The Geography of International Business Telecommunications: The Role of Leased Networks

John V. Langdale

School of Earth Sciences, Macquarie University, North Ryde 2109, Australia

Abstract. International business telecommunications traffic is dominated by large transnational corporations (TNCs) and focused on major industrialized countries such as the United States and the United Kingdom. Leased networks are a small but important part of international telecommunications, especially for large TNCs. Many of these firms (particularly in the banking and finance and electronics industries) view their leased networks as key elements of their global corporate strategy; they have sophisticated networks that use high-speed leased circuits to link major industrialized countries. These TNCs transfer large amounts of information on their networks to support their internationalization of production. The location of regional hubs of international leased networks is an important component of TNCs' internationalization strategy; there is mounting competition between countries to become regional hubs for traffic on international leased networks, particularly in Western Europe and East Asia. The U.K. is by far the most dominant regional hub for Western Europe, although it is likely to face increasing competition from other countries. No single country dominates the Asia-Pacific Region; there is strong competition between Japan, Hong Kong, Singapore and Australia to hub regional leased networks. The international role of leased networks is linked to the geographical literature on information flows and organizational structures, given that these networks are a significant component of the infrastructure facilitating information flows for organizations.

Key Words: international telecommunications, leased circuits, regional hubs, transnational corporations, information flows, internationalization of production, computers, banking, finance.

A global economy is emerging that requires massive international information flows in order to operate effectively. Societies are increasingly interdependent through trade, social and cultural exchanges. Yet most studies of international linkages have focused on trade in commodities and manufactured goods, with very little attention given to flows of information. It is becoming increasingly apparent that, as industrialized countries move into an information economy, international trade in information is becoming a significant part of overall trade flows; international telecommunications is a vital infrastructure to support these global information flows. Despite the importance of telecommunications in the global economy, little is known about its geography.

Geographical analysis of business international telecommunications traffic patterns is important in understanding the internationalization of production in a number of information service industries such as banking, finance and computer services. New telecommunications services enhance the ability of global firms to coordinate their international operations. Thus the growing interest by geographers in the internationalization of services (Brunn and Leinbach forthcoming; Daniels 1986, 1987; Langdale 1985a, b) needs to be complemented by analyses of international information flows. Such analyses would also improve understanding of international trade in services, an area long neglected by geographers.

This paper advances two principal arguments. The first is that the growth of international leased networks is dominated by large transnational corporations (TNCs); these networks are important in facilitating the emerging internationalization of production. Leased cir-

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cuits are a small but increasingly important area of domestic and international telecommunications and are heavily used by many TNCs at an international level. They are circuits used by a particular organization and are generally leased from a common carrier for a flat fee: the organization leases a circuit at a certain speed of data transfer and may use it twenty-four hours a day for no extra charge. Leased networks are a key component of the internationalization strategy of a number of TNCs: thus an understanding of the size and location of these networks sheds light on the nature of the geography of internationalization of production.

A second and closely related argument is that the location of regional hubs of international leased networks is an important part of TNCs' internationalization strategy. There is growing competition between countries to become regional telecommunications hubs. Countries, regions and cities that dominate these networks (and international business telecommunications traffic in general) are likely to attract rapidly growing information-intensive industries (e.g., banking and finance) and become central locations in the information economy. Continued growth of many information industries is dependent on firms being centrally located to high-quality international telecommunications services and other information flows such as face-to-face contacts. The role of these telecommunications-dominant countries is likely to become more important, since low cost and high quality telecommunications is becoming critical for the operations of a number of industries.

Two types of hub locations on international leased networks may be recognized. The first is a global hub, which is generally associated with a TNC's headquarters. The U.S. and, to a lesser extent, Japan and major Western European industrialized countries are the global hubs of many of these networks, because of the location of major TNCs' headquarters in these countries. This paper focuses on the second type—the regional hub. Many TNCs use regional hubs to collect traffic originating/terminating in a region before transmitting it via high-speed circuits to the companies' global headquarters or other regional hubs. Utilizing data on leased circuits, particularly those connecting the U.S. to the rest of the world, the paper examines competition between countries in the Western European and Asia-Pacific Regions to become the regional hubs of leased networks for their respective regions.

An important reason for the increasing "tradeability" of services is that electronic information systems are being more heavily utilized. Improvements in international telecommunications services in general and leased networks in particular are facilitating growth of trade in services. For example, a transnational bank such as Citicorp is better able to engage in trade in banking services given its extensive international leased network; more fundamentally, it is able to facilitate trade in its customers' business whether they are in service or manufacturing activity. Thus there is an increasing information service content embodied in trade in manufactured products.

Factors Influencing Growth of Leased Networks

A number of factors are identified as influencing the nature of leased networks: the nature of internationalization of production, corporate organizational structure, and level of government regulation. Particular attention is directed towards an analysis of the internationalization of production; this factor has been important in stimulating growth of international telecommunications in general and leased networks in particular.

Internationalization of Production and Leased Networks

Research on the geographical implications of the internationalization of production has highlighted the role of TNCs (Dicken 1986). Surprisingly, few case studies in the geographical literature have examined how TNCs integrate their production, finance and marketing across national boundaries, although Rimmer (1988) has examined the internationalization of engineering consultancies. Rimmer found that firms range from those that have centralized management of international operations to those with completely integrated management and operations on a global basis. Other research has examined the nature of international production in a number of industries including electronics (Scott and Angel 1988; Scott 1987)

and automobiles (Dicken 1986), but little attention was given in these studies to the strategies firms employ to integrate their global operations.

The term internationalization of production is defined in this paper as the extent to which an industry or a firm has moved towards the global integration of production, marketing and finance. A firm may operate in different countries, but not have internationalized production. Until the 1970s, many firms allowed their international subsidiaries to operate relatively independently; there was very little international sourcing of production or coordination of marketing decisions. By the 1980s, some firms were moving towards global operations. There is no fixed level at which a firm or industry could be called internationalized; rather they need to be placed on a continuum ranging from highly-internationalized to primarily nationally-oriented.

The term internationalization of production is somewhat misleading. The market for products and services may be global, but production is generally dominated by three regions: North America (primarily the U.S.), Western Europe, and the Asia-Pacific Region (primarily Japan but also including the rapidly growing Asian Newly Industrializing Countries). Ohmae (1985) argues that TNCs moving to internationalize production need to have production bases in each of the key core industrialized countries/regions: the U.S., Western Europe, and Japan. Africa, Latin America, the Middle East and the centrally planned economies of the USSR and Eastern Europe are either minimally included or totally excluded in most firms' global production networks, although they may have a significant role as markets.

The preeminence of industrialized countries in the international economy is related to their concentration of economic and political power. Like most large TNCs, intergovernmental organizations (e.g., UN, OECD and UNCTAD) are headquartered in industrialized countries. These organizations are heavy users of telecommunications, and much of their traffic is centered on their head offices. There is also a historical legacy: a number of industrialized countries had colonial empires in the past; telecommunications traffic patterns reflect these "neo-colonial" linkages between former colonies and the "mother" country. The largest international telephone traffic flows from former African colonies of France and the U.K. are still to their respective former colonial powers (AT&T 1983).

The internationalization of production may be seen at an *intracorporate* and an *intercorporate* level. At an intracorporate level, a number of large TNCs are integrating their production, warehousing, marketing and finance on a global basis. IBM, for example, relies heavily on international systems to support its internationalization of production. IBM products are designed and manufactured on a worldwide basis, requiring constant information flows between laboratories, sales offices, ordering and scheduling departments, manufacturing and warehousing plants (McCann 1986; Bakis 1987). Telecommunications and information technologies have facilitated this integration, particularly with respect to the rapid growth of international intracorporate information systems; international leased networks are a key component of these internationalization developments, since they allow firms to internalize information flows.

The role of intracorporate information flows has been raised in the literature on internalization (Rugman 1981). Internalization refers to transactions within an organization rather than on external markets. It facilitates the coordination of the flow of goods and services from one part of an organization to another. Firms are able to achieve a more effective scheduling of flows and a more intensive use of facilities and personnel in production and distribution processes (Chandler 1977, 6–7).

Intracorporate information is essential for the operation of TNCs. The ability to effectively use information at an international level gives TNCs a major advantage over national firms. International intracorporate information flows take place in many different forms, including electronic and non-electronic (personal contact, mail and courier) means. While most TNCs make extensive use of both public and leased networks, there are numerous advantages (e.g., lower costs, security, and compatibility of computer standards) in maximizing usage of the firm's internal leased network.

Internalization may occur for a number of reasons. One is that a TNC may have undertaken sophisticated R&D and may use various means of intracorporate communications, in-

cluding its leased network, to transfer this technology to its subsidiaries in different countries and to service customers' needs. Control is maintained over proprietary information. High-technology manufacturing firms in electronics, computer and telecommunications equipment use their leased networks to facilitate the transfer of technology to their subsidiaries. Some TNCs (particularly IBM) have internationalized R&D and have used their leased network to improve coordination between their worldwide laboratories (McCann 1986).

Another reason for internalizing transactions may arise if there is a high level of uncertainty in the market. Transnational banks have internalized many transactions, given the levels of uncertainty in the international banking and finance industry. Global leased networks allow these banks to cheaply and quickly transfer large amounts of information on market developments and minimize the level of uncertainty. Leased networks also allow banks to maintain a high level of security over their financial transactions.

The growing complexity in the internationalization of production at an *intercorporate* level is reflected by the rapid increase in the volume of information flows taking place between firms. Linkages between firms within an industry (e.g., banking and finance and transport) are growing rapidly, with firms needing improved telecommunications systems to facilitate information flows. Intercorporate electronic funds-transfer systems such as SWIFT are vital for the banking and finance industry. Similarly, electronic data interchange (EDI), which permits the transfer of messages in a cheap and standardized format, is of growing significance for the transport, retailing and automobile industries. International and domestic telecommunications linkages between firms in closely related industries, including airlines (SITA and computerized reservations systems such as SABRE) and the accommodation (hotel and motel) industry are also growing rapidly. Traditionally, leased networks have not been heavily utilized for intercorporate communications, largely because of government regulatory restrictions and the incompatibilities between different companies' computer networks.

The internationalization of production has also been linked to the global or world-city framework (Cohen 1981; Friedmann 1986). World cities have a global reach; major TNCs headquartered in these cities need to be accessible to the rest of their organizations, but also to developments in their operating environments throughout the world (Daniels 1985). International telecommunications is vital to the growth of information service industries in world cities such as New York and London (Moss 1984, 1987). Centrality to international information flows is essential for the continued growth of these cities. Ideally telecommunications traffic flows on an urban/regional basis are needed to identify the role of global or world cities in the circulation of information; unfortunately, such information is rarely available. While the leased circuit information in this paper is nationally based, it is likely that the vast majority of leased circuits connect large cities.

Corporate Organizational Structure

Research on the geographical implications of information flows in large organizations has been undertaken by Törnqvist (1970) in Sweden, Goddard (1975) in the U.K. and Pred (1974) in the U.S. This research links the type and geographical patterns of contacts (e.g., face-to-face, mail and telecommunications) to the structure of organizational hierarchies. Head offices of large organizations occupy a key role in the geographical pattern of organizational information flows. While head offices have a diverse range of contact types, face-to-face contacts are of particular importance and play a significant role in the intricate web of linkages among organizations within CBDs.

There has been very little geographical research at an international level on the interrelationships between information flows and organizational structure, yet similarities exist with the national level. Head offices of TNCs are the locus for high-level strategic decisions, particularly in corporate strategy and financial planning, activities that are heavily reliant on inside and outside information flows, and have a key role in controlling these flows. The greater the level of internationalization of production in a TNC, the greater the complexity in the geographical pattern of these flows.

Research on corporate head offices has highlighted their concentration in large cities (Pred 1974; Friedmann 1986). A parallel can be drawn

between countries (and cities) with concentrations of head and regional offices of major organizations and those that are the global and regional hubs of telecommunications networks; both variables provide a measure of the locational concentration of economic power. Global and/or regional nodes for international leased circuits are central locations in corporate information networks.

The role of regional offices in large organizations has not attracted much attention in the geographical literature. It has been argued that regional and local offices, in contrast to head offices, tend to use more routine types of contacts, with intra-organizational usage of telecommunications and mail being more important (Pred 1974). Regional head offices' main responsibility is to coordinate and control the activities of the firm's affiliates and to act as the intermediary between the head office and branch offices and plants within the region (Dicken 1986). In terms of intra-organizational information flows, regional offices act as a gateway. Instructions from the head office are relayed to branch offices in the region. Conversely, detailed information moving up the organizational hierarchy is filtered out before being sent on to the head office.

In the previous section, I argued that many TNCs were internalizing many transactions; international leased networks are important in facilitating these transactions. While the head office has control over the global network, the larger the TNC's information flows and the greater their geographical complexity, the more likely that regional administrative offices will assume a role of managing regional information flows.

The geographical implications of the relationships between telecommunications and corporate organizational structure have attracted a limited amount of research. Howells and Green (1988) argue that the spatial configuration of corporate computer-communications systems not only reflects the geographical organization of a company in terms of the locus of control and decision-making, its information flows and its functional layout, but also, once established, it can in turn influence corporate organization. Hepworth (1986) examined the international leased network of Bell Northern Research, a Canadian telecommunications equipment manufacturer, and found that the computer network enabled the company to decentralize production and facilitated the international coordination of R&D.

It is difficult to generalize about the relationships between corporate organizational structure and international leased networks, given the paucity of research. At a broad level of aggregation, there is evidence that some large cities function both as regional administrative and regional data-processing centers for many TNCs, although this does not necessarily mean that these TNCs have followed the same regionalization strategy. The extent of this parallelism may be illustrated with reference to U.S. TNCs whose regional administrative offices in Europe are dominated by London and Brussels (Dunning and Norman 1983; Economic Consulting Services 1983). London also functions as the regional hub connecting high-speed circuits from the U.S. with circuits linking European subsidiaries. Hong Kong and Tokyo perform similar functions for the Asia-Pacific Region. A number of international firms have moved their Asian regional administrative offices to Tokyo, given the importance of Japan in this region; others, because of high telecommunications charges from Japan, hub their leased networks from Hong Kong. Latin America presents a different situation: many U.S. firms hub their Latin American regional operations in Miami, partly because of the unreliability of telecommunications networks in Latin America (Economic Consulting Services 1983). Miami also functions as the Latin American regional administrative office for many U.S. TNCs (Grosse 1982).

Government Regulation

The nature of government regulations on the operations of leased networks in various countries has a significant influence on their geographical extent (Economic Consulting Services 1983). While the issues of deregulation and competition versus monopoly in international telecommunications are fiercely debated topics at present, it is likely that there will be some deregulation and competition introduced in the near future (Langdale 1989). Competition is likely to lower costs on heavily-trafficked routes, especially in the North Atlantic Region, connecting the U.S. with Western Europe. Such a development would enhance the concentration of traffic on high-speed leased circuits.

Government restrictions in different countries on the operations of leased circuits have led to numerous complaints by TNCs. A particular complaint has been the inability of TNCs to operate their global networks on a uniform basis. Complaints have been directed at the governments of both industrialized and Third World countries. Some industrialized countries, such as West Germany and Japan, have had very restrictive conditions on the way in which international leased networks could be used, although the latter has partly deregulated its telecommunications market recently. Many Third World countries also have restrictive conditions. The car manufacturer Volvo has been unable to link Brazil directly into its global corporate network because of the country's restrictive laws on transborder data flow (Lamb 1987). In addition, the poor quality and limited availability of the telecommunications infrastructure (especially in Third World countries) inhibits the growth of leased networks. These factors tend to negate a major competitive advantage of the TNC, viz., the ability to rapidly and cheaply transfer information on a global basis.

Leased Networks in Large TNCs

Organizations' usage of leased networks should be seen in conjunction with their use of public telecommunications services (e.g., telephone, telex and data); most large firms make extensive use of all these services. In addition, many firms use services provided by common user networks. This paper focuses on leased networks, partly because of space limitations, but also because of the limited information available on the interrelationships between private and public networks.

Large TNCs account for a significant percentage of international business telecommunications traffic. Their dominance is even higher for international leased networks. A survey of the telecommunications usage of 102 major U.S. international business users in 1985 found that almost 60 percent had at least one leased circuit. Surveyed firms carried a relatively high percentage of U.S. international business telecommunications: they accounted for approximately 50 percent of the total U.S. commercial international leased circuits, 16 percent of U.S. international business telephone revenue, and 15 percent of international telex revenue. The sampled firms had in total 663 international leased circuits with a U.S. termination point, or more than 8000 if circuits to Canada are included (MarTech 1985). A number of firms in the survey had multiple leased circuits: 18 respondents had more than 10 circuits and accounted for 29.3 percent of the total. Many surveyed firms had leased circuits in other parts of the world although no accurate figures were available.

Similar trends exist in other countries. In Japan, a survey of international communcations usage of firms in 1987 found that of the 696 firms surveyed, only 14 percent used international leased circuits. But firms using these circuits had very heavy overall expenditure on international communications: they spent 72 percent of the total expenditure on communications of all surveyed firms and had an average expenditure of 426 million Yen as compared with only 28 million Yen for firms not using leased circuits (Japan Ministry of Posts and Telecommunications 1988).

Advantages and Disadvantages of Leased Networks

The advantages of leased networks for large organizations are significant, given that they link headquarters and regional and branch offices into global networks. Leased networks allow TNCs to internalize a substantial proportion of their intracorporate telecommunications traffic at a relatively low cost. While no detailed figures are available, it has been estimated that 70 percent of the demand for international business telecommunications is at an intracorporate level (British Invisible Exports Council 1986). Thus large TNCs are able to transmit huge amounts of information on a global basis within the firm and to utilize a key advantage, the ability to mobilize resources on an international basis.

One reason for the importance of international leased networks for large TNCs is that the unit cost of a leased circuit falls as usage increases; major TNCs thus have a substantial advantage over smaller companies in being able to channel large volumes of information in their leased network, although they also make extensive use of public switched services (telephone, telex, and data). Leased circuits may be

enhanced with special features so as to be more reliable than the public switched network; many organizations feel that these networks are more secure. The significance of international leased circuits for large TNCs is illustrated by their strong lobbying in many countries against moves by telecommunications carriers to introduce charging for leased circuits on the basis of traffic volume rather than the current flat-rate system.

The growth of leased networks needs to be seen in the context of competitive strategies. Many TNCs see their leased network as a central part of their competitive advantage; they have invested large sums to make them as up-to-date as possible and maximize the geographical extent of their network. Furthermore, the move towards competition in domestic and international telecommunications has led to some large TNCs assigning their leased networks a key role in their global corporate strategy. These networks are likely to provide a basis for some of these TNCs entering the public telecommunications services market in the future.

Smaller companies are generally unable to operate leased networks and rely either on public switched services, common user networks provided by computer service bureaus (e.g., GEISCO), or cooperative networks which operate in some industries. The competitive situation between large and small firms may be illustrated by using the banking and airline industries as examples. Each has a large cooperative network, SWIFT and SITA respectively. While major banks and airlines belong to their respective cooperative networks, there are tensions between the desire of the cooperative networks to expand their range of services and geographical extent and the desire of major TNCs to preserve the competitive advantage of their international leased networks. For example, in international banking, 35 of the largest banks accounted for approximately 50 percent of SWIFT's traffic in the first six months of 1985 (Tate 1985). SWIFT is concerned that the leased networks of the major banks could be used for their interbank transfers, thus removing a major part of SWIFT's traffic base. Conversely, the major banks see SWIFT as encroaching on their business.

A disadvantage of leased networks is that they are relatively expensive and are economical only if the organization is large enough to generate sufficient traffic to save on the more expensive public switched services. They are also relatively inflexible: an organization cannot rapidly change its network to meet the changing information flow requirements for various branch plants and offices.

Despite the advantages of leased networks outlined above, it is likely that they will become less important in the future. One reason is that telecommunications carriers will be able to provide a much wider range of services as they move into integrated services digital networks (ISDN). Users will be able to operate flexible leased networks on the basis of the level of their demand at a particular time. In addition, cooperative networks (SITA and SWIFT) as well as managed network providers (General Electric or GEISCO and McDonnell Douglas) are increasingly providing services to users that reduce the need for private networks (Norton 1988).

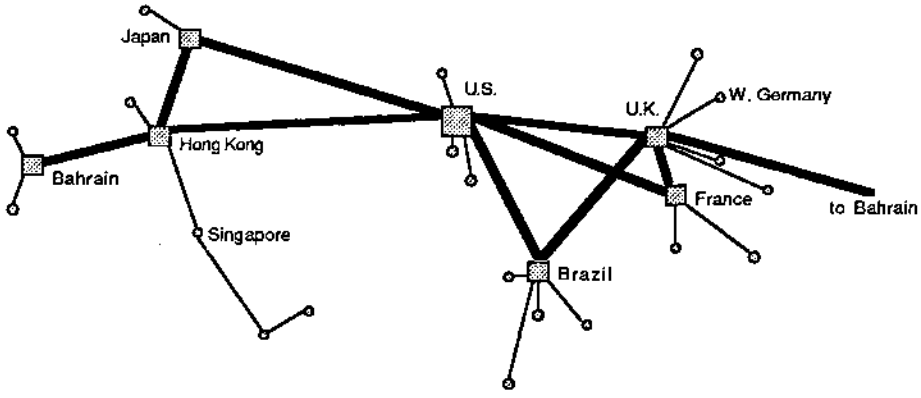
Nature of Leased Networks in Large TNCs

Three types of leased networks may be recognized: centralized star-shaped, regional hub-and-spoke and global networks (Fig. 1). This classification is highly simplified, and real-world networks are likely to be more complicated. TNCs may operate a centralized system in one region and a hub-and-spoke system in others. Some firms may operate a very small network connecting only two or three countries.

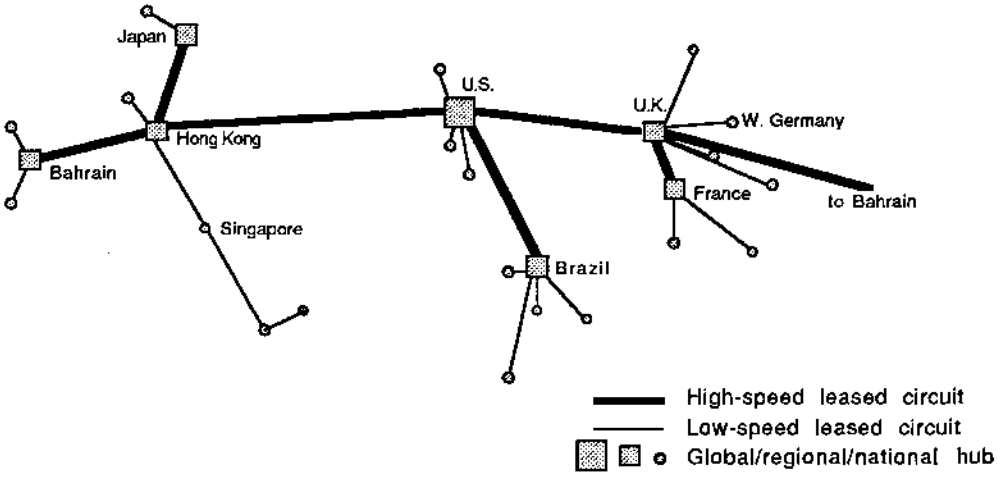
A centralized network may be selected by a TNC for a number of reasons. Firms with leased networks to only a few countries do not require regional nodes. In addition, some regions, particularly in the Third World, may have no cities suitable as regional hubs because of unreliable telecommunications services or shortages of skilled computer personnel. Centralization allows the TNC to obtain economies of scale in equipment and personnel.

Regional hub-and-spoke and global networks provide a higher level of connectivity and are thus less vulnerable to disruption than centralized networks. This is particularly true of global networks since regional hubs are connected to the rest of the network by at least two routes: if equipment in one location is faulty, traffic may be routed through another hub to the rest of the network. Of course it is possible for the TNC to use public switched services as a back-up, although this may be an

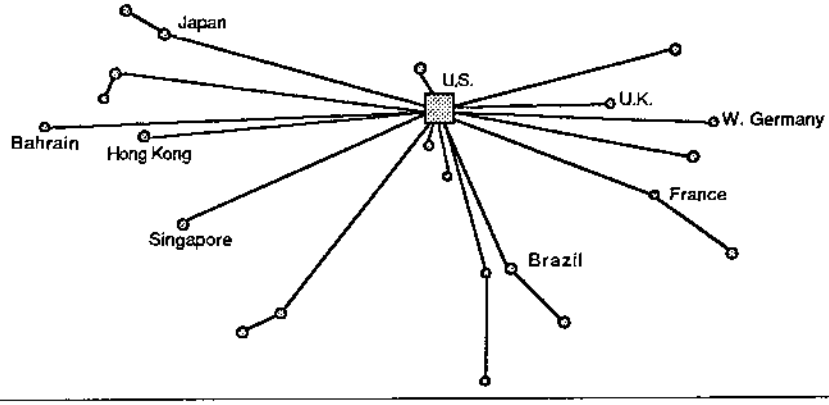
Global Network



Regional Hub-and-Spoke Network



Centralized Network



undesirable option given the poor quality and unreliability of public services in many Third World countries. The Bank of America operates a regional hub-and-spoke network, with hubs in San Francisco covering the U.S. and Latin America, in the U.K. covering Western Europe, and in Hong Kong covering the Asia-Pacific Region (Mertes 1987). In contrast, Citicorp operates a global network with duplicate connections between its regional nodes (described in detail below).

Both regional hub-and-spoke and global networks allow traffic to be concentrated and sent along high-speed circuits, allowing significant savings for users since most countries' carriers provide discounts for traffic on high-speed circuits. For example, Citicorp utilizes high-speed circuits (2.048 megabits per second) on a heavily-trafficked route between New York and London (Glaser 1988). In addition, new high-speed services are generally introduced first on heavily-trafficked routes linking major industrialized countries. The likely introduction of competition in international telecommunications will further lower costs on heavily-trafficked routes.

A survey of Japanese companies using international leased networks found that the circuits were arranged in two types: a regional hub-and-spoke network with Tokyo at the center and cities such as London, New York and Hong Kong as the regional hubs at the other end, and a global network with Tokyo, New York and London as the vertices (Japan Ministry of Posts and Telecommunications 1988). Regional hub-and-spoke networks are set up to concentrate information in Tokyo and are formed mainly by general trading companies (Sogo Shosha) and large machinery firms. They are comprised largely of slow-speed telegraph circuits, although these are being replaced by high-speed circuits. In contrast, global networks are used mainly by large Japanese banks and securities firms to connect their offices in the world's three financial centers: Tokyo, London and New York. Each of these world cities is connected to smaller banking and financial cities in their respective regions. The circuits linking the three world cities are high-speed ones. Thus the global leased networks of Japanese banks and financial firms reflect the vertices of the international financial market.

Industry Usage of Leased Networks

It was suggested earlier from the internalization literature that TNCs in high-technology industries (such as electronics, computer and telecommunications equipment) are likely to have a heavy demand for internal communications, since firms wish to maintain control over proprietary information and need to transfer information on their R&D to overseas subsidiaries. In addition, TNCs in industries faced with a high level of uncertainty in the market (such as banking and finance) also internalize transactions and may have developed global communications networks linking their branch offices in order to improve their ability to monitor the rapidly changing global environment and to minimize the risk of transferring large amounts of money.

Little information is available on the type of firm using international leased circuits. A survey of major U.S. users of international leased circuits included, in the sample of firms, 46 percent from the manufacturing sector and 15 percent from banking and finance (MarTech 1985). Banking and finance firms dominated the large user group (defined as having expenditures on international telecommunications services of more than U.S. $5 million) with 33 percent of the total. Unfortunately, the survey did not cover U.S. government agencies, which are very heavy users of leased circuits. For example, in May 1980, the Department of Defense leased 496 international circuits from commercial carriers in addition to its own major military international communications satellite system (U.S. Department of Defense 1980). In addition, other U.S. government departments and agencies (e.g., NASA) have extensive international leased circuit requirements.

A survey of expenditure by Japanese users for international leased circuits found that the heaviest expenditures were by machinery manufacturers (principally electrical and electron-

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Figure 1. International leased network options for a hypothetical U.S. transnational corporation.

Table 1. United Kingdom International Leased Circuits by Industry Category, October 1982

Industry Category	Number	Percentage
Primary (agriculture and mining)	135	3.65
Mineral oil, gas extraction and refining	124	
Other	9	
Manufacture (minerals, metals and chemicals)	118	3.19
Chemicals (includes man-made fibers)	94	
Metals manufacturing	17	
Other	7	
Engineering	673	18.20
Office machinery, data processing, electrical and electronic engineering	305	
Machinery, other industrial equipment	200	
Motor vehicle manufacture	70	
Vehicles	37	
Precision instrument and general engineering	32	
Aerospace	27	
Other	2	
Other manufacturing	69	1.87
Food, drink and tobacco	34	
Other	35	
Construction	15	0.40
Distribution	302	8.17
Wholesale (non-comestible)	231	
Wholesale (food and drink)	47	
Other	24	
Transport	380	10.28
Shipping	128	
Air transport	120	
Miscellaneous travel services	98	
Other	34	
Public utilities	42	1.14
Finance, banking and insurance	1330	35.98
Other financial institutions	743	
Banks	574	
Insurance companies and brokers	13	
Business services	293	7.93
Other business services	236	
Computer services	43	
Other	14	
Social (Education, medicine and justice)	4	0.10
Government	105	2.84
Overseas government's establishments	81	
U.K. government departments	17	
Other	7	
Leisure and catering	64	1.73
Broadcasting	27	
Hotels and motels	23	
Other	14	
Other services	109	2.95
Information providers	109	
Unclassified	58	1.57
Total	3697	100.0

Source: Unpublished information from British Telecom.

ics equipment), banks and financial firms and commercial (principally general trading) firms (Japan Ministry of Posts and Telecommunications 1988). The survey divided firms' usage of leased circuits into three groups: slow-speed telegraph, voice, and medium- and high-speed circuits. Telegraph circuits were heavily utilized by commercial users (principally general trading companies) with 42 percent of the total, although many of these firms are in the process of upgrading their networks to higher-speed circuits. Financial firms dominate voice (58 percent of total users) and medium- to high-speed (61 percent) circuits.

Information is available on the industry categories of U.K. international leased circuits in October 1982. The largest users were in finance, banking and insurance (36 percent), engineering (particularly electronics, office and data processing equipment with 18 percent), with smaller numbers in transport, distribution and business services (Table 1). London's role as a global financial center accounts for the dominance of banking, finance and insurance, although these industries have internationalized their operations faster than other information services and transfer very large amounts of financial information in electronic form. Information equipment firms (electronics, office and data processing) have expertise in electronic information systems and have also internationalized their operations. The U.K. has a major international transport industry and uses a relatively large number of leased circuits in the transport and distribution sectors. The location of these circuits within the U.K. is unknown, but it appears likely that London is the dominant location. Of course, many firms would then connect these circuits to a national leased network and/or the public switched network.

While evidence is sketchy, industries with the heaviest usage of international leased circuits in three major industrialized countries are information equipment (electronics, computers and telecommunication) and banking and finance. Both industries have rapidly internationalized production, and many firms in these industries operate on a global basis. Internalization theory suggests that both industries would be heavy users of intracorporate communications systems. Further research is needed on the volume and type of information that is transmitted on leased and public switched services for firms in these industries.

Table 2. Telecommunications Traffic on Citicorp's Global Communications Network

	Originating		Terminating		Originating from Asia-Pacific Region		Terminating in Asia-Pacific Region	
	No. (10^6)	(%)	No. (10^6)	(%)	No. (10^6)	(%)	No. (10^6)	(%)
Asia-Pacific	89.4	(12.5)	126.2	(17.7)	34.0	(38.0)	34.0	(26.9)
Middle East & Africa	65.6	(9.2)	70.6	(9.9)	2.5	(2.8)	2.7	(2.1)
Europe	120.8	(16.9)	144.6	(20.2)	9.0	(10.1)	10.0	(7.9)
Latin America	42.8	(6.0)	83.6	(11.7)	1.1	(1.2)	1.2	(1.0)
New York head office	249.5	(35.0)	121.9	(17.1)	24.4	(27.3)	63.0	(49.9)
Other New York	103.8	(14.5)	86.5	(12.1)	12.4	(13.9)	11.4	(9.0)
Other U.S.	41.9	(5.9)	70.0	(9.8)	3.3	(3.7)	4.0	(3.2)
All points bulletin	0	(0)	10.7	(1.5)	2.7	(3.0)	0	(0)
Total	713.8	100.0	714.1	100.0	89.4	100.0	126.3	100.0

Source: Tong 1984.

The banking and finance industry is of particular interest as a case study because of its rapid internationalization of production and heavy usage of information technology. Major U.S. banks spent approximately 14 percent of operating expenses on information technology in 1986, and this is expected to rise to over 16 percent by 1990 (Sowton 1987). Domestic and international telecommunications are vital in linking transnational banks' global operations, and leased networks are a key element in this overall strategy. Leased networks are especially important because firms need tight security in the transmission of financial information.

Citicorp, one of the world's largest banks, has invested heavily in information technology. In the U.S., it has extensive telecommunications operations and also provides data processing services for other banks. It has internationalized its operations and operates one of the world's largest and most sophisticated leased networks; the network extends to 145 cities in 74 countries (Glaser 1988). As early as 1977, its leased network connected 80 of its branches in 65 countries and handled 90 percent of its telegraph traffic and 63 percent of its telephone traffic (White 1977). Citicorp's leased circuit network is a key component of its global strategy. There are a number of services operated on its basic network: voice, telex and data traffic for its own requirements as well as for customers wishing to access Citicorp databases.

There are six regional nodes on the Global Telecommunications Network (GTN), each having a control function (Much of this section is based on Tong 1984.). The nodes and the regions they serve are New York (North America), Puerto Rico (Central and South America), London (Europe), Bahrain (Middle East), Hong Kong (East Asia), and Singapore (South Asia, Southeast Asia and Oceania). Within the GTN, there are two sub-networks: global communications network (GCN) and a network that handles interactive data traffic. The GCN has the function of transmitting telex-type messages within the bank and between the bank and its customers. It is likely that the GCN will be superseded by the interactive data network as the bank and its customers adopt more sophisticated telecommunications equipment.

The regional distribution of traffic on Citicorp's GCN is dominated by the head office, located in New York (Table 2). The head office sends 35 percent of all messages on the GCN, while it receives only 17 percent. Head office combined with Other New York traffic originates just under 50 percent of the total traffic. With respect to regions outside the U.S., Europe and the Asia-Pacific Region originate and terminate the largest volume of traffic (Table 2).

This dominance is even stronger for traffic originating and/or terminating in the Asia-Pacific Region: head office originates 50 percent of the region's traffic, while it receives only 27 percent. Intra-regional flows are also significant: 38 percent of all traffic originating in the Asia-Pacific Region also terminates in the region. Surprisingly, for an internationalized company, linkages to other regions (Middle East and Africa and Latin America) are relatively small, with the partial exception of Other New York and Europe.

While it is true that there has been an inter-

nationalization of the banking and finance industry, Citicorp's traffic flows were dominated by the head office with important intra-regional flows. Intracorporate information flows were still dominated by a simple vertical organizational hierarchy, with few cross-hierarchical linkages between regional offices. This pattern of information flows is similar to the case studies in Sweden examined by Törnqvist (1970), rather than the more complex geographical patterns that might be expected from an organization that has fully internationalized operations. It should be recognized, however, that the data are limited in terms of the coverage of intra-organizational information flows and refer to traffic in 1983. While Citicorp has a highly interconnected global leased network, the traffic patterns suggest that a somewhat less connected regional hub-and-spoke pattern may be sufficient to handle the traffic.

Geographical Distribution of Leased Networks

The geographical distribution of leased networks provides a partial measure of the emerging internationalization of production and the extent to which particular countries are emerging as global or regional hubs in the international information economy. Regional telecommunications hubs facilitate TNC regional administrative offices' role in coordinating and controlling the activities of the firms' affiliates and provides a connecting link for information flowing between head office and local branch offices.

Geographical research at a national level on the role of regional and local offices has emphasized the importance of telecommunications and mail as against face-to-face contacts; this reflects these offices' primary role in facilitating vertically-structured intra-organizational information flows, which are mainly routine in nature (Törnqvist 1970; Pred 1974). But at an international level regional administrative offices of many TNCs have considerable autonomy and may generate and receive diverse types of information at local, national and international scales. Thus the theoretical framework used by geographers at a national level needs to be broadened, given the growing complexity of TNCs' international operations.

It should be stressed that the focus in this section on regional leased network hubs is only one component of the diverse range of international information flows associated with the internationalization of production. A more complete analysis would examine other forms of telecommunications, but also mail, courier and face-to-face contacts. The geographical distribution of leased circuits is used in this paper as a proxy for the actual information flows, given that very little public information is available on how much information is actually transmitted over them. One problem with this analysis is that the circuits may be of different speeds, thus carrying significantly different volumes of information between countries.

Substantial variations in leased circuit charges exist in different countries. One study used West German charges as an index of 100 and found that out of eight industrialized countries (mainly European), the U.K. had the lowest charges with 36 and the U.S. was next with 43. Leased circuits were considerably more expensive in other countries: Switzerland was the most expensive with 182, Spain 115, and Japan 104 (Thomas 1987). Low charges in the U.K. enhance its position as the West European telecommunications hub. The extent of these differences is important for TNCs with heavy international telecommunications requirements and with extensive leased networks. TNCs tend to minimize their usage of telecommunications facilities in high-cost countries.

Western European International Leased Networks

The geographical distribution of international leased circuits from West European countries shows a dominance of intra-European linkages. Bergendorff (1984) examined the major destinations of leased circuits from a number of West European countries in 1976 and 1981. The study considered the growth of all leased circuits, but focused on a subset of data circuits primarily used for transmitting computer data. International data traffic on leased circuits was primarily to neighboring countries. For example, 80 percent of data circuits originating in Sweden terminate in one of its Nordic neighbors. While this "neighborhood effect" is also apparent for general-purpose leased circuits, it is less strong.

The overall pattern for Western Europe is one of high intra-regional connections with relatively few linkages to countries outside the region. Two regional clusters emerge: one centered on the U.K. with linkages to Switzerland, the Netherlands, France, and Italy; the other a Nordic cluster centered on Sweden. The U.S. exerts a weak international influence in Europe, with the exception of the U.K. Many U.S. TNCs use the U.K. as their regional hub for Western Europe. Bergendorff did not include Belgium in the study, although he did examine its rivalry with the U.K. to become a European communications hub. While Belgium has a relatively large number of international leased circuits, it has about half the U.K. total and only about 7 percent connect countries outside Western Europe (Bergendorff 1984). Thus while Belgium is a major European regional administrative office location for U.S. TNCs operating in Western Europe (Dunning and Norman 1983, 1987; Dicken 1986), its relatively high international leased circuit costs discourage these firms from hubbing their data networks there.

A study of the geographical spread of leased circuits for West Germany in December 1982 corroborates a number of Bergendorff's conclusions for Western Europe (Braun, Muller and Schmidt 1985). West Germany's international leased circuits were concentrated in a relatively small number of Western European countries, with the top ten origins/destinations accounting for 93 percent of the total of 2106 circuits. Nine of the top ten countries were in Western Europe, the only exception being the U.S. with 6 percent. The Netherlands (22 percent) and the U.K. (19 percent) were the most important countries. Of the total number of leased circuits, 725 (34 percent) were digital or data circuits; these provide linkages for computer systems and were extensively used by large TNCs. Contrary to Bergendorff's study, the geographical distribution of West Germany's digital circuits was less geographically concentrated than the general-purpose ones, with the top ten countries accounting for only 80 percent of the total. Western Europe was still dominant, but the U.K. (18 percent) was the largest destination. As we have seen already, the U.K. functions as the Western European regional hub for many U.S.-based TNCs. Belgium was the third-ranked country for digital leased circuits from West Germany.

Braun, Muller and Schmidt (1985) relate the geographical distribution of leased circuits to West Germany's international trade and foreign investment. They found that, with the exception of the U.S., trade and foreign investment were dominated by Western European countries. The relatively low number between West Germany and the U.S. was explained by the use of regional hubs in the U.K. and Belgium by TNCs. The use of these regional hubs by companies operating in Germany minimizes their usage of high-cost West German circuits.

U.S. International Leased Circuits

The most detailed information on international leased circuits is provided by the U.S. Federal Communications Commission. It publishes information on the geographical distribution of alternate voice data (AVD) circuits: circuits that have sufficient bandwidth (9600 bits per second or 9.6K bps) to carry voice and/or medium-speed data traffic. (It is possible to obtain higher speeds from these circuits, but the reliability cannot be guaranteed.) The geographical distribution of high-speed or wideband data circuits from the U.S. is also analyzed in this section. Circuits of varying speeds may be leased, ranging from slow speed (telegraph or teletype) through AVD to high-speed or wideband circuits with a capacity of up to 2.048M bps (M being a million).

The growth of these various business services is interrelated. Users are moving towards higher-speed services and away from slower ones such as telex. Even medium-speed circuits are being replaced: the growth rate of U.S. AVD circuits is declining, as wideband services are used more intensively by large U.S.-based TNCs. The growth rate of U.S. AVD circuits was approximately 20 percent in 1983–85, but declined to 3 percent in 1985–86. It has been estimated that large users of international telecommunications will migrate fairly quickly to higher-speed services. For example, a user with two AVD circuits (each of 9.6K bps) to an overseas country would pay approximately U.S. $77,000 per year, whereas a single 64K bps circuit would cost only U.S. $49,800 per year (U.S. National Telecommunications and Information Administration 1986).

Western Europe. The U.S. and Western Europe have traditionally had very close economic and cultural linkages. U.S. TNCs have in-

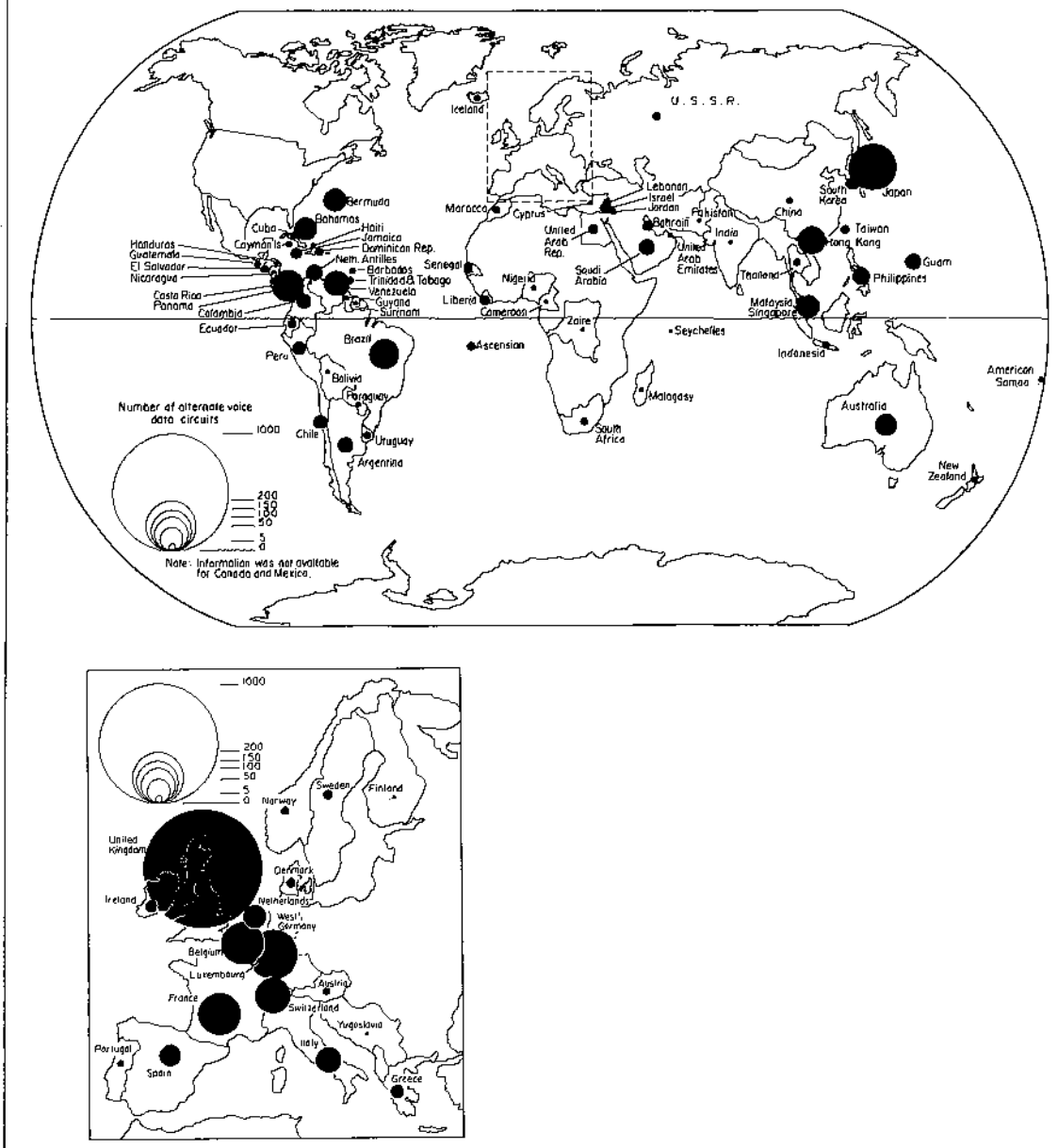

Figure 2. Number of international alternate voice/data (AVD) circuits from the U.S. to other countries, December 1985. Source: Unpublished information from the U.S. Federal Communications Commission, Washington, DC.

vested heavily in Western Europe. During the 1980s in common with its overall decline as a net foreign investor, U.S. firms' investment in Western Europe has relatively declined as compared with the position in the 1970s (OECD 1987). In contrast, West European TNCs have been investing heavily in the U.S. in the 1980s.

The investment and trade linkages between the U.S. and Western Europe are reflected in the volume of telecommunications traffic and by the number of leased circuits between the two regions. The geographical distribution of AVD circuits from the U.S. is heavily dominated by Western Europe (Fig. 2). While Western Eu-

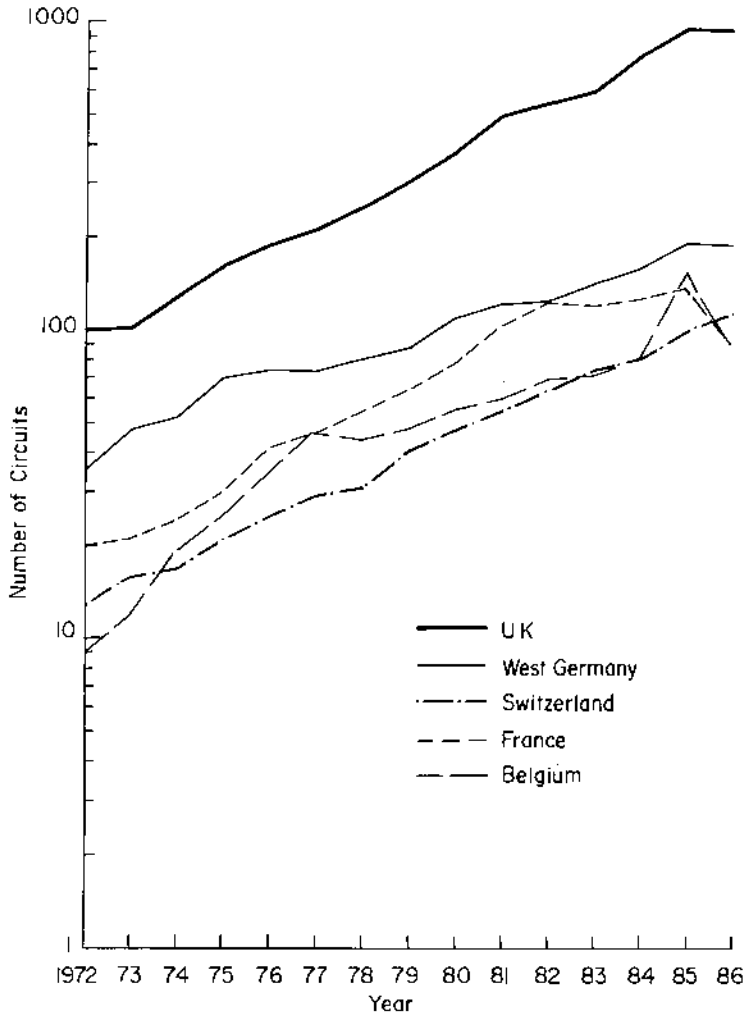

Figure 3. Number of alternate voice/data (AVD) circuits: U.S. to major Western European countries, 1972–86. Source: Unpublished information from the U.S. Federal Communications Commission, Washington, DC.

rope's relative importance has been constant, the U.K.'s role has expanded very rapidly, rising from 24 percent in 1972 to 34 percent in 1985. The U.K. is an important location for U.S. TNCs operating in Europe, but its growing role reflects the desire of TNCs to lower their trans-Atlantic communications costs by concentrating their traffic in a country with reliable and cheap communications. The growth rate of U.S. to U.K. AVD circuits is substantially higher than that of the U.S. to other major Western European countries from 1972 to 1985 (Fig. 3). Approximately one-third of U.S. TNCs operating in Western Europe hub their communication networks in the U.K. (de Jonquieres 1984), although the U.K. hub may also serve Africa and the Middle East. But in 1986 the number of AVD circuits to the U.K. and some other European countries declined, largely because of the impact of high-speed circuits.

The dominance of Western Europe and particularly the U.K. is even higher for high-speed circuits. Western Europe accounted for 72 percent of the total number of 50K and 56K bps circuits from the U.S. in 1985, an increase from 50 percent in 1980 (Table 3). The U.K. alone accounted for 43 percent of these circuits in 1985. In addition, INTELSAT offers even higher speed services (International Business Services or IBS) by satellite. In June 1986 there were 93

Table 3. Geographical Distribution of High-Speed (50K and 56K bits per second) Circuits from the U.S., 1980 and 1985

Continent/Country	1980	1985
Europe	9	43
France	1	2
West Germany	1	5
Netherlands	1	6
Spain	2	4
U.K.	4	26
Africa	0	6
Ascension Is.	0	3
Senegal	0	3
Latin America	1	5
Bermuda	0	3
Chile	1	2
Asia/Oceania	8	6
Australia	3	0
Guam	3	0
Hong Kong	1	4
Singapore	1	2
World total	18	60

Source: Unpublished information from the U.S. Federal Communications Commission.

Table 4. Geographical Distribution of High-Speed Circuits from the U.S., June 30, 1986

	Speed in bits per second (K—thousand, M—million)				
	64K	123K	768K	1.544M	2.048M
Europe					
U.K.	44	2	4	18	2
Belgium	2				
Netherlands	4				
France		2			
Switzerland		1			
Americas					
Canada	2				
Bahamas	4				
Mexico	4			2	
Trinidad			2		
Total	60	5	6	20	2

Source: Unpublished information from the U.S. Federal Communications Commission.

from the U.S. and, of these, the U.K. accounted for 70 or 75 percent of the total (Table 4). It is likely that an increasing number of U.S. TNCs are using high-speed leased circuits to a U.K. computer hub and then operating lower-speed circuits to other countries in Western Europe and, to a lesser extent, the Middle East and Africa. By 1988 the IBS high-speed circuits connected other regions as well: Australia, Hong Kong and Japan in the Asia-Pacific Region.

The U.K.'s move to introduce competition in international and domestic telecommunications is partly related to its desire to be the international telecommunications hub in Western Europe. While there is little immediate competitive threat to the U.K.'s position, there are competitive moves in some countries (Howells and Green 1988; Howells 1988). Ireland is attempting to attract the communications hub activities of U.S. TNCs. American Airlines and Digital Equipment Corporation (DEC) have established such facilities; the Irish Development Authority in conjunction with Telecom Eireann (the Irish telecommunications carrier) are concentrating on the trans-Atlantic data needs of U.S. firms with manufacturing or software-development facilities in Ireland (FinTech 1987). But the hub of DEC's European leased network is in Reading, located close to London. DEC uses high-speed satellite circuits across the Atlantic to connect its European and U.S. operations, although it plans to use both satellite and fiber-optic circuits in the future to provide back-up facilities. Furthermore, London's role as an international financial center has attracted DEC's computer services division (Dodsworth 1987; Sedacca 1987).

Asia-Pacific Region. There has been considerable discussion of the international trade rivalry between the U.S. and Japan. Far less attention has been paid to the growing interdependencies between the two countries. A massive increase in the volume of Japanese foreign investment in the U.S. has occurred in the 1980s; the U.S. accounted for 45 percent of total Japanese foreign direct investment in 1986 (Japan External Trade Organization 1988). This interdependency may be seen in the banking and finance industry in such areas as foreign exchange, futures and securities trading. In addition, Japanese TNCs in manufacturing (automobile and electronics) and trading firms have strong trading and production linkages with the U.S. A number of information equipment TNCs (e.g., IBM) have established major R&D facilities in Japan and have linked these facilities into an international network. Japan is also emerging as the regional head office for many U.S. TNCs in the Asia-Pacific Region.

The interdependency of the U.S. and Japanese economies is reflected in the fact that the largest number of AVD circuits from the

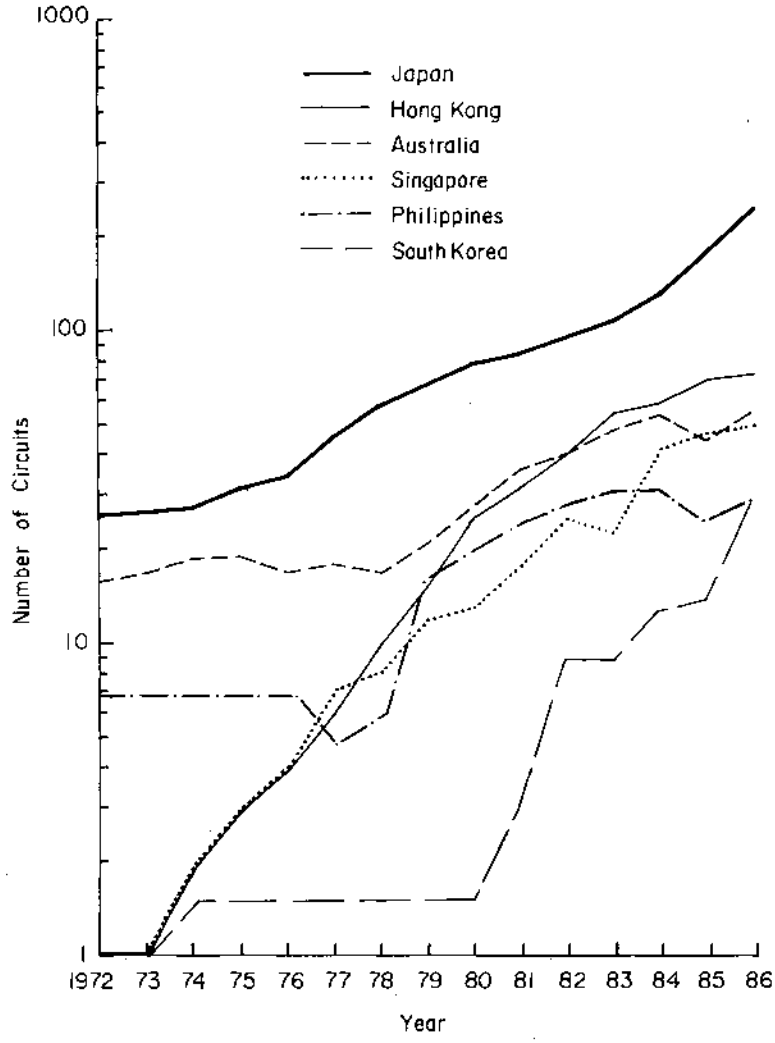

Figure 4. Number of alternate voice/data (AVD) circuits: U.S. to major Asia-Pacific countries, 1972–86. Source: Unpublished information from the U.S. Federal Communications Commission, Washington, DC.

U.S. to the Asian region is to Japan; the growth rate has increased in the period from 1984–86 (Fig. 4). A survey of international telecommunications usage of Japanese firms found that North America accounted for 46 percent of the total number of Japanese medium- and high-speed circuits (Japan Ministry of Posts and Telecommunications 1988). The banking and finance industry is of particular importance in this category.

There is considerable rivalry between Japan, Hong Kong, Australia and Singapore to become regional hub locations for U.S. and, to a lesser extent, West European TNCs' international leased networks. U.S. AVD data illustrates this rivalry, since a number of U.S.-based TNCs operating in the Asia-Pacific Region have sophisticated leased networks (Fig. 4). While Japan dominates U.S. AVD circuits, Hong Kong has been quite successful as a regional hub. Part of its success has been because of the high rates charged by the Japanese international telecommunications carrier, Kokusai Denshin Denwa (KDD). Hong Kong's regional role may also be illustrated using Japanese leased circuit data provided for 1978 (Kokusai Denshin Denwa 1983), when approximately 27 percent of all leased circuits from Japan terminated in Hong

Kong. KDD estimated that only 11 percent were specifically for Hong Kong-based customers; the rest were linked to leased circuits to other countries. KDD also estimated that when it removed the regional hub role of Hong Kong, the biggest impact was on leased circuits to the U.S., which increased from 15 to 21 percent, although there were significant changes for other countries as well. However, Hong Kong's role as a regional hub for Japanese firms has declined in recent years; by 1987, it accounted for only 14 percent of the total number of Japan's international leased circuits (Japan Ministry of Posts and Telecommunications 1988).

Latin America. Latin America is strongly tied to the U.S. through international trade and foreign investment. Consequently, it is not surprising that international telecommunications between the two regions is quite large. As we have already seen, Miami is the hub of numerous U.S. TNCs' Latin American leased networks, but others, for example, the Bank of America in San Francisco, hub from their head office.

A substantial number of U.S. AVD circuits connect with Central and South America and the Caribbean Region. Offshore banking centers of Panama, the Bahamas and Bermuda are important destinations for U.S. AVD circuits (Fig. 2). Further growth in the Caribbean Region is likely, as U.S. firms with data processing operations are increasingly using low-cost labor in such islands as Barbados and Jamaica to enter information. Leased circuits are then used to transmit the information back to the U.S. (U.S. Office of Technology Assessment 1985). Approval has been given for the construction of a teleport in Jamaica using high-speed data transmission, and others are under consideration in the Dominican Republic, the Bahamas and Barbados (James 1987). The teleport would have a number of satellite earth stations that would send/receive international telecommunications and be linked to offices and factories in the developing country. Offshore data entry is not confined to this region, and a number of Asian countries could possibly have a significantly larger role in the future of this industry.

Other Regions. It was argued earlier that the term internationalization of production was a misnomer, since a number of regions were either connected weakly or not at all to global production networks, although they do represent significant markets for products and services. U.S. AVD circuits illustrate this situation, given that the number of circuits to the Middle East, Africa and the centrally planned economies is quite small. The largest number of circuits is to Saudi Arabia and Israel, countries with obvious strategic and economic interest to the U.S. The paucity of circuits to Africa is understandable in the light of the continent's overall poverty and low rate of economic growth. Centrally-planned economies are also weakly connected, although this may change in the future if ideological barriers are lowered.

Conclusion

Geographical research on the interrelationships between information flows and organizational structures has highlighted locational interdependencies at national and international scales of analysis. Most research has focused at the national scale and emphasized such themes as the information flows associated with urban concentrations of head offices of large organizations (Pred 1974; Goddard 1975; Törnqvist 1970). A subsidiary and closely related theme is the lack of information and economic decision-making power in peripherally located regions—the branch plant economy (Goddard and Gillespie 1986). It is important to consider the international implications of this research, given the growing internationalization of production.

While these themes have scarcely been explored at an international level, parallel arguments may be advanced. World cities are the decision-making control centers of the international economy. The role of these cities may be seen in terms of the local, national and international information flows associated with head offices at TNCs and information services (banking and finance, accountancy, etc.) (Moss 1987). Reasons for the growth of world cities such as New York, London and Tokyo as corporate decision-making centers need to be examined partly in terms of domestic or local factors, but also in terms of the nature of information flows between head and regional offices as well as with the global network of branch offices and manufacturing plants. World cities need excellent local, national and international linkages.

Leased networks are a significant component

of the infrastructure facilitating information flows. International telecommunications networks represent the central nervous system of the international economic system. The concentration of head offices in major cities, whether at a national or international level, needs to be seen in the context of the overall network of offices and branch plants. While economic power is locationally concentrated in particular cities, it is applied in the context of organizational networks, which rely on advanced telecommunications services.

The role of regional offices in organizational networks is of considerable importance at an international level, given that many TNCs are devolving power to a regional level in order to respond rapidly to local and regional needs. From a different perspective, regional offices are becoming a key part of national industrial strategies: countries in Western Europe and in the Asia-Pacific are competing within their respective regions to attract these regional hubs, since they see substantial employment and industrial growth potential associated with them.

An international information economy is emerging, characterized by massive electronic information flows linking world cities. Complementing these international flows is a dense web of national, regional and local information flows whose rapid growth reflects changes in technology, the nature of business operations, and modes of government regulation. The geography of the world economy is in a rapid state of flux as a result of these changes. The nature of distance is changing as major corporations and governments use information technology to link their international networks of offices and manufacturing plants.

The geographical patterns of international leased networks outlined in this paper are likely to be substantially altered in the near future. Some of the more important factors influencing these changes are: (1) introduction of new telecommunications and other information technologies; (2) internationalization of production in manufacturing, service and information industries; (3) changes in government policy including liberalization of international trade in information services and competition in international telecommunications.

There has been concern that new telecommunications and information technologies will enhance the degree of centralization of control that the head offices of TNCs exert over their global networks. Global telecommunications networks installed by major TNCs tend to be centrally managed from head and regional office locations, although it is possible for branch offices to access the entire company information database. Little is known about the impact of new technologies on the geographical centralization of control; it appears that there are both centralizing and decentralizing aspects. Some firms use the technologies to centralize control, others to decentralize it.

Advances in telecommunications technologies have facilitated the internationalization of production in a number of industries. In particular, international leased circuits have been very important in the global operations of major TNCs in the banking and finance and information equipment industries. These industries have the internal expertise to develop sophisticated international information systems and the need to internalize a substantial number of information transactions. While detailed company case study research is needed to examine the nature of the internalization of information flows in TNCs in these and other industries, it is clear that international leased networks are a central element in this corporate strategy.

Other large TNCs are likely to follow the lead of Citicorp and IBM in operating global telecommunications networks. Aside from the advantages of internalizing intracorporate information flows, such networks give firms the capability of entering the highly profitable public telecommunications services industry, assuming that governments allow competition to emerge. Further advances in the degree of internationalization of production are likely as a number of industries move towards global operations; such changes will further increase the volume of international telecommunications and increase the level of complexity in the regionalization of traffic flows.

We should not assume that all firms are moving towards installing global telecommunications networks and internationalizing their operations. Global leased networks are unsuitable for all but large TNCs, nor are they suited to handle interorganizational communications. Future international telecommunications will be provided partly by public digital switched services (telephone and data) provided by common carriers, third-party providers (e.g., GEISCO and McDonnell Douglas), cooperative net-

works (e.g., SWIFT in the banking and SITA for the airline industries) and private leased networks operated by large TNCs.

A more general point emerges concerning the trend towards the internationalization of production. This trend should be seen in the context of the role of national information economies; the thrust towards global markets for all industries is not inevitable, nor is it irreversible. Local and regional forces are still key factors; despite reductions in the friction of distance resulting from the introduction of new telecommunications technologies, information flows are still subject to a distance decay effect. The processes influencing the operation of the international economic system need to be seen at various geographical scales—global, national, regional and local. No one level predominates. A full analysis of the reasons for the growth of the international information economy requires an examination of the interdependencies in the forces acting at each of these geographical scales.

There are substantial pressures for government policy changes in the trade in services and international telecommunications areas. Policy makers are increasingly considering the two issues as being interrelated. Competition in international telecommunications will expand in the near future and is likely to lead to a reduction in costs for large users on routes connecting major industrialized countries. In contrast, users on routes connecting Third World countries are likely to be faced with relatively higher charges. Such developments are likely to further enhance the internationalization of production and the growth of global leased circuit networks. Massive amounts of electronic information will be transferred between Western Europe, the U.S. and Japan; it will be in these three countries/regions that competitive rivalry to become the hubs of these global networks will be fiercest. Countries (and cities) that are able to become regional hubs for international telecommunications traffic will gain revenue from transit fees for traffic, but more importantly, will be accessible locations for information-intensive information service industries such as banking and finance. The regional hub-and-spoke patterns of international leased networks may provide an indication of broader patterns of economic activity.

While this study has focused on international business telecommunications between countries, there are important urban and regional implications. New patterns of locational competitive advantage and disadvantage are emerging. Cities that will attract information service industries such as banking and finance, computer services, advertising, media, and accountancy are those that are central to global, regional and national information flows. While geographers have examined the connectivity and accessibility of cities and regions on transportation networks in the past, it is increasingly important in the international information economy to consider the accessibility and connectivity of countries, regions and cities in terms of telecommunications traffic as well as other forms of information flow. Such a perspective is essential to understand the geographical patterns of international trade in services.

List of Acronyms

AVD—Alternate voice data circuits, having sufficient bandwidth to carry voice and/or medium-speed data traffic.
GCN—Global Communications Network of Citicorp, a subnetwork of Citicorp's GTN which handles telex-type messages.
GEISCO—General Electric Information Services Company.
GTN—Global Telecommunications Network, Citicorp's overall international leased network.
IBS—International Business Service, a high-speed data communications service offered by INTELSAT.
ISDN—Integrated Services Digital Network, integrating all telecommunications services into a digital network.
SITA—Société Internationale de Télécommunications Aéronautiques, a cooperative telecommunications network owned by airlines, which handles many international transactions between airlines such as passenger reservations.
SWIFT—Society for Worldwide Interbank Financial Transactions, a cooperative telecommunications network owned by banks.
TNC—Transnational Corporation.

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