979. However, intensified Japanese competition and the economic slowdown in West Europe led to a sharp decline in exports there in 1980. Total exports, therefore, dropped to an estimated 130,000 units in 1980, 30 percent below the 1979 level. A moderate improvement is expected in 1981, as domestic manufacturers produce more small cars that appeal to overseas markets. For the year, exports should total 150,000 cars.

Regulatory Influences on the Industry

Of all the regulations affecting autos, those mandating fuel conservation will have the most dramatic, long-term impact on the size, cost, and performance of the product. The Energy Policy and Conservation Act of 1975 specified that the fuel consumption of all cars made by a manufacturer must average 18 miles per gallon in 1978, with the standard increasing by increments each year to 27.5 miles per gallon in 1985.

Although improved design and lighter materials will help increase fuel efficiency, most of the improvement required by 1985 can be accomplished only by reducing the size and weight of all models and by selling proportionately more smaller cars. The industry has now completed the first phase of downsizing, with General Motors having started the trend in 1977 models with smaller full-size cars. The second phase of downsizing will take place from 1981 to 1985. Unlike the first phase, which relied primarily on proven technologies, this phase will involve extensive use of new technologies and materials in addition to new design concepts. Accordingly, this phase entails substantial financial, technological and marketing risks.

The lack of adequate data on the effects of automotive emissions on public health is a source of continuing controversy. Experts within and outside the industry question the cost effectiveness of both the 1981 carbon monoxide (CO) and revised nitrogen oxides (NO_x) standards. Compliance with the standards will require large-scale capital expenditures and an additional cost to the consumer of approximately $250 per car. Congress gave the Environmental Protection Agency (EPA) the flexibility to grant 2-year waivers for CO emissions and 4-year waivers of NO_x for "innovative" engines. Upon submission of adequate substantiating data, the EPA has granted a number of such waivers.

In early 1980, the EPA established standards for diesel particulate exhausts. The standard set for 1985 was admitedly technology-forcing. The risks, however, are of unnecessarily high development costs and the elimination of the fuel-efficient diesel engine from its principal auto market—medium- and large-size cars.

Having estimated that 9,000 lives would be saved annually, the Department of Transportation (DOT) in 1977 mandated passive restraint systems, either airbags that deploy on impact or automatic seat belts. These are to be phased in starting with full-size cars in 1982, intermediates and compacts in 1983, and subcompacts in 1984. This gradual approach

will ease production problems and minimize market disruption. The regulation has come under strong attack because it is based largely upon controversial extrapolations of laboratory-simulated accidents. Critics argue that there is insufficient field data to evaluate the extent to which the passive restraints reduce fatalities and severe injuries. The critics also argue that the current three-point lap and shoulder belt system gives superior protection, if used, and note that comparable protection in air-bag equipped cars can be approached only if lap belts are worn. However, past efforts to increase seat belt usage have proved unsuccessful. The passive restraint regulation has also been criticized for favoring imported cars by not requiring their use on subcompacts (90 percent of imports are subcompacts) until 1984. Passive restraints are expensive and cars required to use these devices will, therefore, be at a competitive disadvantage to cars not using them.

Estimates of air bag costs vary substantially. The DOT estimates the retail price impact of air bag systems in high volume production (700,000-800,000 units annually) at approximately $300 per car. In contrast, industry estimates range from $500 to $575 per car at this volume. At lower volumes, industry estimates increase up to $800 per car.

In summary, regulation has had a major impact on the auto industry in recent years. In view of the currently depressed economic state of the industry, it is not surprising that the companies are pressing for regulatory relief. Although this could provide substantial aid in the long term, in only minor capital savings would be possible during the critical 1981–82 period. The Administration's auto industry assistance program announced in July 1980 had little relief from regulations. However, the assistance package was termed a first step in the recovery program and was designed principally to provide short-term aid. For the longer term, the Administration proposed a partnership approach with government, industry, and labor working together to restore the economic health of the auto industry. For the program to be successful, a comprehensive program of regulatory review should be pursued to identify and modify or eliminate those regulations excessively costly relative to benefits derived. Both industry, independent sources, and Federal Government agencies such as the Department of Commerce and the Council on Wage and Price Stability have questioned the cost effectiveness of a number of the more important automotive regulations. Regulations in question include the previously discussed passive restraints and light-duty diesel particulates, in addition to the 5-mile-per-hour bumper, the 1984 heavy-duty engine emissions control, and emissions performance warranty regulations. The cost effectiveness of the proposed 1983 light-duty truck emissions control and aftermarket emission control parts certification regulations have also been questioned. In addition, the Congressionally-mandated 1981 CO and revised NO_x standards are considered excessively stringent by both industry and a number of independent experts.

Research and Development

The automotive industry is trying to achieve major fuel efficiency gains at acceptable emission levels by improving today's engines and developing alternative powerplants. The industry is being assisted in its alternate engine research through programs sponsored by the Departments of Defense and Energy, and the National Aeronautics and Space Administration.

The only alternate engine with even a remote possibility of commercial production between 1981 and 1985 is the stratified charge. This engine and the recently introduced light-weight diesel are derivatives of the current spark-ignited engine, and, therefore, do not involve the long lead times for research and development and tooling required for more exotic engines.

The light-weight diesel was first introduced in U.S.-made cars as an option in the 1978 Oldsmobile. Its usefulness is at this time, questionable for two reasons. The first is that preliminary studies suggest that diesel exhaust may be carcinogenic. The EPA currently is investigating this issue and plans to release preliminary findings in the near future. The second problem is that the engine cannot meet the revised nitrogen oxides standard together with the recently promulgated particulates standard. However if these environmental issues can be resolved, the turbocharged diesel is probably the leading candidate for the fuel efficient engine of the future.

The other powerplant with short-term, high production potential is the stratified charge engine. Ford is developing a fuel-injected version which may improve fuel economy 20 percent over today's conventional gasoline engine, compared to the diesel's improvement of 25 to 30 percent. However, it does not have the diesel's problems of difficult cold starting, sluggish acceleration and particulate formation. The major problem is development of a reliable fuel injection system suitable for high volume production.

Alternate powerplants with long-term potential include the gas turbine, Stirling-cycle engine, electric propulsion and electric hybrids. The gas turbine and Stirling-cycle engines are totally different from current automotive power plants and require major technological breakthrough for development of production designs. Then production lines would have to

be completely rebuilt. Some gas turbines might be commercially available in the early 1990's, under the most favorable circumstances, and the Stirling-cycle engine a number of years later.

The electric propulsion automobile has attracted considerable interest. However, a technological breakthrough in developing a high-energy density battery is needed to make electric propulsion practical in general automotive use. Until then, the the potential for electric propulsion is limited to short-range vehicles used primarily for stop-and-go driving, as in urban deliveries. Two recently announced advances appear to have promise—General Motors' zinc-nickel-oxide battery and Gulf and Western's zinc-chloride battery. Substantial development work is needed to make them suitable for high volume usage. General Motors is optimistic regarding the future of electric vehicles and plans to introduce a small electric car in 1985 and produce 100,000 units the following year.

A concept receiving limited attention is the electric hybrid, a vehicle propelled by a combination of an electric motor and an internal combustion engine to overcome the limited range of battery power. The vehicle would be powered by its batteries for short-range urban-trips and by both motors for longer trips. A major disadvantage is cost; equipping a vehicle with two power plants is inherently expensive.

In addition to new engine concepts, research is also being directed to development of alternative fuels including alcohol-gasoline blends and hydrogen.

Gasohol (a blend of 90 percent gasoline and 10 percent ethyl alcohol) has received considerable attention recently as a petroleum extender. One of its attractive features is that no engine modifications are required. However, gasohol will never be abundant. Today's short supply of ethyl alcohol results from a lack of distilling capacity. When this bottleneck is eliminated, there are still the problems of high cost and inadequate raw material supplies,

specifically surplus grains. The entire process of growing and transporting grain, and producing alcohol from it, consumes considerable amounts of energy. Using grains and non-oil or gas-fired distilleries, production of ethyl alcohol for fuel use is expected to reach 200-300 million gallons per year by 1985 and approximately 800 million gallons ultimately. However, this latter volume represents less than 1 percent of U.S. gasoline consumption. Although the use of gasohol as an automotive fuel will be very limited nationwide, its use could become significant on a local basis, specifically in areas with plentiful supplies of alcohol-producing materials.

For the long term, methyl alcohol (methanol) appears to be a more promising fuel extender than ethyl alcohol because it can be produced in much greater volume and at substantially less cost. Although currently derived from natural gas, it can be produced from coal, or biomass, with methanol from coal significantly less expensive than that derived from biomass. However, methanol has corrosive properties, which would require replacement of sensitive materials in the fuel supply system. Without engine modification, methanol content would be limited to 1-3 percent of the blend. To be economically attractive, methanol producing plants must be large, requiring major investments and long lead times. Accordingly, methanol cannot be expected to be available in significant quantities as a gasoline extender before the late 1980's at the earliest.

Liquid fuels from oil shale and coal appear to be the most promising alternates to petroleum-based fuel from an economic standpoint. Processing these synfuels will be more expensive than petroleum, and there are major environmental problems. Production facilities will require huge investments and long lead times. If the problems can be resolved, these fuels will be available in significant volume in the 1990's.

In addition to research efforts directed to the development of specific engine concepts and alternate fuels, a basic research program to explore fundamental mechanical and chemical phenomena has been initiated by the Department of Transportation and will involve Federal, industry, and university scientists. As currently envisioned, the joint program would extend for approximately 10 years and would involve basic research in areas such as thermodynamics, fluid dynamics, combustion, and friction.

Since the 1973 oil embargo, the industry has made substantial progress in improving the fuel efficiency of its products. The fuel economy average for new domestic-make passenger cars, as reported by the EPA, has increased from 12.9 miles per gallon (mpg) in 1974 to more than 23 mpg in 1981 models, an improvement of 80 percent. The earlier fuel economy improvements were made by using radial tires, driveline components selected for fuel economy rather than performance, and new devices, such as electronic control of spark timing and the catalytic converter. Introduction of catalytic converters in 1975 models was a major technological advance that recovered a substantial portion of fuel economy losses previously incurred in the control of exhaust emissions.

The industry is now in a more dramatic phase of its long-term program to meet the Government's 1985 objective of a 100 percent improvement in passenger car fuel economy (i.e., doubling the miles-per-gallon) over 1974. General Motors began downsizing its cars in 1977. By 1985, average car weight will be reduced by 1,200 to 1,250 pounds, or approximately 30 percent of the 1975 model average. Smaller cars improve fuel economy not only because they are lighter, but also because they can be powered by smaller engines and still give acceptable performance. In addition, major changes in the devices controlling air-fuel mixtures, such as electronically controlled carburetors and variable venturi carburetors, are improving fuel economy. Major advances in automotive transmissions, including lock-up converters and automatic transmission overdrives, are also gas savers. Engine turbocharging, introduced as an option in the 1978 Buick, will be incorporated in more car lines for its fuel economy advantages. By providing excellent acceleration for the small fraction of driving time (less than 5 percent) where such performance is needed, turbocharging permits reducing engine size, which saves gasoline.

A rapid increase in the use of electronic components is taking place because of the precise control they provide and their rapid feed-back capability. Engine control functions, such as fuel-air ratio, spark timing and exhaust gas recirculation, are ideal applications. The new 3-way catalytic converter requires a very precise control of fuel-air ratio, which has led to the introduction of microprocessor-controlled systems for engine control functions. These systems will be installed in the majority of U.S.-produced cars in 1981, and the installation rate is expected to increase to 80–90 percent by 1985. The use of on-board, computerized diagnostic equipment will also boost the growth of automotive electronics with 50 percent of U.S.-produced cars expected to have this equipment by the 1985 model year. Electronics are also being used in automatic speed control, driver information (fuel consumption, average vehicle speed and estimated arrival time), and systems to adjust vehicles to loads. By the late 1980's, electronic control of automatic transmissions will be in wide spread use.

Typical Car of the 1980's

Radical changes will be incorporated in passenger cars during the next several years. Front-wheel drive will be universal in small cars (compacts and subcompacts) and will also be incorporated in a majority of intermediate and full-size cars because it gives passengers more room. By the mid-1980's, more than 90 percent of the cars produced will be front wheel drive. By 1985, between 50 and 60 percent of the cars produced in this country will have 4-cylinder engines, compared with only 6 percent in the 1977 model year. The standard engine for the full-size passenger car of the mid-1980's will be a V-6; by 1985, this engine will be installed in 20 to 25 percent of car production. Conventional V-8's will be close to extinction by the mid-1980's, accounting for 5 percent or less of production. Assuming the diesel engine's environmental problems are resolved, it is expected to achieve a 15–20 percent penetration of the passenger car market by 1985.

The large weight reduction required to meet fuel economy standards will significantly change the industry's consumption of materials. Lighter weight materials such as aluminum, plastics and high-strength, low-alloy steel will be used extensively. By 1985, aluminum use is expected to more than double from an average of 75–80 pounds per 1975 model car to approximately 200 pounds, plastics to almost double from 150–160 pounds to 250–300 pounds, and high strength, low-alloy steels to increase from less than 100 pounds to 250–300 pounds per car. Cast iron use should be reduced by half, from 600–650 pounds per 1975 car to about 300 pounds by 1985. Use of conventional steel should drop from 2,500 pounds to less than 1,300 pounds per car. These changes will heavily affect the producing industries, because the automotive industry is a major consumer of these materials. In 1978, for example, the automotive industry used 22 percent of total U.S. consumption of steel and 17 percent of aluminum.

The Industry's Future

The automobile industry is now in an extremely critical and challenging period. Its most immediate challenge is recovery from the current recession. It also must meet stringent government regulations over the next several years. In addition, it is facing unprecedented market challenges in consumer demand for improved fuel efficiency and in Japanese competition for the U.S. market.

Federal safety and emissions regulations, together with the need to meet market demand for improved fuel economy, will require extensive product changes with large capital expenditures. These changes, which include use of lighter-weight, more expensive materials and new, more sophisticated components, will result in a substantial increase in prices between 1980 and 1985. Industry sources estimate these increases will total $950 to $1,000 (in 1979 dollars) for the average car.

In addition, inflation will also be pushing prices up. In recent years, labor and material cost increases have averaged approximately 10 percent annually. Manufacturers, however, have not raised prices enough to recover all the cost increases resulting from inflation and Federal regulations. Their reluctance to do so is because of import competition and the fear that large price increases would hurt sales. As a consequence, profitability has been declining.

The accompanying chart shows the trend of profits as a percent of sales for the four car manufacturers in comparison to the Fortune 500 companies. Although the trend of the Fortune 500 is downward, with a negative annual growth rate of 1.5 percent for the 1961–79 period, the decline for auto manufacturers is far more severe, with a negative annual rate of 5.6 percent.

This trend has serious implications for the long-term economic health of the motor vehicle industry and its capability to generate the large amounts of capital that will be needed during the 1980's. The industry estimates it will need a total of $80 billion from 1979 to 1985 for new plant and equipment, special tooling, and research and development. This is more than double the expenditure rate of the previous 7 years. Raising capital on this scale is a formidable task. The major portion must come from retained earnings and depreciation and amortization allowances. As noted in the introductory section, the industry incurred major losses in 1980. Although the industry is expected to be profitable in 1981, its earnings will not be sufficient to support the investment program. Therefore, substantial outside financing will continue to be required.

The difficult capital formation problem highlights one of the principal risks of regulation. In the past, capital spending could be adjusted to meet the cash derived from sales, as well as the competitive conditions the manufacturers faced. Today, however, the key feature of the portion spent to meet regulatory requirements is that it must be incurred on an inflexible time schedule even though the market is highly cyclical. This imposes great financial risks on the individual companies. The present period is critical due to a dismal profit performance and the extraordinarily high level of capital spending. As a result, the capital structures of American Motors, Chrysler, and Ford are under severe strain. Without support from Renault, American Motors could not survive. Chrysler was saved from bankruptcy by the Federal Government's loan guarantee program. Ford's North American Automotive Operations incurred huge losses in 1979 and 1980, resulting in the company becoming dependent on its overseas subsidiaries for financial assistance.

Although the current pressures on cash flow are expected to ease as the industry recovers from the recession, capital formation will continue to be a problem, though of lesser magnitude. The larger-size cars and the luxury models have historically had higher profit margins, while small cars generally had low margins and, in some instances, were unprofitable. Thus, profit margins will tend to diminish as small cars increase their market share. This situation reflects the influence of import pricing which, to a considerable degree, controls domestic small-car pricing. To achieve some degree of profitability in the small-car business, domestic manufacturers will promote optional equipment and introduce small luxury and specialty models. During the 1980's, manufacturers will face a major challenge in developing and producing a fleet of cars with a sales mix that can provide an adequate return on investment. This problem will be aggravated by the public's apparent reluctance to pay higher prices for mandated features such as emission controls.

In addition to regaining a reasonable degree of profitability, the other crucial problem facing the industry in the 1980's is import competition. The competition is primarily Japanese and is particularly intense in terms of product quality and cost.

Japanese auto manufacturers have been highly successful in projecting an image of quality. The quality of their product is excellent in, for example, paint and surface finishes, sheet metal mating and molding fits. In these respects, Japanese quality is unquestionably superior to American. The superior quality image of Japanese cars is an important marketing advantage and is an issue domestic manufacturers must meet directly to be successful in recovering the large market losses of recent years.

Lower manufacturing costs are a second major Japanese competitive advantage. Their labor costs, in particular, are much lower than the U.S. auto industry's. Although reliable comparative cost data are not available, manufacturing costs of the Japanese car makers are apparently at least 20 percent below those of their U.S. counterparts. This advantage enables Japanese manufacturers to land cars on the West Coast, net of U.S. import duties and transportation costs, at an estimated $400 to $600 per car less than U.S. producers can deliver comparable vehicles. Lower costs provide the opportunity of adding performance and quality to the product rather than passing the full cost savings through to the consumer. The combination of both a quality and cost advantage provides Japanese producers with an extraordinarily strong competitive position.

The industry is responding to these challenges with a rebuilding program of unprecedented scope. It is completely redesigning its entire line of products, and it is modernizing its production plants with the latest state-of-the-art manufacturing equipment. This program is expected: 1. to result in products that will be competitive with foreign-produced cars in fuel economy, quality, and other major consumer demands and 2. to reduce substantially the gap in manufacturing costs.

However, the program involves major risks. These risks would be less severe if the industry were in a period of strong growth. However, the automotive market in the United States is now essentially mature, with replacement demand representing 75 to 80 percent of total demand. With higher energy costs and continuing inflation eroding their purchasing power, consumers can be expected to allocate more of their income to goods of a less discretionary nature than automobiles. Taking these various fac-

tors into consideration, a long-term real growth rate of only 1.5 to 2 percent can be expected for passenger car sales.—*Robert V. Coleman, Office of Producer Goods, (202) 566-7425.*

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TRUCKS AND BUSES

Retail sales of trucks (including vans) and buses boomed, setting successive annual records, in 1976, 1977 and 1978. Trucks constituted the great bulk of sales, with buses representing less than 1 percent of sales during these years. Unit sales increased 28 percent from 1975 to 1976, followed by a 16 percent increase in 1977, and 12 percent in 1978. Light trucks of 10,000 pounds gross vehicle weight (GVW) and less led the sensational advance, accounting for almost 90 percent of the total market in 1978, compared with an average of 82 percent during the 1967–74 period.

However, the "energy shock" of 1979 hurt the domestic-make light-truck market even more severely than the passenger car market, with 1979 sales dropping 23 percent below the 1978 level. The decline continued in 1980 with the onset of the recession. Sales of domestic-make light-duty trucks fell to an estimated 1.8 million units in 1980, 31 percent below 1979 and 47 percent below the 1978 record level. Sales of medium- and heavy-duty trucks were also severely affected by the recession in

Truck and Bus Retail Sales Including Imports
(Thousands of Vehicles)

	10,000 lbs GVW and under	Over 10,000 lbs GVW	Total
1967	1,214	330	1,544
1968	1,489	342	1,831
1969	1,586	384	1,970
1970	1,418	393	1,811
1971	1,757	339	2,096
1972	2,191	438	2,629
1973	2,652	496	3,148
1974	2,263	424	2,687
1975	2,178	299	2,477
1976	2,855	326	3,181
1977	3,296	379	3,675
1978	3,670	442	4,110
1979	3,086	394	3,480
1980[1]	2,330	270	2,600
1981[1]	2,580	320	2,900
1985[1]	3,650	550	4,200

[1] Estimates by Bureau of Industrial Economics (BIE).
Source: Motor Vehicle Manufacturers Association.

1980, dropping 29 percent below the previous year. Total sales of domestic-make trucks, including light-, medium- and heavy-duty, amounted to an estimated 2.1 million units in 1980, 31 and 45 percent under the 1979 and 1978 levels, respectively.

As with passenger cars, sharply rising fuel prices generated an unprecedented demand for imported, mini-pickup trucks. Sales in 1979 jumped 40 percent over 1978 and increased another 11 percent in 1980 to an estimated 520,000 units.

The sales slump ~~of heavier trucks~~ led to severe inventory problems during the latter part of 1979. When sales continued to decline in the first half of 1980, production was sharply curtailed. Total output for 1980 was only an estimated 1.7 million vehicles, 44 percent below 1979, 54 percent under 1978 and the smallest number of trucks produced since 1967.

With the national economy recovering slowly in 1981, truck sales (including imports) are expected to increase modestly to 2.9 million units from 2.6 million in 1980. Due to their fuel-efficiency, mini-pickup trucks imported from Japan are expected to remain in strong demand, even though their tariff classification has been changed and the vehicles are now subject to a 25 percent import duty rather than the 4 percent tariff formerly imposed. Imported truck sales should total 500,000 units in 1981.

With the period of inventory liquidation—which began in mid-1979—completed and the market for domestic-make trucks strengthening, production should increase in 1981 to 2.4 million units, more than 40 percent above the depressed 1980 level of 1.7 million trucks and buses. However, projected 1981 output is still low in comparison to recent years and is only 6 percent above production in the recession year 1975.

The light-truck market was turbulent during the last decade. Starting in the early-1970's, light trucks became popular for personal transportation. As cars became smaller and less powerful, many motorists desired the additional interior space for passengers or the load-hauling capacity of light trucks. In addition, Class 2 trucks (6,000 lb. to 10,000 lb. GVW) did not require catalytic converters until 1979 and therefore could be fueled with less expensive and more available leaded gasoline. The multipurpose character of trucks also had great appeal. The personal transportation segment of the light truck market grew rapidly during the 1970's and, in the opinion of many analysts, accounted for approximately one-half of light truck sales during the latter part of the decade.

However, rapidly rising fuel prices have apparently ended the popularity of light trucks for personal transportation. As noted earlier in this section, sales of domestic-make light trucks collapsed with the "energy shock" of 1979. Sales are expected to remain low until domestic producers introduce mini-pickup trucks starting in 1982. Even these new, more fuel-efficient vehicles will probably not generate sufficient demand for the light truck market to recover to its ~~1979~~ 1978 peak, because their smaller size and reduced power have limited their utility to the consumer.

International Trade

As noted in the passenger car section, the United States and Canadian motor vehicle industries are integrated, and shipments of new vehicles between the two countries are duty-free. Therefor, shipments to and from Canada are not regarded within the industry as exports and imports.

Excluding U.S. trade with Canada, Japan now accounts for 99 percent of U.S. truck imports. The mini-pickup trucks produced in Japan have proved very popular in this country with volume expanding dramatically in recent years. As recently as 1970, shipments from Japan totaled only 27,000 units. In contrast, sales in 1980 are expected to exceed 500,000 trucks. Sales are expected to remain at approximately this level in 1981. However, import sales may peak in the 1980–81 period. Domestic manufacturers will be entering this segment of the market, beginning with the 1982 model year, and Nissan (Datsun) is building a truck assembly plant in this country that will start production in 1983.

Imports of medium-duty trucks have been in the range of only 2,000 to 4,000 units annually in recent years. Most have been diesel-powered. In Europe, these have been important for years because diesels save on fuel costs. Now the mid-range diesel is being promoted in the U.S. market by both European and domestic producers.

Iveco, a European manufacturer 80 percent owned by Fiat, has initiated an aggressive marketing campaign. Renault and Volvo have concluded agreements with Mack and Freightliner respectively, for marketing their mid-range diesel trucks in the United States. Mercedes-Benz, increasing its efforts to sell trucks in the U.S. market, has built an assembly plant in Hampton, Virginia, which opened in 1980. General Motors responded to the competition by introducing a new mid-range diesel engine in its 1980 model GMC and Chevrolet trucks. Analysts forecast that diesel engines will capture 50 percent of the medium-duty truck market by the mid-1980's.

As with passenger cars, exports of trucks and buses, excluding those to Canada, represent a very small portion of total U.S. production, never having exceeded 100,000 units per year until 1977 when 101,000 vehicles were exported. Exports increased

moderately in 1978 to 111,000 units, but then declined to 93,000 units in 1979. The total rose to an estimated 95,000 units in 1980 and is expected to be in the 95,000 to 100,00 range in 1981.

Although far fewer units are exported than imported, the value of exports approaches that of imports because exported trucks are generally larger, thus, more expensive, while 99 percent of imports are mini-pickups. For example, although truck and bus exports in 1979 amounted to less than 20 percent of imports in terms of units, their value ($1 billion) was two-thirds the value ($1.5 billion) of imports.

Effect of Government Regulation

The production and marketing of commercial vehicles will be directly affected by Government mandates for quieter, safer, more fuel-efficient vehicles with lower emission levels. Fuel economy standards for light trucks first became effective with 1979 models. Standards have now been established through the 1982 model year. Originally, light-truck fuel economy standards were an important part of the Government's energy conservation program. They now are considerably buttressed by fuel economy having become the principal driving force in consumer demand.

The Department of Transportation had earlier planned to extend applicability of a number of passenger car safety regulations to light trucks. However, a 6-month moratorium on new safety regulations was included in the Administration's industry assistance package announced in July 1980. This moratorium, and any subsequent related actions taken to assist the industry, will probably not significantly affect the substance of future light-truck safety regulations.

The Environmental Protection Agency (EPA) recently established stringent 1984 heavy-duty engine emission control regulations, which went beyond statutory requirements. In the review period prior to promulgation of this regulation, both the U.S. Department of Commerce and the Council on Wage and Price Stability (COWPS) in formal comments questioned the cost effectiveness of the EPA's proposal. In the final rulemaking, however, the EPA rejected Commerce's and COWPS' recommendations.

EPA has also proposed comparable emission control regulations for 1983 and later model years. These proposals raise cost-effectiveness issues similar to the heavy-duty engine emission regulations. The Department of Commerce has formally submitted its concerns to EPA. Although EPA has not announced its decision on 1983 light-duty truck emission regulations, most automotive industry analysts expect it to follow the precedent it established in the promulgation of 1984 heavy-duty engine emission regulations.

Trends in Truck Design

As with passenger cars, the need to conserve fuel will greatly influence future truck designs. Conventional light-duty trucks will be downsized, but only slightly because they still have to carry loads. If environmental problems can be resolved, diesel use in both light- and medium-duty trucks will be expanded substantially. Over 90 percent of heavy-duty trucks are already diesel-powered.

There will be increased use of lightweight, high-strength, low-alloy steel in the chassis. Aluminum will be used more extensively in cabs, bodies, and trim accessories. Thermoformed plastics will be used for hoods, doors, roof panels, fenders, and grilles. Heavy-duty leaf springs, some drive shafts, and possibly selected frame rails and crossmembers will be made of composite materials by the end of the 1980's. Greater emphasis will be placed on improved aerodynamics, which will increase the use of air deflectors. Drivetrain efficiency will be improved through multispeed transmissions and low axle ratios. By the late 1980's, most long-distance trucks will have automatic transmissions.

Electronics will be making significant inroads. Electronic components will be used, as in passenger cars, to control exhaust emissions and to improve fuel efficiency. Rapid advances are expected in electronic troubleshooting of truck malfunctions; such systems could be either on or off the truck. Although onboard systems would be considerably more expensive, they may be justified in a number of applications by reducing maintenance expenses. The system would constantly alert the driver to operating conditions, which should reduce the need for major repairs.

Outlook

As noted earlier, the extraordinary boom in the purchase of light trucks for personal transportation use has been brought to an end by high-priced fuel. Thus, a lower long-term growth rate in sales should now be expected.

In addition, Government regulations have conflicting effects on the market. Future fuel economy standards may decrease the variety of product offerings by reducing or eliminating the less fuel-efficient vehicles. If future safety regulations have a substantial impact on prices, an additional sales disincentive would be introduced. Prices could also be adversely affected by other future regulations. For example, future light-

truck emission requirements, as currently proposed, will add significantly to prices.

Partially offsetting these factors will be the effect of car downsizing. As cars and engines continue to shrink in size, their cargo-carrying and trailer-hauling capabilities will be reduced. This could enhance the appeal of light trucks.

The aggregate impact of the various factors appears to indicate a sharp reduction in the light-truck growth rate that prevailed prior to 1979. For light trucks, an average growth rate of 2 percent annually is likely through the mid-1980's. The average growth rate for medium- and heavy-duty trucks is projected at 3 ~~to 3.5~~ percent annually.

The outlook for the light truck market adds to the car manufacturers' financial problems. The four car manufacturers account for 99 percent of U.S. light-truck production. As with large-size and luxury cars, light trucks have historically had relatively high profit margins. As per-unit car profits have declined in recent years, this source of income has been particularly important to the car manufacturers. With a substantially lower growth rate in sales projected for future years, the light truck contribution to profits will be significantly lower.—*Robert V. Coleman, Office of Producer Goods, (202) 566-~~7425~~ 7018.*