

# economic review

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FEDERAL RESERVE BANK OF CLEVELAND

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# SOME ASPECTS OF INTERNATIONAL MONETARY RESERVES

Recently, the international monetary system has come under increased scrutiny, due largely to the emergence of a number of problems. One such problem concerns the matter of international monetary reserves — specifically, the adequacy and composition of reserves. Official concern over the adequacy and composition of international monetary reserves was highlighted at the annual meeting of the International Monetary Fund (IMF) in Rio de Janeiro in September 1967, when a basic plan for supplementing existing reserves was approved in principle by member nations. Moreover, recent developments, such as the balance of payments programs initiated by the United Kingdom and the United States and the two-tiered gold market introduced in March by the “gold pool” nations, as well as the proposal for Special Drawing Rights (SDRs), have important implications for both the level and composition of international monetary reserves.

The general purpose of this article is to present some background on the composition and uses of international monetary reserves. The article first summarizes the role of international reserves under a fixed exchange rate system, and then discusses the major types of reserve assets and their respective roles.

## ROLE OF INTERNATIONAL RESERVES

The current role of international reserves is a direct result of the existing international monetary system, which came into being with the Bretton Woods Agreement establishing the IMF in 1944; IMF member countries undertake to collaborate to promote exchange stability, under a system of declared par values. The official par value of a foreign currency is the level at which a certain quantity of that currency is established to equal a fixed amount of gold or one United States dollar. For example, at par, four German

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marks equal one dollar; 3.62 Dutch guilders equal one dollar; and 12.5 Mexican pesos equal one dollar. The United States dollar is directly tied to gold; one United States dollar is defined to be equivalent to 0.888671 grams of pure gold in official transactions.<sup>1</sup> Therefore, every foreign currency fixed in value in relation to the United States dollar (or to another currency fixed in relation to the United States dollar, such as the pound sterling and the French franc) has a fixed value in terms of the official price of gold and vice versa.

Gold, by itself, does not determine the value of a nation's currency. Both the domestic and international value of a nation's currency is determined by the economic strength of the issuing country, supported by responsible monetary and fiscal policies. Expectations regarding the future value of a national currency are often affected by the monetary and fiscal policies of the issuing government. Consequently, in the long run, these policies would have to be considered appropriate by the governments of those countries that have chosen to hold the currency as a reserve asset if they are to continue to do so.

<sup>1</sup> The United States has agreed to buy and sell gold at the rate of \$35 an ounce, in transactions with foreign central banks. Before March 17, 1968, the United States supported that pledge through participation in the London Gold Pool, as well as through direct settlements with foreign central banks. Since March 17, 1968, the United States will honor that price only in dealing with foreign central banks and will undertake no transactions with other than official accounts, a change in policy that led to a two-tiered gold market. In official transactions, gold continues to be valued at \$35 an ounce, whereas the "free market" price is free to fluctuate in response to supply and demand.

Countries that have established a currency par value under the IMF arrangements are responsible for maintaining the parity rate of their national currency in foreign exchange markets and ensuring a smoothly operating exchange market. The IMF requires that fluctuations in exchange rates be kept within plus or minus one percent of parity. Many countries, however, adopt a narrower range. For example, soon after the establishment of the European Monetary Agreement nearly ten years ago, the member countries agreed to a range of roughly three-fourths of one percent on either side of parity. Since the change in parity of the pound sterling to  $\text{£}1 = \$2.40$ , the pound has been permitted to fluctuate between the upper limit of  $\text{£}1 = \$2.42$  and the lower limit of  $\text{£}1 = \$2.38$ , or approximately 0.83 percent on either side of parity.

### Relation of Reserves to Exchange Rates.

Fluctuations in the foreign exchange market price of a nation's currency are due to supply and demand factors. If a country imports more goods and services than it exports, or purchases more financial or nonfinancial assets of foreign countries than it sells of its own assets, an excess supply of that country's currency will develop in world markets. If the supply of a national currency exceeds the demand, the exchange rate will fall. If the exchange rate falls to a level near its lower limit, the official monetary agency of the deficit country must enter the foreign exchange market to purchase its own currency, thereby creating a demand for its own currency that the market is unable (or unwilling) to create in order to arrest the decline in the exchange rate. A deficit country uses its

existing international reserves of foreign exchange to purchase its own currency in order to support its exchange rate.<sup>2</sup>

In contrast, if a country has a balance of payments surplus, demand for its currency would exceed the market supply. If, as a result, the exchange rate approaches the upper support limit, the official monetary authority of the surplus country must enter the foreign exchange market. The official monetary authority would receive foreign exchange in exchange for its currency and thereby gain international reserves. It should be noted that if exchange rates were not "pegged" and could fluctuate freely in response to supply and demand conditions, there would be no need for international reserves. (There would be a number of major problems, however, under a flexible or fluctuating exchange rate system, which are beyond the scope of this article.)

Because a country has a limited amount of international reserves to give up, while it can accumulate a virtually unlimited amount of reserves, the discipline of losing reserves because of payments deficits is much more severe than that of gaining reserves because of payments surpluses. The lack of symmetry in payments discipline can prevent the full balance of payments adjustment process from operating smoothly.

In general, the balance of payments adjustment mechanism is not permitted to work

<sup>2</sup> If a country reduces its reserves to a minimum without eliminating the excess supply, then it may have to devalue its currency; that is, a country in perpetual deficit at the existing exchange rate for its currency may have to establish a new par value with the IMF, offering more of its currency per unit of gold or the United States dollar in an effort to realign supply and demand.

smoothly because the necessary discipline — normally (though not always) deflation in times of payments deficits and expansion in times of surpluses — may run counter, or be secondary, to domestic economic priorities and goals, such as full employment, steady economic growth, and stable prices. Furthermore, because prices are not always flexible in a downward direction, the primary impact of a deflationary adjustment would likely fall on income, employment, and growth. As a result, many countries choose to sterilize the impact of reserve gains and to offset reserve losses with a combination of monetary and fiscal policies.

The net result of inhibiting the balance of payments adjustment process in order to achieve domestic economic goals is to place a much greater burden on international reserves. In recent years, swings in the balance of payments of individual countries have tended to become protracted, necessitating a higher level of international reserves to weather a series of deficits. The potential need of a large stock of reserves over a long period of time inhibits surplus countries from taking the necessary steps to return to balance and to interrupt the process of reserve accumulation.

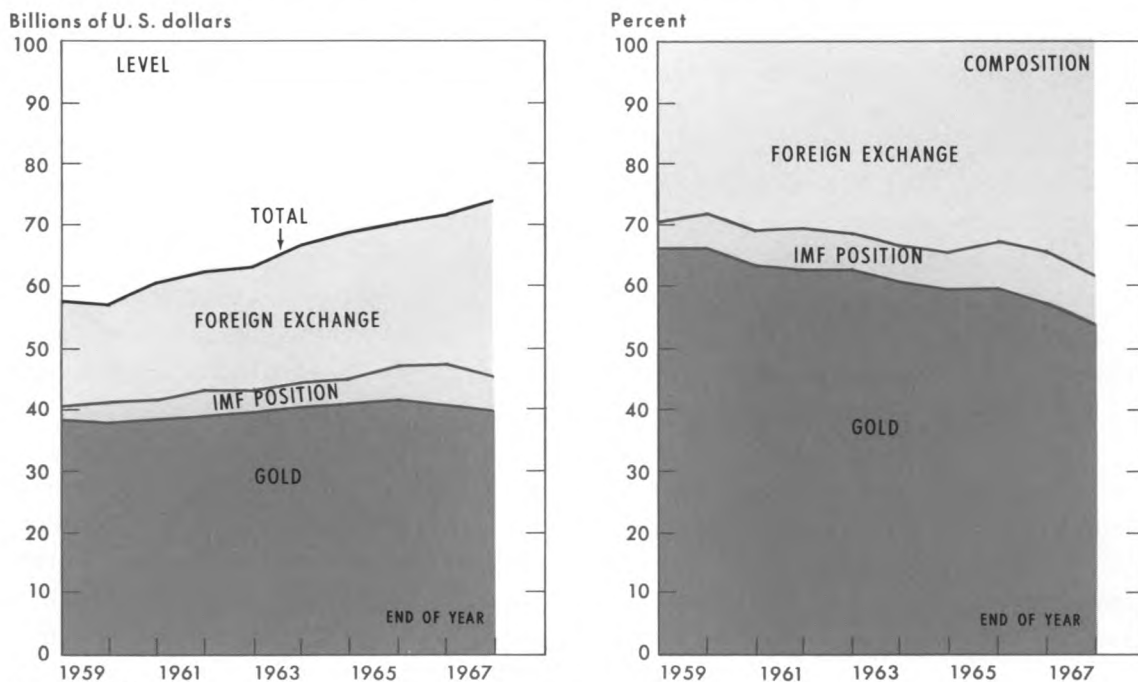
## TYPES OF INTERNATIONAL RESERVES

Although the gold-exchange standard has undergone a process of evolution, the basic foundation was relatively unchanged from late 1958 to early 1968. As shown in Chart 1, total international monetary reserves amounted to \$57.6 billion at the beginning of 1959 and increased to an estimated \$73.3 billion at the end of 1967, or a compound

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Chart 1.

### FREE WORLD INTERNATIONAL MONETARY RESERVES



Last entry: 1967

Source of data: *International Financial Statistics*, International Monetary Fund

annual rate of growth of slightly more than 3 percent. As also shown in Chart 1, the proportion of reserves held in the form of gold declined from 1959 to 1967. While the absolute dollar volume of gold holdings expanded during the period, total reserves increased at a faster rate, due partly to institutional changes. For example, IMF quotas were increased in September 1959 and February 1966, which raised reserve positions in the Fund as a percent of total reserves. Most of the growth, however, in total reserves during the 1959-1967 period was in the form of increased holdings of foreign

exchange, largely dollars and pounds made available by the payments deficits of the United States and United Kingdom, respectively. To put these reserve changes into perspective, it is helpful to examine each form of reserve asset.

**Gold.** Although gold is still the largest component of total international reserves, its position of prominence has declined since 1959. At yearend 1967, gold accounted for 53.9 percent of total free world reserves, down from 66.0 percent at the beginning of 1959. Gold has been used as a monetary asset for many years, perhaps reflecting the

fact that for some time many countries and individuals have placed a higher "value" on gold than on paper currencies or other forms of fiat money. However, the fact that gold can be used to settle international transactions is the major reason that nations hold gold in monetary reserves; gold no longer serves any essential monetary purpose in domestic economic life.

There are two basic sources of new gold<sup>3</sup> — newly mined gold produced in free world countries and gold sold by the U.S.S.R. and mainland China. Gold sales by the U.S.S.R. and mainland China are considered as a second source of gold because these two countries are not part of the free world's international monetary system. Thus, in 1966, when the U.S.S.R. stopped selling gold on the London market and mainland China absorbed or purchased an estimated \$75 million in gold, the amount of gold available for free world use was less than the total gold production.

As shown in Chart 2, the annual output of newly mined gold increased steadily from 1958 through 1964, at an average annual rate of 5.3 percent. The steady increase in the annual production of newly mined gold came to a virtual halt in 1966, as production remained at about the 1965 level. In 1967, gold production actually declined by a fractional amount. The large increase in the output of gold early in the period under review was due chiefly to the discovery and exploitation of new mines in South Africa.

It appears that, unless another large gold discovery is made, an era of exceptional growth in gold production in the free world countries is unlikely.

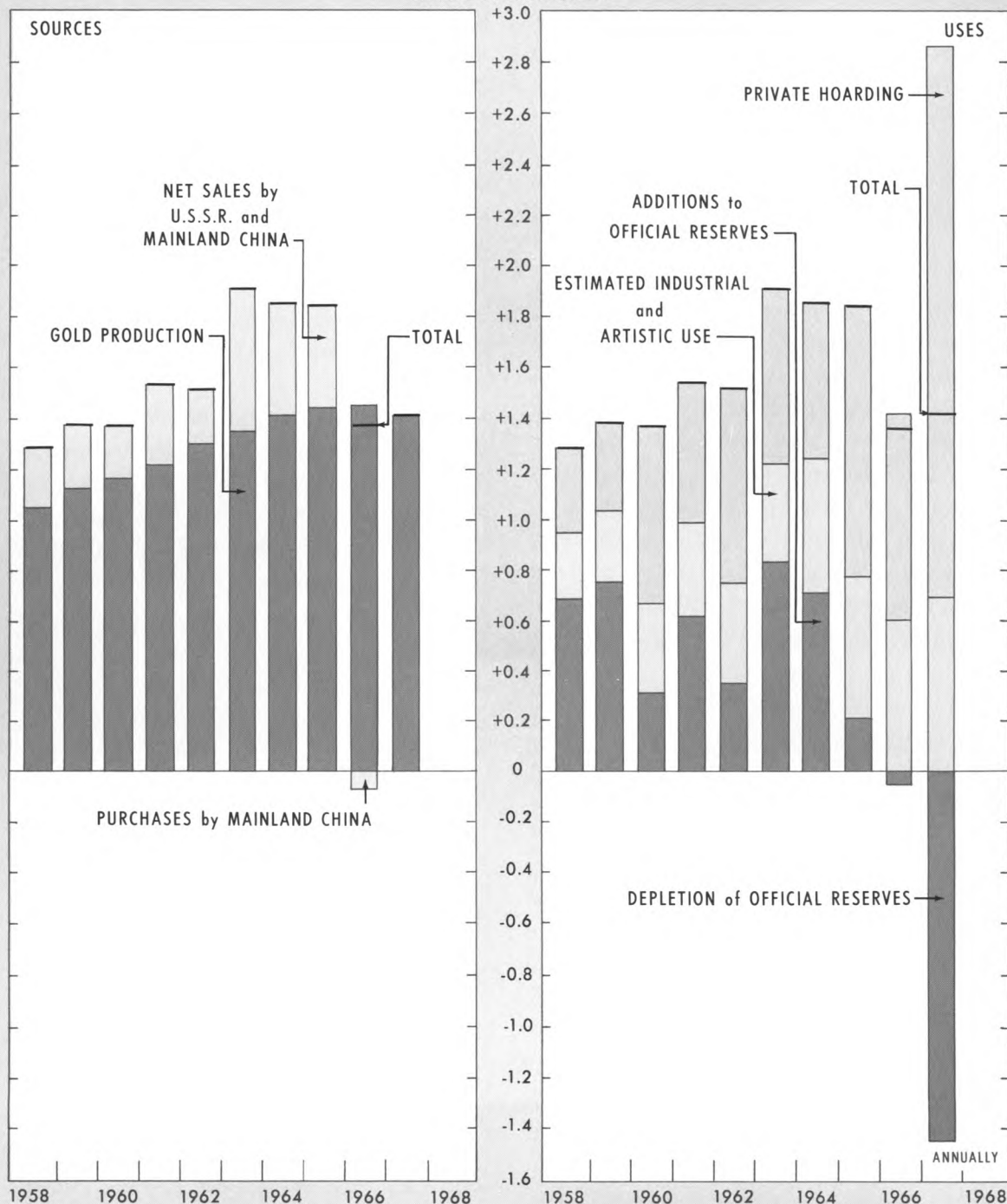
South Africa ranks first in the production of newly mined gold (75 percent of 1966 production), followed by Canada (8 percent) and the United States (4 percent). Africa (other than South Africa), Latin America, Asia, and the rest of the free world account for almost equal shares of the remaining 13 percent of newly mined gold. The relative share of South Africa in total gold production has increased since 1959 when the proportions were as follows: South Africa, 62 percent of the total; Canada, 14 percent; the United States, 5 percent; and the rest of the free world, 19 percent.

As shown in Chart 2, sales and purchases by communist countries have caused the total supply of new gold to move erratically. During the 1959-1965 period, the U.S.S.R. was a net supplier of gold. Soviet gold sales, principally through the London gold market, actually started in 1952 and ended in 1965. Sales reached a peak of \$550 million in both 1963 and 1965, but averaged just over \$350 million per year during the 1959-1965 period. Over the same period, mainland China was a sporadic net purchaser of gold, with the largest purchases amounting to \$150 million and \$75 million in 1965 and 1966, respectively. Because data are not available, the 1967 estimate for gold production shows no activity on the part of the U.S.S.R. or mainland China. However, as a general matter, it is recognized that these two countries added a degree of instability to the flow of

<sup>3</sup> Gold not already held by official monetary institutions, industrial and artistic users, or private speculators and hoarders is defined as new gold.

## ANNUAL CHANGES in the FREE WORLD GOLD STOCK

Billions of U. S. dollars



Last entry: 1967

Sources of data: *International Financial Statistics*, International Monetary Fund and Federal Reserve Bank of Cleveland



gold into the free world market in recent years.

Chart 2 also shows the uses of annual changes in gold. Total uses are the sum of annual additions to official reserves, estimated industrial and artistic uses, and absorptions through private hoarding. The fact that holders of official reserve assets became net suppliers of gold in 1966 and 1967 stands out dramatically. Between 1959 and 1964, official institutions in each year added, on average, approximately \$600 million of gold to their stocks. There was, however, a noticeable setback in the next three years in the accumulation of officially held gold. This turnaround can be traced to two factors: (1) the sources of new gold contracted by \$430 million after 1964, and (2) private demand for gold increased very sharply (about \$1,400 million).

Private demand for gold comes from two sources — industrial and artistic use and private holdings. Industrial and artistic use of gold in the free world amounted to approximately \$280 million in 1959. Industrial and artistic use expanded at an average annual rate of over 16 percent from 1959 to 1967; as a result, estimated demand for this purpose in 1967 amounted to \$690 million. Demand from this source appears to be growing as (1) consumers become wealthier and more able to afford jewelry and other goods made of gold; (2) electrical, electronic, and aerospace industries continue to exploit the special metallic properties of the metal; and (3) the price of gold falls relative to its substitutes (the prices of other metals are not pegged and have shown a generally rising trend).

Private holders of gold bullion provide the second source of private demand. Although the citizens of the United States and the United Kingdom are prohibited from owning gold bullion, most other countries do not have such restrictions. As pointed out elsewhere, gold is

... the customary mode of savings in the Far East, the Middle East and parts of Africa; ... gold [is used] to secure protection against the continuing depreciation of money and political upheavals, ... in much of Europe and Latin America.<sup>4</sup>

The growth of speculative demand (which includes non-reported industrial demand and non-reported central bank accumulation) from an approximate volume of \$350 million in 1959 to \$795 million in 1966 was almost equal to the growth in demand for artistic and industrial uses. However, it appears that speculators absorbed nearly \$1.4 billion more gold in 1967 than in 1966, raising total demand from private holders to almost \$2.2 billion. General uncertainty about the future of the international monetary system and the key currencies on which the monetary system is based is cited by most observers as the major reason for the large increase in private holdings of gold.

The outlook for gold in monetary reserves changed importantly with the introduction of the two-tiered gold market in March 1968. The absolute amount of gold held in the form of international reserves now may hold fairly

<sup>4</sup> "Annual Gold Review," *Monthly Economic Letter*, First National City Bank, New York, January 1967, p. 9, (brackets supplied).

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steady, because the major gold-owning countries have agreed not to sell gold to non-official buyers, and have also agreed that, in view of the prospective establishment of the Special Drawing Rights system, purchase of gold is no longer necessary. If these agreements are adhered to, the amount of gold held in the form of international reserves should remain at the approximate level of March 17, 1968.<sup>5</sup>

**Foreign Exchange.** Foreign exchange is the second largest component of international monetary reserves. In the past, the United States, being the country whose currency was the main reserve currency held by other countries, kept its own reserves predominantly in the form of gold and held little or no foreign exchange. Early in 1961, the United States Treasury began operating in foreign exchange markets for the first time in the postwar period. As a consequence of these transactions, the United States included foreign exchange among its reserve assets in 1961. In early 1962, the Federal Reserve System followed the Treasury's action in an effort to cooperate with the central banks of other countries in maintaining an orderly market for national currencies. An adjunct to the decision to deal in foreign exchange was the initiation of a series of bilateral swap arrangements by the Federal Reserve System with the central banks of other countries. By the end of 1962, there were ten such agreements amounting to \$1 billion.<sup>6</sup> At the

<sup>5</sup> This will depend in large part on whether the IMF, or some central banks, or both, buy gold from South Africa and other gold-producing countries.

<sup>6</sup> With the Austrian National Bank, Bank of France, Bank of England, Netherlands Bank, National Bank of Belgium, Bank of Canada, Bank for International Settlements, Bank of Italy, Swiss National Bank, and German Federal Bank.

end of March 1968, the swap agreements included fifteen arrangements amounting to \$9.36 billion.<sup>7</sup>

The rationale of the swap arrangements, which are restricted to official organizations, is to supply the Federal Reserve System with foreign currencies or to supply a foreign central bank with dollars for a limited period of time in order to offset foreign exchange market pressure against the dollar or foreign currencies without resorting to other steps, for example, transfers of gold. The swap mechanism allows an immediate exchange of dollars for an equivalent amount of a foreign currency, while guaranteeing the reversal of the transaction at existing exchange rates. Although the swaps can be and sometimes are rolled over by mutual consent, most swaps have an original maturity of three months.

Holdings of foreign currencies accounted for 38.3 percent (\$28.1 billion of \$73.3 billion) of international monetary reserves as of December 31, 1967, as compared with 29.5 percent at the end of 1958. During 1959-1967, the average annual increase in foreign exchange held as international reserve assets amounted to 7.2 percent, which far outstripped the rate at which gold was added to reserves. The increasing proportion of foreign exchange held as an international reserve asset is a corollary to gold's diminishing role in international reserves.

There has been a distinct shift in the currency composition of foreign exchange assets

<sup>7</sup> The additions included: National Bank of Denmark, Bank of Japan, Bank of Mexico, Bank of Norway, and Bank of Sweden. In July 1968, an increase in the swap arrangement with the Bank of France raised total swap agreements to nearly \$10 billion.

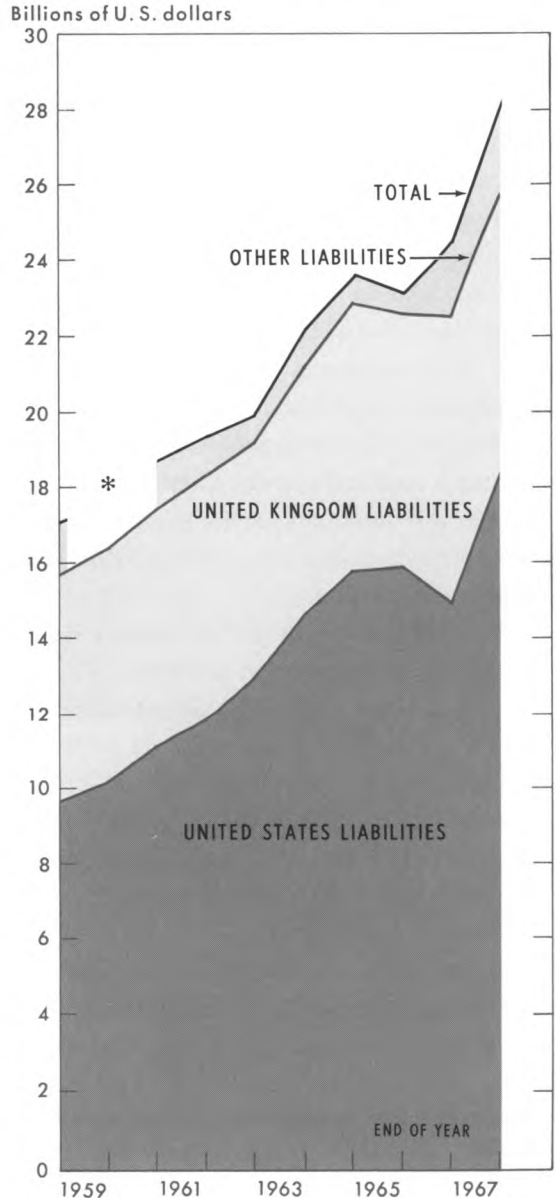
held as international reserves. Chart 3 shows clearly the growth of United States dollar-denominated liabilities held as reserve assets by foreign countries. During 1959-1967, United States dollar liabilities to foreign official institutions increased at an average annual rate of 9.9 percent, with 1966 the only year in which the level of outstanding liabilities actually declined. Chart 3 also shows the relative stability in the use of sterling-denominated assets, with an average annual increase of less than 3 percent.

When the major free world currencies became convertible into dollars in late 1958, other foreign exchange began to be held more freely as reserve assets, augmenting existing holdings of dollars and pounds. Comparing average annual rates of change, the group of liabilities that excludes dollar and pound liabilities grew at the fastest pace. As shown in Chart 3, most of this growth occurred in the most recent two years (1966 and 1967), reflecting in part an increase in the use of non-key currency assets made possible by the swap arrangements.

**Reserve Positions at the IMF.** The facilities of the IMF that are considered as international reserves are probably the least well known and in monetary value are the smallest reserve asset, although the fastest-growing in recent years. At the end of 1958, such IMF facilities accounted for only 4.5 percent of the value of all international reserves; by December 31, 1967, however, the value of the facilities at the IMF counted among the international reserves of member countries had more than doubled and represented 7.8 percent of total reserves. This growth largely reflects increased quotas

Chart 3.

COMPOSITION of FOREIGN EXCHANGE HELD as FREE WORLD INTERNATIONAL RESERVES



\* Break in series; consistent data not available.

Last entry: 1967

Source of data: *International Financial Statistics*,  
International Monetary Fund

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agreed to by the members of the IMF in 1959 and 1966. The nature and extent of the facilities is flexible, and the IMF has demonstrated the ability to modify its reserve creating and facilitating powers on an *ad hoc* basis (for example, the General Agreements to Borrow) and as a by-product of long-term planning (the Special Drawing Rights).

A member country's *gold tranche* is one IMF facility that is counted among a country's international reserves. Normally, the gold tranche is the excess of a country's quota over the IMF's holdings of its currency. This means in effect that the size of any country's gold tranche at any given time is mainly a function of quotas and the extent to which a national currency has been drawn by other IMF members, or the extent to which other currencies have been drawn by the IMF member in question.

One of the privileges of having a gold tranche position with the IMF is that a country may, almost automatically, purchase with its own currency an equivalent amount of another member's currency up to the limit of its gold tranche position and subject to repayment within three to five years.<sup>8</sup>

If a country draws another currency from the IMF under its gold tranche position, then that position is reduced by an equivalent

amount, since the foreign exchange must be purchased with the drawing country's national currency. The IMF's holdings of the drawing country's currency increase, and the IMF's holdings of the currency drawn are diminished, thereby increasing the gold tranche position of the country whose currency is drawn.

It frequently happens that the drawing country is in one of its credit tranches. That is, it has already drawn the currency of other members up to a total equal to, or greater than, the value of its own gold tranche. In this case, the rise in the gold tranche of the country whose currency is drawn is not paralleled by a decline in the gold tranche of the drawing country. This results in a temporary rise in total world reserves (temporary because it disappears when the drawing country repurchases its currency, i.e., repays its drawing).

A second method of expanding the level of international reserves was developed in 1962. In that year, the "Group of Ten"<sup>9</sup> countries entered into an agreement with the IMF known as the *General Arrangements to Borrow* (GAB). Under GAB, these ten countries committed themselves to lend the IMF specified amounts of their individual currencies, up to a total of \$6 billion, if the IMF needs additional reserves to offset adverse developments in the international monetary system. This approach became necessary because of the extent to which the IMF's holdings of usable currencies had been reduced by 1961, and by the possibility that without

<sup>8</sup> See "Implications of the U. S. Gold Tranche Position at the IMF," *Business Trends*, Federal Reserve Bank of Cleveland, February 11, 1967, p. 1. The three-to-five year repayment rule does not apply to use of what is called a super gold tranche position. A member has such a position if, and to the extent, that the IMF's holding of its currency is less than 75 percent of its quota.

<sup>9</sup> The Group of Ten countries are Belgium, Canada, France, Germany, Italy, Japan, the Netherlands, Sweden, the United Kingdom, and the United States.

the new arrangements the IMF, in certain circumstances, might be unable to meet drawings. To the extent that countries lend to the IMF under the GAB, such lendings are formally defined by the IMF as part of "Reserve Positions in the Fund," and thus add to the volume of international monetary reserves.

**Special Drawing Rights.** Although the IMF facilities described above provided temporary additions to world reserves in the past, serious questions were still raised concerning the adequacy of the level of international reserves, that is, the diminishing rate of growth in international reserves in relation to the increasing rate of growth of international trade. As a result, in September 1967, the members of the IMF unanimously elected to develop a plan for additional international reserves by creating a reserve asset known as *Special Drawing Rights* (SDRs).<sup>10</sup> The plan establishes a precedent in international monetary cooperation in that it involves the deliberate creation of a new international reserve asset.

An accord was reached in March 1968 on the language of the "SDR amendment" by the Group of Ten countries, with the exception of France. SDRs will be distributed by the IMF to participating member countries in

proportion to each country's quota in the IMF. SDRs will be used to effect settlements between official monetary institutions and thus will become an international reserve asset whose value and usefulness will depend on their usage and acceptability. Since SDRs will be a permanent addition to the level of international reserves and will serve long-term reserve needs, it is expected that the SDRs will serve as a foundation on which the future growth of international reserves will be built so that the trend toward increased trade need not be constrained by inadequate reserve growth. This rationale contrasts markedly to other arrangements currently in use—the swap facilities, the credit tranche, and the GAB—which were designed only to satisfy short- and intermediate-term international reserve needs.

On June 6, 1968, Congress approved legislation authorizing United States participation in the SDR plan. The bill was signed into law by President Johnson on June 19, 1968, and on July 15 the Secretary of the Treasury, Henry H. Fowler, formally notified the IMF of United States acceptance of the proposed Amendments to the IMF Articles of Agreement establishing the SDR facility. Other countries are taking the domestic steps necessary to enable them to accept the Amendment, and it seems likely that the new plan will have been formally adopted by some time next year at the latest.

<sup>10</sup> For a discussion of the nature and technical aspects of SDRs, see "Special Drawing Rights," *Economic Commentary*, Federal Reserve Bank of Cleveland, January 20, 1968.

# FREIGHT TRANSPORTATION AND INDUSTRIAL ACTIVITY IN THE UNITED STATES

The freight transportation system in the United States is a comprehensive network that tranships the raw materials and finished products essential to the nation's economic activity and growth. By encouraging economic specialization and efficiency and by helping to maintain an interrelated, inter-regional structure of commodity prices, the freight transportation system plays a major role in developing mass markets for goods.

During the postwar period, about 20 percent of Federal (nondefense), state, and local government expenditures have been devoted annually to expansion, improvement, and maintenance of highways, rivers and harbors, airports, and air control systems. While some of these funds benefited passenger travel, a significant proportion helped improve the nation's freight transportation services.

In 1966, gross operating revenues<sup>1</sup> of Federally regulated freight carriers<sup>2</sup> amounted to \$22.4 billion, or more than 5.4 percent of

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<sup>1</sup> Nineteen sixty-six is the latest year for which data on gross operating revenues of freight carriers are available.

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<sup>2</sup> The Interstate Commerce Commission is empowered to regulate rates, terms of entry, and certain other factors of common carriers engaged in interstate commerce. These include railroads, pipelines (except gas and water), motor carriers (except those engaged exclusively in transporting agricultural products, school children, newspapers, etc.), and domestic waterway carriers (except those transporting liquid cargoes of not more than three commodities). A common carrier is for hire by the general public and is obligated to serve all who offer goods for shipment, provided that the goods are among those which the carrier offers to carry. No economic regulation is exercised over private highway or waterway carriers, or over intrastate carriers. The Civil Aeronautics Board (CAB) regulates air carriers similar to the ICC's control over other carriers in interstate commerce.

gross corporate product originating in non-financial corporations. Gross operating revenues of Federally regulated freight carriers have declined almost steadily relative to gross corporate product since 1948, when the ratio reached a postwar high of 8.5 percent. This is perhaps not surprising since agricultural, mining, and manufacturing activity, which accounts for the bulk of goods moved by regulated freight carriers, has increased more slowly in the postwar years than other types of economic activity. For example, between 1948 and 1966, the amount of national income generated in agriculture, mining, and manufacturing rose 131 percent, compared with 208 percent in all other types of economic activity.

As a general matter, no new basic means of shipping goods has been developed since the late 1920's, when commercial air-express service was introduced. Nevertheless, a number of innovations and related improvements occurred in the various modes of freight transportation. As a result, substantial changes took place in the proportion of total freight business handled by the five major modes of domestic freight transportation — trucking, railroads, pipelines, airways, and waterways. This article reviews each of these modes and evaluates the relationship between freight transportation and the nation's industrial activity in the post World War II period.

## MAJOR MODES OF TRANSPORTATION

**Trucking.** In 1966, the gross operating revenues of regulated motor carriers amounted to \$10.9 billion, compared with \$2.7 billion in 1948, or a gain of 300 percent (see Table I). Putting it another way, during 1948-1966,

gross operating revenues of motor carriers increased at an average annual rate of 8 percent. The motor carriers' share of gross operating revenues of all Federally regulated carriers rose from 23 percent in 1948 to 49 percent in 1966.

The structure of the trucking industry is considerably more complicated than each of the other four modes under review. Truck shipments are local, intercity, and interstate. In addition, highway carriers are both commercial (for-hire) and private (shipper-owned). Commercial carriers may be subject to or exempt from regulation by the ICC, depending largely on whether or not operations are interstate. Moreover, commercial carriers are subdivided into common and contract carriers, and these are further classified into general or specialized freight carriers.

Compared with the railroads, freight traffic by truck makes use of more nonspecialized equipment and requires a considerably smaller initial investment. Investment in the industry largely involves the means of transport, due to the fact that road systems are expanded and maintained mostly at public expense. The growth of trucking has been encouraged by an expanding highway system, growing industrial decentralization, and improvements in both trucking equipment and packaging techniques. The trucking industry is typified by a high degree of flexibility in choice of routes between points of origin and destination. In addition to relative freedom from fixed routes, trucks have the advantage of relatively lower cost for hauls. Truck freight, more than most other transportation modes, tends to consist of high-valued manufactured goods carried over relatively

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**TABLE I**  
**Gross Operating Revenues of Regulated Freight Carriers, by Mode**  
**Selected Years**  
**1948-1966**

	1948	1950	1955	1960	1965	1966	Average Annual Rate of Growth 1948-1966
<b>Revenues (mil. \$)</b>							
Highway	\$ 2,698	\$ 3,737	\$ 5,535	\$ 7,214	\$10,068	\$10,853	+ 8.0%
Railroad	8,271	8,135	8,888	8,390	9,287	9,751	+ 0.9
Pipeline	377	442	678	770	904	941	+ 5.2
Airway	90	120	159	278	463	503	+10.0
Waterway	190	259	321	335	314	328	+ 3.1
Total	\$11,626	\$12,692	\$15,581	\$16,988	\$21,036	\$22,376	+ 3.7%
<b>Percent Distribution</b>							
Highway	23%	29%	36%	42%	48%	49%	
Railroad	71	64	57	49	44	44	
Pipeline	3	4	4	5	4	4	
Airway	1	1	1	2	2	2	
Waterway	2	2	2	2	1	1	
Total	100%	100%	100%	100%	100%	100%	

NOTE: Details may not add to totals because of rounding.

Source: American Trucking Associations, Inc.

short distance. The average length of haul for trucks is approximately 230 miles per ton of freight. Absence of large terminal complexes frees truckers from the high terminal costs incurred by other modes of freight transportation.

Freight transportation by truck generally follows the routes of the interstate, defense, and Federal-aid primary highway systems that form a network closely following the national railroad system. Service is still concentrated east of the Rocky Mountains, which are crossed by only four main routes serving major centers on the Pacific Coast. These centers are connected by one main interstate highway from Seattle, Washington, to San Diego, California. Mississippi Valley and East Coast systems provide the other principal north-south routes.

**Railroads.** In 1966, gross operating revenues earned from transportation of goods by all railroad operating companies amounted to \$9.8 billion, compared with \$8.3 billion in 1948 (see Table I). Railroad freight revenues increased by only 18 percent between 1948 and 1966, or at an average annual rate of 0.9 percent, the slowest rate of increase among the five major modes of transportation. Nevertheless, railroads still account for the second largest share of gross operating revenues of all regulated carriers (44 percent). In addition, the inroads being made by other modes of transportation appear to have slowed in recent years.

Privately owned companies provide freight transportation by rail. These companies furnish their own roadbeds, tracks, rolling stock, and related equipment, in contrast to other



modes of transportation whose right-of-way, roadway, etc., are provided either by nature or public funds. In 1966, capital spending for roadway and structures (in contrast to rolling stock and related equipment) accounted for over 20 percent of the railroad industry's total new capital expenditures of \$1.95 billion. Spending for maintenance of roadway and structures accounted for more than 41 percent of the industry's total maintenance expenses of \$3.15 billion.

Rail service is heavily concentrated east of the Continental Divide. All major systems except the Atlantic and Pacific coastal routes pass through Chicago, the principal interchange for rail traffic between the core industrial area of the nation and other areas.

Railroad equipment and facilities are expensive and almost completely specialized, creating high direct and risk costs of entry into the industry. Rail freight traffic consists primarily of long-distance, intercity shipments of bulk raw materials (such as coal, iron ore, and lumber), as well as a wide variety of manufactured products. The average length of haul of rail freight carriers in 1966 was 488 miles per ton, more than twice the average distance per ton of intercity highway carriers.

**Pipelines.** In 1966, gross operating revenues of pipeline companies amounted to \$0.9 billion, compared with \$0.4 billion in 1948, a gain of 150 percent. Gross operating revenues of pipeline companies increased at an average annual rate of 5.2 percent during 1948-1966. Pipeline companies account for the third largest share (4 percent) of gross operating revenues of all Federally regulated carriers (see Table I).

The major pipeline systems originate in the oil-producing areas of the Southwest (mainly Texas, Louisiana, and Oklahoma) and extend into the Midwest and the industrial centers bordering the Great Lakes. Another system extends from the oilfields in the Southwest to the Gulf ports, where petroleum is shipped by tanker to the Atlantic Coast. A third system transports crude oil primarily from the oilfields in southern and southwest California to seaports in that state.

Pipelines that are used for interstate shipment of commodities are classified as common carriers and are subject to regulation by the ICC. In a typical case, a pipeline company is owned by a so-called integrated petroleum company, which extracts crude oil, refines it, and distributes both the crude and refined oils through its pipeline subsidiaries. About three-fourths of crude oil and a substantial proportion of refined petroleum products are moved through pipelines. A distinguishing characteristic of this mode of transportation is that the commodity moves in only one direction through the carrier, which unlike all other modes remains stationary. This means that running costs are relatively small.

**Airways.** During the 1948-1966 period, air freight carriers experienced the fastest rate of growth in gross operating revenues among the major modes of transportation, or at an average annual rate of 10 percent. Gross operating revenues of air freight carriers operating domestically in the United States amounted to \$0.5 billion in 1966, compared with \$0.09 billion in 1948. Although air freight revenue showed the largest percent increase (460 percent) of the five major modes between

## ECONOMIC REVIEW

1948 and 1966, air freight revenues still account for only 2 percent of total operating revenues of all regulated freight carriers.

The Federal airway system constitutes the basic air network, which, like the highway system, conforms closely to the geographical pattern set by the railroads. Private companies provide air freight transportation and the primary investment is in the means of transport—the aircraft. While nature provides the airways, public investment supports in large part the initial cost of airports, terminal facilities, and air-control systems. Although the private investment requirements, per dollar of revenue, are greater for airways than for trucking, these requirements are far below the relative investment necessary for railroads and pipelines. Air cargo consists in part of high-value perishable commodities carried long distances at high speeds, whose transportation alternatives are less economical or beyond the capabilities of the other modes. The average length of haul for air cargo is 716 miles per ton.

**Waterways.** Ships and barges are one of the oldest means of freight transportation, but inherent inflexibility and overall lack of speed have led to a loss of traffic share to the faster, more efficient modes. Regulated waterway freight carriers<sup>3</sup> had an average annual rate of growth of 3.1 percent during 1948-1966. In 1966, regulated waterway freight carriers had gross operating revenues of more than \$0.3 billion, compared with almost \$0.2 billion in 1948. Water carriers accounted for only 1 percent of the gross operating revenues

of all Federally regulated carriers in 1966, in contrast to 2 percent in 1948.

Two major inland waterway routes serve the nation—the Great Lakes system and the Mississippi River system. The Great Lakes system extends from the western end of Lake Superior (at Duluth, Minnesota) to the Atlantic seaboard via the New York State Barge Canal and the St. Lawrence Seaway. The Mississippi River system extends from St. Paul and Chicago in the north, and Pittsburgh in the east, to New Orleans in the south. These systems compete with the Chicago-East Coast and Mississippi Valley railroad routes in serving the industrial and agricultural heartlands of the nation. Although nature provided some of the waterways, the shipping channels are maintained and most of the port facilities are furnished by public investment. Thus, the bulk of private investment is required for the means, rather than the medium, of transport.

The principal advantage of ships and barges, like the railroads, lies in large hauling capacity. Shipments by water consist mainly of bulk items, such as grain, petroleum, and ores, which need to be transported at low rates over relatively long distances and well-established routes where steady flow and large volume, rather than speed, are of prime importance.

## COMPOSITION OF GROWTH IN FREIGHT REVENUES AND TRAFFIC

In view of the dominance of trucking and railroads in freight transportation, there have been only minor changes in the revenue shares of the other three modes. For example,

<sup>3</sup> The ICC has authority over domestic water transportation similar to that applying to highway, rail, and pipeline carriers.

as indicated earlier, the very sharp increase in airline freight revenues only raised that mode's share of total freight revenues to slightly over 2 percent in the 1960's, after being around 1 percent during the first decade or so of the postwar years. Accordingly, most of the variation in revenue shares reflects developments in trucking and the railroads.

In 1948, rail freight revenues were slightly more than three times greater than revenues of regulated highway carriers. Since that time, trucking revenues have grown rapidly and after 1962, the motor carriers' share exceeded that of the railroads. The fact that railroad freight typically involves longer hauls and lower valued commodities has apparently slowed the growth of earnings of railroads per ton-mile.

A comparison of the distribution of revenues and ton miles accounted for by each mode clearly illustrates this point. For example, in 1966, truckers earned 49 percent of total operating revenues of all regulated freight carriers (see Table I), but accounted for only 9 percent of total ton-miles carried (see Table II). On the other hand, in 1948, the railroads accounted for 66 percent of total ton-miles carried and 71 percent of total operating revenues; in 1966, the railroads had to haul half of the nation's total freight ton-miles to account for only 44 percent of the nation's freight revenues. This corresponds to a rise of less than 2 percent in gross revenues per ton-mile for the railroads between 1948 and 1966, compared with increases of 38 percent for regulated truckers, and 26 percent for all carriers, including the railroads.

The relatively slow rise in earning power

of the railroads is also attributable in part to competition with other modes of freight transportation. For example, in 1946, the trucking industry accounted for 54 percent of new automobiles transported, with rails carrying 41 percent (water carriers accounted for the rest). With the advent of double-decked trailers, trucks were able to command a rising share of automobile shipments. By 1959, the railroads' share of new auto traffic was only 8 percent, while trucks carried 90 percent. The railroads then countered with triple-decked auto carriers and lower rates. As a result, by 1966, the truckers' share slipped to 54 percent, while that of the railroads rose to 46 percent (a postwar high). The railroads' recovery of automobile shipments was, however, achieved at some cost to earnings per ton-mile.

The impact of rate competition can also be seen in the case of pipeline and waterway carriers as reflected in the growth patterns of ton-miles and gross operating revenues (see Tables I and II). While the ton-mile shares of both types of carriers increased appreciably during the 1950's, the respective shares of total operating revenues remained relatively stable and substantially smaller than the ton-mile shares.

## TRENDS IN FREIGHT TRAFFIC AND INDUSTRIAL ACTIVITY

As discussed earlier, from 1948 to 1966, gross operating revenues of regulated freight carriers increased more slowly than national income in those sectors supplying the bulk of commodities involved in regulated traffic. Similarly, during the same period, movement of freight rose more slowly on average

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**TABLE II**  
**Ton-miles of Regulated Freight Carriers, by Mode**  
**Selected Years**  
**1948-1966**

	1948	1950	1955	1960	1965	1966	Average Annual Rate of Growth 1948-1966
<b>Ton-miles (millions)</b>							
Highway	46,706	65,648	82,906	104,355	128,241	135,987	+ 6.1%
Railroad	647,267	596,940	631,385	579,130	708,700	750,800	+ 0.8
Pipeline	119,597	129,175	203,244	228,626	306,400	332,900	+ 5.9
Airway	223	318	481	778	1,910	2,250	+13.7
Waterway	161,846	163,344	216,508	220,253	262,400	265,000	+ 2.8
Total	975,639	955,425	1,134,524	1,133,142	1,407,651	1,486,937	+ 2.4%
<b>Percent Distribution</b>							
Highway	5%	7%	7%	9%	9%	9%	
Railroad	66	62	56	51	50	50	
Pipeline	12	14	18	20	22	22	
Airway	*	*	*	*	*	*	
Waterway	17	17	19	19	19	18	
Total	100%	100%	100%	100%	100%	100%	

\*Less than one-half of one percent.

NOTE: Details may not add to totals because of rounding.

Source: American Trucking Associations, Inc. and Federal Reserve Bank of Cleveland

than manufacturing and mining output.<sup>4</sup> As shown in Table II, total ton-miles of regulated freight carriers increased at an average annual rate of 2.4 percent between 1948 and 1966; over the same period, industrial output increased at an average annual rate of 4.5 percent.

As reflected in the changes in ton-mile composition of freight traffic referred to earlier, the rates of growth of the five modes of freight transportation varied widely in the 1948-1966 period. As shown in Table II, air-freight carriers had the highest rate of growth (13.7 percent), due in part to a small starting

base. In terms of ton-miles, the growth rates of pipelines (5.9 percent) and trucking companies (6.1 percent) were faster than both industrial production (4.5 percent) and total freight ton-miles (2.4 percent), while the average growth rate for waterway carriers (2.8 percent) was virtually the same as that for all carriers. Railroads showed the slowest growth rate, well below the average for all five modes and industrial production.

Differing rates of growth in ton-miles among the five modes of freight transportation and industrial production perhaps reflect two major factors — variations in average length of haul and differences in the composition of goods transported. Nonetheless, other factors, such as innovations reducing the

<sup>4</sup> Calculated from Federal Reserve indexes of industrial production (total minus utilities).

bulk of goods, may be significant in individual cases. With reference to the composition of goods transported, there was a shift in the relative importance of the types of goods shipped by air, specifically in favor of less bulky items. In 1955, machinery parts and equipment and cut flowers ranked as the two most important products shipped by air; in 1965, auto parts and accessories were second and cut flowers slipped to seventh place. The sharp increase in available cargo capacity also influenced the growth of air freight. Between 1960 and 1965, for example, total hold capacity of all-cargo planes expanded by more than 290 percent.

The average annual rate of growth of pipeline traffic is nearly the same whether computed in terms of ton-miles, or in terms of barrels originated into pipeline systems, implying little change in average length of haul. Pipeline ton-miles grew faster than industrial production during 1948-1966, although gross consumption of petroleum as an energy resource by industrial users increased less rapidly than output, implying some increase in total stocks. Waterway ton-miles increased at twice the rate of waterway tonnage between 1948 and 1965, suggesting a rise in average length of haul per ton of freight. Major dependence upon mineral products that lagged the growth of output of manufactured goods explains in part the slower growth in waterway traffic than in industrial production.

Perhaps the principal reason for the slower growth of rail traffic involves the composition of goods transported by rail, as compared with the composition of industrial production (see Table III). About 48 percent of the ton-

**TABLE III**  
**Commodity Composition of Industrial Production, Railroad Freight, and Highway Freight**  
**Selected Years**

Commodity Class	Industrial Production*	Railroad Freight†	Highway Freight‡
Agriculture, forestry, and fisheries	-0-	9.5%	6.3%
Mining	8.7%	47.7	6.7
Manufacturing	91.3	38.6	83.9
Durable goods	50.8	21.9	29.0
Nondurable goods	40.5	16.7	54.9
Miscellaneous freight	-0-	4.2	3.1
Total	100.0%	100.0%	100.0%

\* Percent distribution of 1957-1959 value-added weights covered by the Federal Reserve index of industrial production, excluding utilities.

† Percent distribution of tons of revenue freight originated on Class I railroads, 1965.

‡ Percent distribution of tons of revenue freight originated on Class I common and contract motor carriers of property, 1963.

Sources: Interstate Commerce Commission; Board of Governors of the Federal Reserve System; Federal Reserve Bank of Cleveland

nage hauled by Class I railroads in 1965 comprised the products of mines. Output of the mining sector, however, advanced only 43.5 percent during 1948-1966 and accounted for less than 9 percent of the 1957-1959 value added by mining and manufacturing, according to the weights assigned in the Federal Reserve index of industrial production.<sup>5</sup>

On the other hand, less than 39 percent of goods hauled by rail in 1965 originated in the manufacturing industries. The significance of the failure to carry additional manufacturing output is revealed in the fact that

<sup>5</sup> Coal accounted for 26.2 percent of the tonnage hauled by rail in 1965 and accounted for 1.2 percent of value added in production during 1957-1959. Output of coal declined more than 21 percent between 1948 and 1966.

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manufacturing production accounted for over 91 percent of the base-period value added by all industries and increased 130 percent between 1948 and 1966. Within manufacturing, production of durable goods industries, which increased 146 percent during 1948-1966 and contributed nearly 51 percent of value added, accounted for only 22 percent of the tonnage hauled by Class I railroads in 1965. Output of the nondurable goods industries, which accounted for over 40 percent of value added in production in 1957-1959 and advanced 117 percent during 1948-1966, accounted for less than 17 percent of all rail tonnage in 1965.

In its general outline, the composition of commodities moved by regulated highway carriers was apparently closer to that of industrial production than was the commodity-composition of rail freight. In 1963, the latest year for which such data are available, almost 7 percent of tonnage hauled by Class I regulated trucking companies consisted of mining output, which was relatively close to the base-period proportion of mining in the industrial production index (see Table III). Similarly, the share of manufactured goods in highway freight was reasonably close to the relevant proportion in industrial production, although nondurable goods were more heavily represented in truck tonnage than in rail tonnage or industrial production. It is not surprising, therefore, that growth in highway freight compares more favorably than railroad freight to growth in production.

### FREIGHT TRANSPORTATION AND INDUSTRIAL PRODUCTION

As a general matter, finished goods are

usually shipped to points of consumption. Consequently, there should be a reasonably close relationship between production and overall transportation of goods — apart from changes in the rate of inventory investment at the production level. Given the similarity between highway freight traffic and industrial production in terms of commodity composition and rates of growth, there should indeed be a close relationship over extended time periods. Since growth rates and commodity composition associated with railroad freight movement and production are not similar, it would be expected that they would not be closely related over time. Thus, as Chart 1 shows, the behavior of truck tonnage closely follows the contour of industrial production, particularly after 1958, while the behavior of rail carloadings does not.

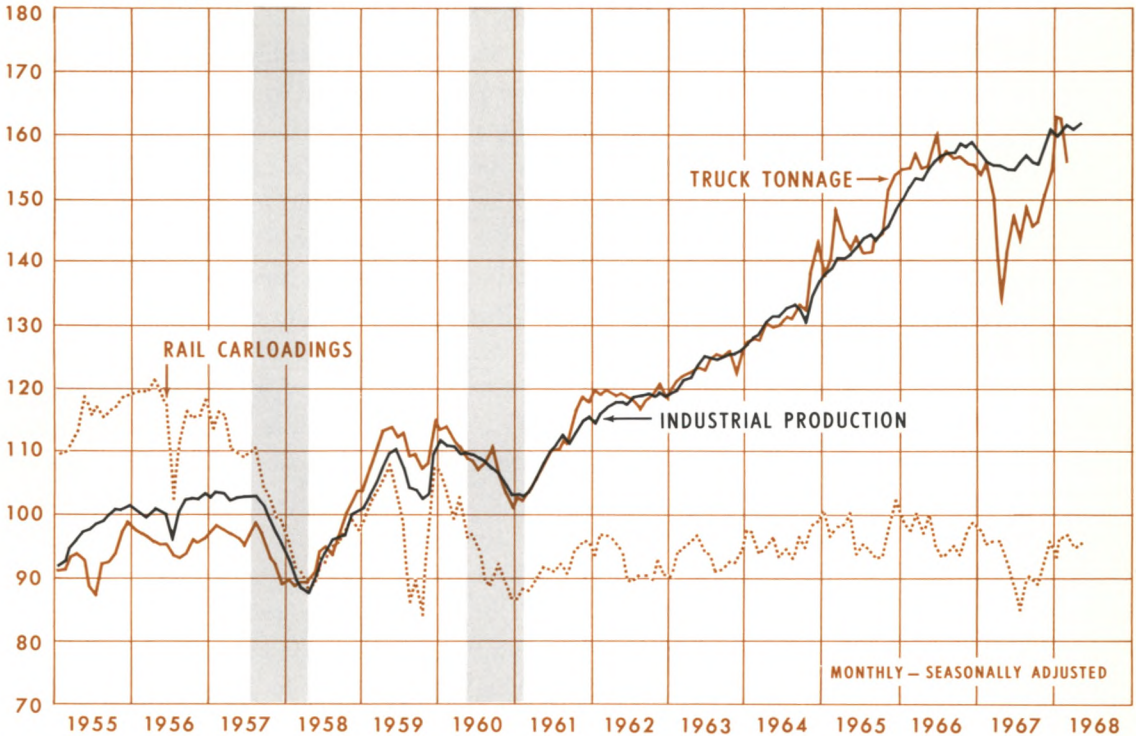
The nature of the relationship between freight transportation and industrial production can be evaluated by comparing a number of series on freight transportation with industrial production. As would be expected, a comparison of annual data on various series on freight transportation<sup>6</sup> with industrial production reveals that the individual series (such as those on trucking, airway, waterway, and pipeline traffic) experiencing a rate of growth as fast as or faster than production demonstrated a high degree of relationship with output. On the other hand, the slower growing series, for example, rail

<sup>6</sup> The series include total truck tonnage, general truck tonnage, pipeline barrels, air cargo tonnage, inland waterway tonnage, total rail carloadings, miscellaneous rail carloadings, and rail ton-miles. Each was compared with annual indexes of industrial production (total less utilities) for the period 1950 through 1965.

Chart 1.

**TRUCK TONNAGE and RAIL CARLOADINGS COMPARED with INDUSTRIAL PRODUCTION**

INDEX 1957-59=100



Last entry: May '68, Mar. '68

Sources of data: American Trucking Associations, Inc.; Association of American Railroads; Board of Governors of the Federal Reserve System

freight traffic, demonstrated a poor relationship with production.<sup>7</sup> The latter is to be expected, particularly since the rail freight series actually declined during portions of the 1950-1965 period.

There is a particular problem in using the

<sup>7</sup> The adjusted coefficient of determination for total rail carloadings on industrial production (total less utilities) for the period 1950-1965 was 0.455, indicating that 45 percent of the variation in carloadings was explained by changes in production, whereas the coefficient for general truck tonnage was 0.979, indicating that 98 percent of the variation in truck tonnage was explained by changes in production.

rail freight series in this type of analysis. The problem can be illustrated in terms of rail carloadings, which are useful data because of the availability of monthly information. The average capacity of individual freight cars increased from 51.9 tons in 1948 to 61.2 tons in 1966 (almost 18 percent), which made it possible for about as many tons of freight, overall, to be hauled with fewer freight cars (almost 263,000 or 15 percent less in 1966 than in 1948). Thus, while total revenue carloadings declined almost 31 percent between 1948 and 1966, total revenue freight tonnage

## ECONOMIC REVIEW

(originated on Class I railroads) declined less than 5 percent. This development largely reflected improvements in loading technology, notably "containerization" and "piggy-back" haulage, which contributed importantly to the 20-percent increase in tons originated per freight car between 1948 and 1966. Because of these factors, the series on rail carloadings has a significant downward bias in representing rail freight traffic and would be expected to demonstrate a poor relationship with industrial activity.<sup>8</sup>

The downward bias in carloadings could be compensated for in part by using data on rail ton-miles. Unfortunately, this series is not a fully suitable alternative, since it simply replaces the downward bias in carloadings with an upward bias, due to the 20-percent increase in average length of haul between 1948 and 1966. Admittedly, both types of bias might be overcome by using data on rail tonnage. In fact, in evaluating industrial activity, the volume of traffic is clearly more important than the length of haul, since production occurs in any event. Unfortunately, monthly information on rail tonnage is not available.

In an attempt to minimize the respective biases in rail carloadings and ton-miles (due to increased capacity and reductions in bulk), monthly data on rail carloadings can be expressed as a percent of computed trend (statistical function on time). This procedure

<sup>8</sup> When monthly data on total rail carloadings were correlated with industrial production (total less utilities) for the 1955-1966 period, the adjusted coefficient of determination was 0.096. In contrast, the adjusted coefficient of determination for general truck tonnage (monthly data) was 0.097.

has an additional advantage insofar as major interest centers on cyclical, or short-term, relationships between freight transportation and industrial activity, rather than on trend, or long-run relationships. For this reason, analysis is confined to the modes of freight transportation for which monthly data are available. Such data are available only for highway and railroad transportation and are in the form of general truck freight tonnage and total rail carloadings.

The results are shown in Chart 2, which presents the individual series as a percent of trend smoothed by a three-month moving average.<sup>9</sup> The smoothing helps reduce erratic month-to-month fluctuations evident in both the trucking and railroad series (see Chart 1) and that obscure underlying cyclical movements.

Chart 2 indicates that compensating for long-run factors in rail carloadings which cause downward bias helps to strengthen the relationship of carloadings to industrial production. On the other hand, the relationship of truck tonnage to industrial production is not as close as previously, that is, before the influence of trend is removed.<sup>10</sup> Nevertheless, as indicated in Chart 2, total rail car-

<sup>9</sup> Trends were fitted to the logarithms of the freight traffic and production series [ $\text{Log } Y_c = a + b(\text{Time})$ ], covering January 1955-December 1966. Other functions could conceivably correct more efficiently for trend in specific series, or different time periods might yield trends with less mean-squared variance.

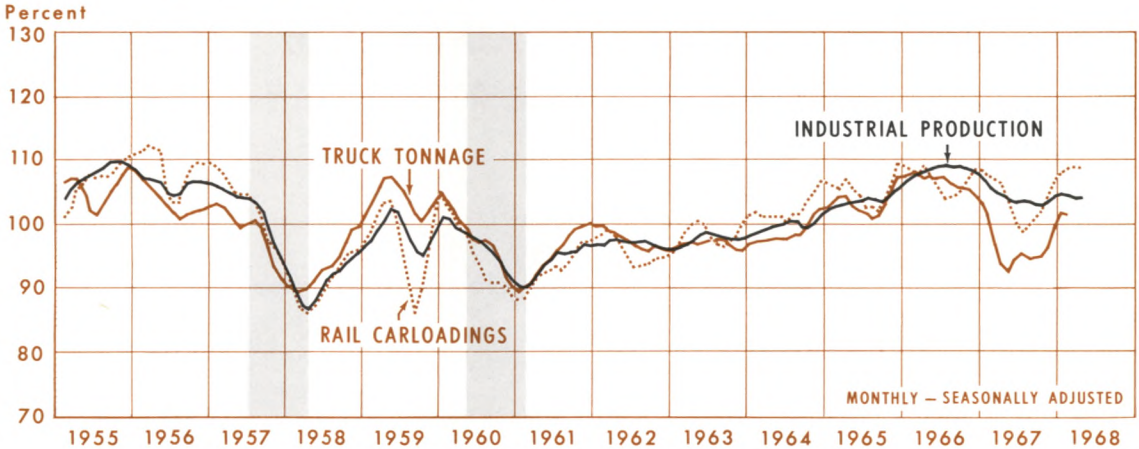
<sup>10</sup> In fact, on the basis of the trend-reduction method employed, rail carloadings showed a higher coefficient of determination on production than general truck tonnage. A different type of trend reduction, however, could yield different results.



Chart 2.

**TRUCK TONNAGE and RAIL CARLOADINGS COMPARED with INDUSTRIAL PRODUCTION**

Percent of Trend, Smoothed with 3-month Moving Averages



Last entry: Apr. '68, Feb. '68

Sources of data: American Trucking Associations, Inc.; Association of American Railroads; Board of Governors of the Federal Reserve System; Federal Reserve Bank of Cleveland

loadings and general truck tonnage generally fluctuate around trend in a manner similar to industrial production. The behavior of all three series clearly reveals the recession of 1957-1958 and the subsequent recovery, which was interrupted by the steel strike of 1959, as well as the milder recession of 1960-1961. Intervening fluctuations in economic activity during the general business expansion since early 1961 also appear in all three series, for example, the moderate slowdown in 1962, the sharp increase in business activity in late 1965, and the significant slowdown in the first half of 1967.

More recently, as shown in Chart 2, the

series indicate that a marked recovery occurred in the volume of goods shipped by rail and truck in the second half of 1967, which was associated with a moderate strengthening of industrial production. Thus, despite considerably different rates of growth over the years and technological improvements in the various modes of freight transportation that have somewhat altered long-run relationships to productive activity, it is apparent that the rail and truck transportation series (which together account for the bulk of commodity traffic) reveal useful and fairly accurate information on economic activity.

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