

The role of telecommunications in economic growth: proposal for an alternative framework of analysis

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Rapid advances in technologies and the remarkable changes in the global economy in recent years have renewed interest in the role of telecommunications in economic growth and contributed immensely to the growth of a body of literature within communication studies. To date, numerous attempts have been made to determine whether or not a causal relationship exists between the economic growth and the prevailing telecommunications infrastructure of a given country. This large body of literature addresses both theoretical concerns and policy issues. However, they are fraught with serious weaknesses. Of these, the most important is their basic assumption that a technocratic perspective can explain the relationship between telecommunications and economic growth. This paper intends to draw attention to this lacuna and offer an alternative framework for analysis. I will argue that the global economic transformation — within which the proliferation of telecommunications technology has taken place and economic growth is anchored — has received very little attention in available literature. Country studies either deliberately ignored, or inadvertently failed to take into account, historical contexts and conjunctures — both of which have serious bearings on the process of economic transformation and on the role of technology in general and telecommunications in particular. Treating political and historical factors as residual and emphasizing the benefits of ‘correct’ policy choices, these studies have produced incomplete explanations.

Taking a different view, I will argue that the role of telecommunications in economic growth needs to be assessed within the broader framework of global economic transformation and the location of the specific country

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within the matrix of a world capitalist system. Experience of Singapore, one of the fastest growing economies of Southeast Asia, will be used to illustrate the point. It will show that expansion of telecommunications infrastructure is intrinsically linked to the internationalization of its economy and has been determined to a great extent by the structural imperatives of the global capitalist system.

Proposal of an alternative framework for analysis

Since the beginning of the 1980s, efforts to understand the relationship between telecommunications and economic growth have intensified, resulting in a number of studies. The works of Hudson (1982, 1984, 1987), ITU (1986), Maitland (1984), Peirce and Jequire (1983), Saunders et al. (1983), Berry (1981), Hardy (1980), Wellenius (1984), Hardy and Hudson (1981) and Goddard and Gillespie (1986) are some of the influential ones. A common aim of these studies is to establish a statistical relationship between telecommunications infrastructure and economic growth. These studies, as one researcher puts it, 'have collected and analyzed data on the levels of infrastructure development of the telephone network and looked for relationships between these data and socio-economic indicators in order to explain the impact and effects of communication technology' (Hukill, 1993: 332). In the main, data on economic development (measured in terms of per capita gross national product, per capita gross domestic product and per capita income) and telecommunications infrastructure development (measured in terms of per capita telecommunications investment and per capita telephone access line) are plotted on a two-dimensional graph (both real and imagined) to determine the relationship. These efforts confirmed the general observation that 'nations with high levels of economic development also have well-developed telecommunications infrastructure' and led to the conclusion that 'investment in telecommunications pays off in the form of general economic growth' (Sinha, 1994: 10). Hence policy prescriptions were drawn that development of telecommunications infrastructures should receive high priority in developing countries.

But what remained to be answered was how the strong relationship between economic development and telecommunications occurs. This led to the emergence of a sub-field called causal analysis (for example, Chen and Kuo, 1985; Cronin et al., 1991; Kim, 1992; and Ang, 1993). Employing a statistical-correlational method in general and Granger's causality test¹ in particular, these studies, each in a separate manner, attempt to develop a model that can be used to examine other cases. Although such a model has yet to be evolved, the findings of these studies succeeded in questioning the underlying assumption of the previous studies that there is a linear relationship between telecommunications and develop-

ment. Kuo and Chen's (1985) study, for example, shows that the relationship between these two variables is reciprocal rather than linear.²

Kim (1992) drawing on an empirical analysis of the relationship between the telecommunications sector and the national economy of Korea and some selected countries concludes, 'the causal relationship is not decisive'. He, however, notices a tendency that the 'telecommunications sector is preceding and causing the national economy in less developed countries while the situation is reversed in advanced countries' (Kim, 1992: 193). Whether that is due to preferential treatment received by the telecommunications sector in the economic plans of developing countries is open to question. The principal contribution of Kim's study is that it points out two serious methodological shortcomings of the previous studies. The first one originates from the assumptions of the researchers. According to Kim:

common econometric practices when analyzing the relationship between the telecommunications sector and the national economy are to regress the former on the latter. The reason for the practices may be that, in estimating and forecasting telecommunications variables, national economic variables, such as GNP, are employed without a verified causal relationship between them. It also seems that such practices are based on the common and vague belief that the telecommunications sector and national economy are closely related to each other. This type of regression analysis can only be justified by their generally high explanatory power as indicated by R^2 . (Kim, 1992: 193)

The second one comes from the use of the OLS (ordinary least square) method. Kim writes:

another problem may come from the fact that these equations are usually estimated by the OLS (ordinary least square) method. Recent studies by Granger and others warn that the OLS method does not yield consistent and efficient estimates when the series concerned are non-stationary and not co-integrated with each other. (Kim, 1992: 193)

Methodological flaws notwithstanding, these causal analyses have some other major weaknesses, including but not limited to, ahistoricity and lack of a contextualization. Equally important — and totally overlooked in the great majority of studies — is an examination of the relationship between the development of telecommunications and the underlying needs that made the development necessary.

These studies primarily looked into a specific point of time, and even where they went beyond that (for example, Cronin et al., 1991), they rarely took into account the historical process of the economic growth and the development of the telecommunications infrastructure of the given country or region. As such the causal relationship, if there is one, between the *historical process of growth*, the infrastructural development in general and the development of a particular mode of communication (for example,

telecommunications), remain unexamined. Such a lacuna puts the validity of the entire exercise in question.

Owing to the lack of contextualization, both economic growth and the proliferation of communication technology is viewed relatively autonomously vis-a-vis global movements. In the worst cases, technology is accorded a determining position, pushing other factors into the margin. The fact that it is not the technology alone but other externalities that determine the course of development is hardly recognized in these studies.

Cronin et al.'s (1991) study illustrates these two lacunae in a paradigmatic way. In their study, 31 years of US data (1958–88) were used to determine whether the level of economic activity (measured in terms of total outputs of 432 industries and annual GNP) caused increased investment in telecommunications or vice-versa. But nowhere was it mentioned, let alone analyzed as a contributory factor, that the US economy underwent several structural changes over this period. The investment in telecommunications infrastructure was made necessary by, among other factors, the heightened US role in the global economy and US investments all over the world. The question of power as well as the global changes remain on the margin of the 'telecommunications and growth' discourse in general and Cronin et al.'s study in particular.

Although these issues received very little attention from communication researchers, scholars of human geography occasionally touched upon some of them, especially the issue of how telecommunications serves as a conduit of and catalyst for the internationalization of an economy. Despite their primary focus on geographic aspects of communications and information, scholars of human geography address issues pertaining to technology, the underlying logic of the adoption of technology and its impacts. Their method of approaching the issue, in a number of cases, reveals the connections between economy and telecommunications development in an understandable way. Moss's (1986) study, for instance, shows that there are close relationships between the internationalization of trade and finance, the centralization of such activities in a few global cities and the development of telecommunications infrastructure in these cities. This conclusion obviously suggests that to discern these relationships one must go beyond simple correlation. This strand of thought, however, has some limitations of its own. Because of its origin in geographical science, this line of thought is more concerned about the spatial effects of telecommunications than any other impacts. Nevertheless, this approach reminds us that the central element in understanding the relationship between economic growth and the telecommunications infrastructure is 'internationalization'.

Internationalization, in fact, is the key to understanding the restructuring of the global economy which in turn performed the role of 'midwife' for new technologies, especially telecommunications. Castells's (1989) description is worth mentioning here:

The internationalization of the economy at an accelerating pace is a fundamental element of the process of economic restructuring now under way. Although the process of internationalization represents a secular trend of capitalism, it has since the 1970s taken on much greater proportions, and has embraced new dimensions, in the attempt by corporations to overcome the contradictions revealed by the structural crises of the world economy, by increasing the rate at which capital circulates and by constantly searching for the most advantageous location for investment, production and markets the planet has to offer. National economies have become increasingly interdependent through the relentless expansion of world trade and the growing volume of exchange of multi-directional capital flows. (Castells, 1989: 307)

As mentioned by Castells, internationalization is nothing new; but what is important is the convergence of the acceleration of this process and technological breakthroughs such as the advances in telecommunications.

After the Second World War, the crises originating from the war and its precursor, the Great Depression, necessitated a restructuring of capitalism leading to the emergence of a new model characterized by a social pact between capital and labour, regulation and intervention by the state in the economic sphere, and control of the international economic order by intervention in the sphere of circulation, via international institutions like the IMF (Castells, 1989: 21–2). This restructuring brought unprecedented economic growth to the western industrialized countries, but continued deprivation to the poor, largely colonized, supplier of raw materials — the Third World. However, by the early 1960s, factors both endogenous (for example, rampant inflation and the successes of social movement and labour struggles in lowering the rate of profit) and exogenous (for example, decolonization of the Third World and the entrance of new competitive actors into the international economy) engendered a structural crisis for global capitalism. Industrialized countries faced severe problems of structural unemployment, underutilized plant capacity, stagnating domestic investment and fiscal crises of the state, which signalled a necessity to restructure the global economy. This restructuring eventually forced the development of a new international division of labour (NIDL) superseding the classical international division of labour. The traditional bisection of the world into a few industrialized nations on the one hand, and, on the other, a great majority of developing countries integrated into the world economy as raw material producers, was replaced by an increasing subdivision of manufacturing processes into a number of partial operations at different industrial sites throughout the world. Commodity production was increasingly subdivided into fragments which were then assigned to whichever part of the world could provide the most profitable combination of capital and labour (Frobel et al., 1980: 13–14). Despite this profound change what remained the same was the basic goals of a capitalist system, namely

to enhance the rate of profit for private capital, the engine of investment, and thus of growth: to find new markets, both through deepening the existing ones and by incorporating the new regions of the world into an integrated capitalist economy: to control the circulation process, curbing structural inflation: and to assure the social reproduction and economic regulation of the system through mechanisms that would not contradict those established to achieve the preceding goals of higher profit rates, expanding demand, and inflation control. (Castells, 1989: 23)

The internationalization of all economic activities produced a system of worldwide interdependent units working in real time. This opened up new markets, connected various segments of the market across borders, allowed capital to take advantage of favourable conditions for investment and production and, more importantly, allowed round-the-clock capital investment opportunities worldwide.

In this respect, internationalization has three distinct forms: the internationalization of production, the internationalization of financial transactions and the internationalization of services. Held (1991), highlighting the first two, writes:

Two aspects of international economic processes are central: the internationalization of production and the internationalization of financial transactions, organized in part by fast-growing multinational companies. Multinational corporations (MNCs) plan and execute their production, marketing and distribution with the world economy firmly in mind. Even when MNCs have a clear national base, their interest is above all in global profitability, and their country of origin may count little in their overall corporate strategy. Financial organizations such as banks are also progressively more global in scale and orientation; they are able to monitor and respond to developments, be they in London, Tokyo or New York, almost instantaneously. (Held, 1991: 214)

Likewise, a wide range of services such as advertising, management consultancy, accountancy and legal services are now being offered on a global basis. One US study quoted by Noyelle and Dukta (1986) estimates the foreign revenue from business services to be 25 percent of total revenue earned in a given period, with about half of this proportion coming from sales of major producer services such as the ones mentioned earlier.

The unprecedented higher level of interconnectedness that grew in the late 1960s has created a demand for a constant exchange of information between and among the participants of the process, making information a necessary input into every aspect of economic decision-making. As Neuberger, at a very early stage of this process noted,

the larger the number of participants in the economic process, the greater the division of labour, the more complex the technological processes, and wider the assortment of goods and economic services an economic system produces, the more information intensive the economic process becomes. (Neuberger, 1966: 132-3)

The interconnectedness brought recognition of information both as a commodity and resource — ‘a catalytic resource which acts as a powerful agent of change’ (Jussawalla, 1993: 128). To tap this resource and trade it as a commodity a system of enhanced capacity to store, retrieve and analyse information and a reliable, faster and constant mode of communication became crucial. The development of the microprocessor in 1971 and the spectacular growth of telecommunications in the 1970s has been the logical advance in this direction. However, as these technologies came into existence they unleashed an array of new and fundamental innovations with profound social consequences of their own.

The relationship between the structural imperatives of global restructuring and the proliferation of these technologies is not as linear a process as one may infer from the above discussion. It is complex and interactive. On the one hand, the context discussed above precipitated the growth of telecommunications while, on the other hand, without the dramatic breakthrough in information technologies (which include telecommunications), the internationalization of economic activities could not have taken place. As Henderson noted:

The emergence of the global option (expansion of production overseas), however, would have been inconceivable without the development of information technologies, and particularly telecommunications. These technologies have been a major material condition for the emergence of the global option in as far as they have enabled particular labour processes, or sometimes entire production facilities, to be dispersed across the globe, while allowing managerial control . . . to remain centralised in the ‘world cities’ of the core cities. So central have been these new microelectronic technologies in the recent development of the international economy, that elsewhere Castells and I have suggested that global restructuring, at root, must be considered as a ‘techno-economic process’. (Henderson, 1989: 3)

Both Henderson (1989) and Castells (1989) are correct in saying that the advances in telecommunications have created the material infrastructure for the world economy as the construction of the railway system provided the basis for the formation of national markets in the 19th century. Thus the impetus for technological innovations came from the restructuring of the global economy but the innovations themselves set in motion the profound changes that followed.

A technocratic interpretation of the development of telecommunications that ascribes primacy to technology fails to take into account this evolutionary aspect of telecommunications and produces an inadequate result. Hence, one needs to take into account the symbiotic relationship between the technological developments and the logic behind its proliferation. One of the most vibrant economies of the ASEAN region, namely Singapore, illustrates this point.

Singapore currently has a modern, highly sophisticated, state-of-the-art telecommunications infrastructure. Grown over the last two decades, and most remarkably in the 1980s, telecommunications development has ascribed to this country the 'model' status for modern communications in developing countries. Singapore's development is so remarkable that it has surpassed a number of developed countries and is now commonly referred to as the 'intelligent city'. This remarkable progress in the telecommunications infrastructure of Singapore came with its integration into the global economy. The mode of insertion into the global economy, as well as the timing, played a crucial role in the development of the telecommunications infrastructure and its contribution to economic growth.

Singapore: a case study

Singapore's rapid economic growth over the last 30 years has involved a major transformation of the economic structure from a labour-surplus, entrepot-trade based one to a modern regional business hub involving high valued-added manufacturing, transportation, trading, financial and business services. Over this period what Singapore has experienced is a planned internationalization of its economy.

The internationalization of Singapore's economy was prompted by several factors, most prominently its lack of resources. Its location as the gateway to Southeast Asia and the presence of state, commercial and ecclesiastical powers such as Holland in Indonesia, Spain (and later the USA) in the Philippines, France in Indochina, Britain in Malaya, Burma, India and Borneo integrated Singapore with the global economy from the early 19th century. The situation, however, changed after 1959, when the city won internal self government from the British colonial authorities. At independence, the newly elected People's Action Party (PAP) formulated a policy of import-substitution industrialization which was characterized by low tariffs on a narrow range of industries. But this experiment did not last for long. In 1966, Singapore turned to labour-intensive manufacturing for export to the world market. With this step, Singapore assumed a new role in the world economy along with its entrepot function. New tax incentives to multinational corporations and political and labour control prompted a surge in foreign investment, particularly after 1967. In manufacturing, investment commitments during 1968–73 totalled more than S\$2.3 billion (Soon and Tan, 1993).

Aided by favourable external and domestic circumstances, this strategy reaped benefits at an unprecedented speed and in a spectacular manner. Domestically, Singapore's geographical location, infrastructure, free trade policies and gradual decline of labour militancy were attracting a large amount of foreign investment. But what played a more crucial role was the

external environment or, to be more precise, a restructuring of the global economy. From the early 1960s, crises in industrial economies, originating from internal and external factors, initiated a new international division of labour. Commodity production was increasingly subdivided into fragments which were then assigned to whichever part of the world could provide the most profitable combination of capital and labour (Frobel et al., 1980: 13–14). Multinational corporations began to relocate industrial production from high-wage sites to low-wage sites to gear their production more profitably toward existing markets at home and abroad by taking advantage of wage differentials. The Singapore government's industrial policies and other advantages made the city-state a good candidate for multinational industries and soon it emerged as the preferred haven of multinationals and an efficient off-shore manufacturing location.

Export manufacturing, especially the electronics industry, experienced an immediate surge. By 1970, a total of 64 establishments, employing 13,856 persons and with an export output of S\$283 billion, were operating in Singapore. About 70 percent of the total output was export oriented. The textile and clothing industry also saw a phenomenal rise. The number of workers employed in this sector increased from 2459 in 1966 to 35,012 in 1973. The city quickly became the regional services and refining centre for the oil exploration and extraction boom which began in the late 1960s. Over a period of seven years 147,500 jobs were created in the manufacturing sector alone. This massive restructuring of the economy engendered an impressive growth, with a share of manufacturing rising sharply from 16 to 22.3 percent. 'Direct exports as percentage of total sales in manufacturing rose from 43.3 percent in 1966 to 53.9 percent in 1973' (Soon and Tan, 1993: 12). This success practically eliminated previously high unemployment and decreased Singapore's reliance on entrepot business. It should be kept in mind, however, that entrepot functions, particularly with respect to oil, remained a major source of revenue. The major implication of the emergence of a multinational-dependent manufacturing sector geared towards export was the incorporation of Singapore with the global economy and the internationalization of its economy. By the early 1970s, Singapore's destiny once again became linked to the vagaries of the global economy.

In 1966, when Singapore first embarked upon its export-oriented industrialization process, it also restructured its telecommunications infrastructure. In a single year S\$30.7 million was spent as capital expenditure in telecommunications. Out of this S\$10.7 million went toward developing national telephone services, while the remaining S\$20 million was spent on developing the international telephone and other services, such as telex and telegrams facilities. Though minor when compared to what happened in later phases, it was a remarkable step at that point, especially when one considers that total annual revenue was less than half of the capital

expenditure. What is of further significance, is that out of S\$15 million revenue, S\$8 million came from international services. That the demand for international telecommunications arose out of entrepot businesses, was an impetus for this upgrading. In the subsequent four years revenues generated from telecommunications services doubled, reaching S\$38.3 million in 1970. Of this, the majority came from the increased international services: S\$25.6 million. This was a more than three-fold increase. Revenues from the national telephone services went up to S\$12.7 million. The low revenue generation from the national service was due to the underdeveloped infrastructure, which prompted S\$22.5 million capital expenditure in national services, as opposed to S\$7 million on international services.

During the same period, in addition to being an efficient off-shore manufacturing location, Singapore was promoted as a major financial service centre. This began with the setting up of a foreign currency unit called Asian Currency Units (ACUs), similar to the Eurocurrency Unit, by the Bank of America in 1968. Singapore's location at the axis of ASEAN and its time-zone advantage bridging Europe, Asia and the Pacific made it attractive to international banks seeking a regional base for operations. The establishment of the ACUs gave a boost and resulted in gradually bringing in some foreign banks. By 1978, the total number of foreign banks reached 68, from 25 in 1968. Furthermore, in 1978 all currency controls were abolished, enabling unrestricted capital movements in and out of Singapore.

In 1973, the Singapore government made an attempt to upgrade the economy. Emphasis was shifted from the labour-intensive manufacturing sector. The timing as well as the nature of the attempted restructuring of the economy posed a crucial test for Singapore. It was an adverse situation for national economies highly dependent upon the global market. The oil crisis of 1973 resulted in a severe recession all over the world. The global economy was sluggish and the markets of industrialized countries were in a deep crisis. The demand for manufacturing goods was decreasing steadily. On the other hand, there was a downturn in the inflow of foreign investment (from S\$708 million in 1972 to S\$376 million in 1973). Critics seriously doubted the sustainability of Singapore's growth and questioned the plausibility of restructuring an economy so deeply dependent upon outward-looking manufacturing. However, the decision to restructure the economy not only reflected the government's perception about a changing economic environment but, in hindsight, it proved to be prudent though not totally successful. In spite of adverse external conditions, Singapore's real GDP grew by 7.4 percent annually in 1974–9. The factor that primarily contributed to this growth was not the manufacturing sector, despite the government's initiative to upgrade it. Rather, it largely consisted of the construction and financial service sector. The contribution of the latter sector, involving a wide variety of institutions (a vast majority of which

were foreign-owned), demonstrates that the government was correct in liberalizing market entry, in order to encourage the entry of international financial and producer services' institutions in the previous decade. It also hinted that in a changing global economic environment, where Singapore was increasingly losing its edge as a supplier of cheap labour, the move to the higher value-added services sector would be the right choice. Thereafter the business and financial services' share of service sector GDP grew steadily — from 39.7 percent in 1960 to 68.7 percent in 1983 (Dixon, 1991: 167). In terms of service and employment, the share of finance and business increased from 6.7 percent in 1960 to 12.9 in 1983 (Mirza, 1986: 30, 179).

By the year 1973, Singapore assumed a pivotal role as the supplier of cheap manufacturing goods to global markets and attracted a large number of multinationals which were in dire need to keep constant contact with their headquarters and markets dispersed all over the world. It was against this background that, in 1974, the Singapore Telephone Board (STB) (which took over a private company, Oriental Telephone and Electric Co. Ltd, in 1953), merged with the Telecommunications Department. The Telecommunications Authority of Singapore (TAS) was formed. Commensurate with the government's plan for technical upgrading, a large amount of money was invested in refurbishing the telecommunications infrastructure. In 1974, automatic computerized international telex services were opened. In the 1975/6 fiscal year a total of S\$149.2 million was spent as capital expenditures, out of which S\$120.8 million went to national telephone services, primarily to wiring and switching equipment. The primary goal was to meet the increasing demand for telephones — both residential and business — and to reduce the waiting period. As a consequence of this massive investment, international direct dialing (IDD) services became available to the public in 1976. In the subsequent six years (1974–80), capital outlays for telecommunications rose around 239 percent on average per year (Crawford, 1984: 12). And no wonder that during this period the growth of telecommunications exceeded that of the country's other key economic priority sectors.

As I have mentioned earlier, from the mid-1970s, especially during 1974–9, financial services contributed significantly to Singapore's high growth rate. Financial services usually operate through closed networks but, because of increased interactive activities, open networks and public telephone services also experienced high traffic.³ The available data pertaining to the growth of the international telephone, telex and telegraph facilities in Singapore during 1975–9 supports this contention. A combination of the growing financial services and other producer services helped increase the amount of telecommunications traffic. In 1975, the total number of international calls (excluding trunk and STD calls to Peninsular Malaysia) was 843,000. The figure rose to 2,490,000 by 1979. Data

TABLE 1
Growth of International Telephone, Telex and Telegraph in Singapore, 1975–1985 (in thousands)

Year	Telegrams	Telephone Calls	Telex
1975	840	843	1552
1976	798	1077	2154
1977	800	1301	2812
1978	739	1760	3673
1979	701	2490	4991
1980	655	3535	6831
1981	567	5058	8894
1982	445	7091	11,074
1983	378	9673	12,620
1984	336	12,643	14,140
1985	275	15,725	14,682

Source: Telecommunications Authority of Singapore, 1986.

presented in Table 1 show that, between 1975 and 1985, international telephone calls increased at a spectacular rate.

In 1979, Singapore entered into a new phase of its economic development, when the government launched 'the second industrial revolution'. Faced with increasing competition from lower cost labour locations (for example, Malaysia, Thailand) and domestic labour shortage (Rodan, 1989: 157), the government initiated a programme to encourage the development of higher value-added production and financial service. It was in line with its previously attempted restructuring.

Under the 'second industrial revolution' inflow of foreign labour was curtailed and a 'wage correction' policy was installed with a goal to increase wages 54–8 percent between 1979 and 1981. The aim was to replace the low-value, labour-intensive manufacturing sector with higher-technology, higher-skill, higher productivity and higher value-added activities. The most important ramification of this structural adjustment was that it initiated a regional division of labour within Southeast Asia. Subsequent developments in the semiconductor industry reveal that more technology-intensive works (for example, wafer fabrication) remain in Singapore, while labour-intensive, low value-added work (for example, assembly) is migrating to other countries of the region — initially to Malaysia, then to Thailand and the Philippines.⁴ With this dramatic change, Singapore assumed a newer role, primarily an intermediate one linking the resource-rich (natural as well as human) countries of this region with the developed countries. This role has been extended beyond manufacturing to other sectors like services. That is what precisely began to take place in the early 1980s. The services sector in general and banking services in particular,

saw a phenomenal expansion. By 1982 every important bank in the world had some kind of representation in Singapore (*Economist*, 1982: 5). As of early 1983, Singapore had 119 commercial banks and 48 merchant banks (Langdale, 1984: 141–2). With the changing role in the global economy, the contribution of the services sector gradually attained a preeminent position in Singapore's economy. Consequently information-related occupations registered an upward change. According to one account, the share of information workers in the labour force in Singapore reached 34.1 percent in 1980, a 6 percent rise from 1970 (Kuo and Chen, 1985). In 1985, Singapore was placed 16th in the world and 2nd among developing countries as an exporter of services (Wei, 1986: 44).

Concomitant with the change in orientation of the economy, there were changes in telecommunications services. From 1979, the Telecommunications Authority of Singapore began providing value-added services. The first step towards enhancing the service facilities was to change the regulatory framework of telecommunications. In 1982, the government created a new statutory body, the Singapore Telecom, to take over the regulatory and operational functions of the TAS as well as those of the Postal Services Department. In fact, the pace of expansion of the telecommunications facilities in Singapore during the 1980s reached a level incomparable to any other country in the world. By 1983, the city-state became the first nation in the world to have a 100 percent push-button telephone system, which enabled the further enhancement of telecommunications services, especially offering diversified value-added services. Within two years of reaching the complete push-button stage, there were at least 150 telecommunications firms operating in Singapore. In 1986, there were 25 exchanges, most of which were linked by optical fibre land cables by the end of 1987. Telex facilities were available for 204 destinations worldwide. Of them, 184 were fully automatic. A 'Teletex' service, capable of operating at 40 times the speed of an ordinary telex, was introduced in 1986. As previously mentioned, by the mid-1980s, the telecommunications sector assumed a preeminent position, and during the recession year of 1985 experienced a 3 percent growth rate despite a negative 1.8 percent GDP growth rate.

However, Singapore's economic condition took a dramatic turn for the worse in 1985, when the most serious recession in 20 years hit the country. A decline in competitiveness, a decline in foreign investment owing to wage increases, a rise in other related costs and an increase in rent in conjunction with the high degree of exposure to the world market (which brought home the global recession) and the sudden collapse of the domestic construction industry boom caused a shuddering halt to the growth. In 1985, real GDP declined by 1.8 percent. The decline in manufacturing (8 percent) and construction (17 percent) was offset by growth in the service sector (5 percent). The transport and communications sector's growth

(especially the telecommunications services), at the rate of 3 percent, was a blessing for the economy.

By late 1986 an array of policy initiatives (such as a reduction in corporate taxes, cuts in statutory charges for government services, the lowering of employer's share in CPF, the institution of a wage restraint policy, etc.) created a favourable condition for recovery. Changes in the external environment, such as the realignment of world currencies, increased Japanese investments from S\$244 million in 1984, to S\$693 in 1988, and a recovery in commodity prices helped bring back the economy to its earlier track of sustained growth. Since then strong growth has characterized Singapore's economy — around 10 percent annual growth for the rest of the 1980s.

The recession of 1985, on the one hand, slowed down the government's much-heralded 'second industrial revolution' while, on the other hand, underscoring the need to bring a service orientation to the economy. The Fiscal and Financial Committee Policy Sub-committee's call to promote Singapore 'as a premier Operational Headquarters (OHQs) for Manufacturing, Finance and Banking Services, especially risk management and fund management, knowledge intensive industries and other traded services' (Singapore Ministry of Finance, 1986: 1) clearly illustrates the government's willingness in this regard. Since then, a number of multinational corporations have been given OHQ status.⁵ Furthermore, in the late 1980s Singapore made considerable progress towards emerging as a major regional and monetary centre. A direct link between the Singapore International Monetary Exchange (SIMEX) and the Chicago Mercantile Exchange, installed in 1985, permits 24-hour trading, reduced margin and fund-transfer cost, intensified capital flow and hence brought a number of financial services providers to the city-state. Data pertaining to the contribution of financial and business services to the GDP reflects the growing trend. In 1970, the contribution of business and financial services was 16.7 percent: corresponding figures for 1980 and 1990 are 18.9 percent and 28.0 percent (Ministry of Trade and Industry, 1990). During the period between 1987 and 1990, the services sector in general maintained a consistent annual growth rate of 10 percent (Low et al., 1993: 352). This meant that in the late 1980s, Singapore's economy gradually shifted toward the service sectors. Commensurate with this trend, the Strategic Economic Plan (SEP), called the 'Next Lap', formulated in 1991 to chart the key economic development policies in the 1990s and beyond, sets a target of making Singapore a global city or total business hub in the Asia-Pacific region within the next 20–30 years. Infrastructural development followed suit. In the post-recession period, especially since 1987, 'there has been increased outward orientation as the national network has diversified services and investment to become more international, in line

with developments in the industrial and services sector' (Kuo et al., 1989: 62).

In terms of its physical infrastructure, as of 1991, Singapore had the third highest tele-density in the Asia-Pacific region after Japan and Hong Kong with 44.7 direct phone exchange lines; one public phone, 2.6 mobile phones, 13.5 pagers and 1.2 fax machines per 100 people. It has one of the world's highest density of urban optical networks, with more than 21,000 fibre-km of cables in use. As at 31 March 1994, about 53 percent of all Main Distribution Frame (MDF) rooms are served by optical fibre links. Digitalization of the domestic telephone network was always a priority for the Singapore Telecom. Between the period of March 1991 and March 1992, the share of digitalized phone lines increased from 49 to 71 percent. In August 1994, the Singapore Telecom achieved its goal of 100 percent digitalization.

Singapore Telecom uses both a cable and satellite transmission system. Currently, it has several satellite earth stations to provide direct analogue and digital international telecommunications to 66 countries. Beside satellite networks, Singapore is increasingly being linked with a number of countries via international submarine cable networks. With the completion of the Brunei-Singapore (BS) link of the ASEAN optical fibre submarine cable network (AOFSCN), Singapore joined the club of countries which have direct optical fibre links. The first segment of the Southeast Asia-Middle East-Western Europe (SEA-ME-WE 2) optical fibre submarine cable system began operations in July 1993. In November 1993, the Asia-Pacific Cable (APC) system linking Singapore, Malaysia, Hong Kong, Taiwan and Japan was formally inaugurated. Singapore Telecom is participating, and has heavily invested in, a number of international submarine optical fibre cable network projects, such as the Trans-Pacific TP4 system, the SEA-ME-WE 2 cable and the Singapore-Jakarta submarine optical fibre cable link. An optical fibre land link between Singapore and Malaysia was completed in 1991.

Cellular mobile phones were introduced in 1988. A CT2 cordless telepoint system was made available in 1992 and over 2000 telepoints or base stations were established nationwide within the first six months. Integrated Services Digital Network (ISDN), customarily viewed as the niche of telecommunications services, came into existence in Singapore in December 1989. The uniqueness of ISDN in Singapore is that it operates in 'narrowband' — the first of its kind in the world. By mid-1992, ISDN services were available to ten countries. In the same year, Singapore Telecom began its trials in broadband ISDN (BISDN).

In terms of basic telecommunications services, a wide range of value-added call management services — such as call-waiting, speed dialling, absentee message, auto-redial, call-transfer, three-way calling and password calling are offered through public switch telephone networks. A large

TABLE 2
Growth of Basic Telecommunication Services in Singapore 1979–1991

Year	Direct Lines (000)	Public Phones	Card Phones (000)	Telex (000)	Mobile Phones (000)	Pagers (000)	Fax
1979	480.0	11,762	na	6.4	na	na	24
1980	536.6	13,356	na	8.4	na	na	38
1981	589.6	13,659	na	10.6	na	na	179
1982	643.0	14,804	na	12.8	na	na	418
1983	693.6	16,077	na	14.8	na	na	831
1984	759.7	16,715	na	16.2	na	na	1818
1985	805.1	19,152	na	16.9	na	na	3306
1986	841.1	21,857	47	17.9	na	na	6095
1987	886.1	25,000	200	17.6	na	156.9	13,827
1988	938.7	26,000	600	15.1	5.5	205.0	20,658
1989	995.0	27,672	2400	14.0	25.0	250.0	27,299
1990	1050.8	26,506	6200	13.0	51.0	333.0	33,269
1991	1387.3	26,950	7401	–	81.9	420.0	39,354
Average Growth							
Rate % (1979–91)	1979–91	1986–91	1988–91	1988–91	1987–91	1979–91	
	9.2	7.2	175.1	–	146.0	27.9	85.3

Source: Singapore Telecom, *Annual Report*, various issues.

TABLE 3
International Telephone Calls, 1986–1991

Year	Number of calls (mn)	Revenue (S\$ mn)	International circuits (000)
1986	23.5	596.3	2.1
1987	32.0	701.0	2.6
1988	45.0	897.0	3.2
1989	63.0	1033.3	4.0
1990	77.0	1133.5	5.1
1991	93.0	1231.4	5.9

Source: Singapore Telecom, *Annual Report*, various issues.

number of public payphones, which has doubled over the last decade (from 13,659 in 1981 to 26,950 in 1991, see Table 2), accepts pre-paid cards enabling callers to make international calls from the streets. It has obviously contributed to the phenomenal rise in total outgoing traffic (from 23.5 million in 1986 to 93 million in 1991, see Table 3). The number of cellular mobile phones, since their introduction in 1988, has increased

substantially (82,000 in March 1992). The number of pagers is also on the rise. Between March 1992 and July 1992, about 38,000 new users have joined bringing the total number of subscribers to 458,000. Singapore Telecom also offers a worldwide global aeronautical satellite voice communication service (Skyphone), allowing air passengers to make telephone calls to any destination on the ground. About 35 aircraft owned by 26 airlines have subscribed to the service.

The infrastructural development described above not only provides the basic telecommunications services but, more importantly, sophisticated higher value-added services (VAS) that make more direct contributions to the economy. The high-speed digital circuit services are one of them. Singapore Telecom offers high-speed digital leased circuit services for data transmission both domestically (through a nationwide domestic digital leased circuit called DigiNet) as well as internationally (through the INTELSAT Business Service — IBS, and since April 1992, optical fibres). IBS supports a wide range of applications, including computer transfer, video teleconferencing and remote printing. Other VAS provided by Singapore Telecom include: a corporate switched telecommunications service (CSTN) that provides multinational corporations with a global private network service; a packet switch data network service (Telepac) providing access to major databases worldwide covering at least 65 countries; and an international email gateway system using X.400 standard.

Electronic Data Interchange (EDI) networks, which have enormous economic potential, have increased significantly over the last five years. Through the collaborative efforts of the National Computer Board (NCB), the Trade Development Board (TDB), the Port of Singapore Authority (PSA) and the Civil Aviation Authority of Singapore (CAAS), an EDI network for trade document processing, TradeNet, was introduced in 1988. TradeNet has proved to be enormously successful. Subsequently these four government agencies jointly formed a new value-added network operator, Singapore Network Services (SNS). The SNS, in addition to the management of TradeNet, developed other EDI networks such as RealNet for contractors and real estate developers, and collaborated with others in developing new EDI networks. Currently MediNet (a network linking hospitals, patient records, pharmacy suppliers, etc.), the LawNet and Lot Base System (LBS) — introduced by the ministry of law, the PortNet of PSA, the SPECTRUM system of the Singapore Air Terminal System and the BizNet system of Registrar of Business and Companies — are all in operation.

The Trade Development Board has also introduced 'a computer-based, public switched on-line service (Datel) connected to more than 300 international databases and 37 destinations to gather information on products, market trends, opportunities for international trade and so on' (Sussman, 1991: 291). NETS, a nationwide electronic fund transfer system

TABLE 4
Singapore Telecom's Income Composition 1986–1991 (in S\$ million)

	1986	1987	1988	1989	1990	1991
International Telephone	596.33	701.00	897.03	1033.33	1133.52	1231.43
National Telephone	226.61	240.32	257.11	273.62	271.88	361.53
Mobile Communications	67.41	93.52	131.57	155.35	177.52	218.76
Network/Public Data	66.29	77.02	96.57	119.78	145.90	170.17
Public Message	207.47	224.90	158.09	140.53	116.50	95.75
Public Telephones	20.43	24.76	21.69	23.42	34.16	–
Postal	119.84	125.94	144.73	168.69	183.12	221.93
Miscellaneous Sources	31.79	21.29	39.22	30.05	37.66	36.18
Total Income	1336.2	1508.7	1746.0	1944.8	2100.3	2290.7

Source: Singapore Telecom, *Annual Report*, various issues.

for the retail business sector, introduced in 1988, is the first of its kind in this region. This helps retailers reduce both paperwork and transaction costs, while enabling customers to shop without carrying cash. A state-of-the-art two-way interactive videotext system, Teleview, began operating from the end of 1990. It provides a wide range of services from on-line news and financial information, telebanking and teleshopping, electronic mail, educational programs for school children and various government services. It can be accessed through TV or through PC-based terminals. Currently, 80 service providers offer more than 350 different kinds of services.

The foregoing description of the telecommunications infrastructure and services in Singapore shows that the city-state has become completely wired and interconnected with other global telecommunications networks. But what is important for us to see is how this interconnectedness is contributing to the economy. This can be assessed by looking at the identity of the users and how this infrastructure/service is attracting potential users. One simple indication is the growing volume of international telephone, network/public data services. Tables 4 and 5 reveal that the international telephone system contributes around 50 per cent of the total income of the Singapore Telecom. Over a period of six years (1986–91), revenue generated from international telephone calls increased more than two-fold. International circuit usage grew rapidly (Table 3). Data presented in Table 6 inform us further about revenues and capital expenditures between 1980 and 1986 and a statistical summary of Singapore Telecom is presented in Table 7.

The most intensive user of telecommunications facilities is not the individual, but corporations engaged in various industries. A summary of the intensive users of international telecommunications provided in Table 8

TABLE 5
Singapore Telecom's Income Composition 1986–1991 (in percentage)

	1986	1987	1988	1989	1990	1991
International Telephone	44.6	46.5	51.4	53.1	54.0	53.7
National Telephone	17.0	15.9	14.7	14.1	12.9	13.8
Mobile Communications	5.0	6.2	7.5	8.0	8.5	9.5
Network/Public Data	5.0	5.1	5.5	6.2	6.9	7.4
Public Message	15.5	14.9	9.1	7.2	5.5	4.2
Public Telephones	1.5	1.6	1.2	1.2	1.6	–
Postal	9.0	8.3	8.3	8.7	8.7	9.7
Miscellaneous Sources	2.4	1.4	2.2	1.5	1.8	1.6
Total Income	100	100	100	100	100	100

Source: Singapore Telecom, *Annual Report*, various issues.

TABLE 6
Revenues and Capital Expenditures of TAS, 1980–1988

Year	Total Revenues (S\$ 000)	Capital Expenditures/ National Services	Capital Expenditures/ International Services	Total
1980/81	302.9	162.8	58.1	220.9
1981/82	397.0	187.9	55.6	243.5
1982/83	369.5	190.9	97.4	288.3
1983/84	299.3	220.8	112.2	333.0
1984/85	369.1	182.9	250.1	433.0
1985/86	317.5	182.5	229.6	412.1
1986/87	367.7	136.8	144.7	281.5
1987/88	446.1	109.1	91.7	200.8

Source: Kuo et al., 1989.

shows, on the one hand, who they are while, on the other hand, it helps us to understand the emerging services sector and telecommunications. The total number of large account users, defined as those with telecommunications bills of over US\$100,000, was 287 in 1989. Of these, 123 were engaged in finance, insurance, real estate and business services. Their share was the highest (42.9 percent), followed by manufacturing (31.7 percent). Of the 91 corporations within the manufacturing sector, 57 were involved in electronic products and components. Their share of the total was 19 percent, the highest amount across all industries. This, as Chong (1991) noted, 'not only indicates the dominance of electronic industry in the Singapore economy but also that the telecommunications dependent nature

TABLE 7
Singapore Telecom — Statistical Summary, 1981–1991 (in S\$ million)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Group Operating Income	917.8	1014.7	1077.1	1215.5	1237.8	1336.2	1508.7	1746.0	1944.8	2100.3	2290.7
Operating Surplus	325.7	296.7	221.0	265.1	241.3	290.9	348.0	493.1	714.0	828.8	1042.9
Total Surplus	396.9	370.3	299.3	369.1	317.5	367.7	446.1	620.2	869.8	1086.4	1285.7
Contribution to Gov't											
Consolidated Fund	—	—	—	—	—	—	60.8	164.6	173.2	217.1	244.1
Capital Expenditure	243.5	288.3	333.0	433.0	412.1	281.5	200.8	193.5	221.0	454.1	1103.1
Total value-added	723.7	764.8	780.9	891.7	869.0	912.2	1025.3	1151.0	1430.5	1673.1	1797.5
Total assets	2017.3	2331.9	2774.0	3264.4	3551.1	3483.4	3753.9	4260.0	4984.3	5997.4	7546.5
Employment	12090	11698	12922	12920	12751	12497	12100	11620	10964	10157	9775

Source: Singapore Telecom, *Annual Report*, Various issues.

TABLE 8
Intensive Telecommunication Users by Industry Type

Type of Industry	Number (Percentage) of Intensive Users	
1. Manufacturing		
Manufacture of Chemicals, Petroleum, Coal, Rubber and Plastic Products	12	(4.2%)
Manufacture of Electronic Products and Components	57	(19.9%)
Other Manufacturing	22	(7.6%)
Total Manufacturing	91	(31.7%)
2. Commerce		
Hotels	42	(14.6%)
Other Commerce	8	(2.8%)
Total Commerce	50	(17.4%)
3. Transport, Storage and Communications		
Water Transport (including shipping lines, representative offices of foreign shipping lines, freight shipping agencies)	16	(5.6%)
Other Transport	5	(1.7%)
Total Transport	21	(7.3%)
4. Finance, Insurance, Real Estate, Business Services		
Domestic Banking Units	7	(2.4%)
Asian Currency Units (Foreign Bankings)	49	(17.1%)
Brokers (securities, gold, forex, commodities)	31	(10.8%)
Information Technology Services	24	(8.4%)
Other Finance, Services	12	(4.2%)
Total Finance, Real Estate and Business Service	123	(42.9%)
5. Other Industry		
Total other industry	2	(0.7%)
Total Number of Intensive Telecommunication Users	287	(100%)

Source: Chong (1991: 17).

of activities in the industry is reflective of coordination and control function over and above the manufacturing function' (Chong, 1991: 18).

In the 1980s, as we already know, Singapore's role in the region involved coordinating manufacturing rather than manufacturing per se. In the context of the New Asian Division of Labour (NADL), Singapore succeeded in assuming this role mainly because of its ability to provide the facilities needed for management and coordination. Without this infrastructure and the ability to render services, it would have been impossible. A number of MNCs involved in the electronics industry shifted their manufacturing plants from Singapore, but retained or brought their regional

coordination activities to the city-state (see Lim and Fong, 1991: esp. 123–34).

Another revelation of Table 8 is that the largest percentage of heavy telecommunications users were in the finance and business sector. This should not come as a surprise because, as our earlier discussion shows, by the late 1980s, the services sector had already assumed a preeminent position in Singapore's economy. We also noted that business and finance services began to rise since the mid-1980s. In 1960, the share of the financial and business services in the GDP was 14.1 percent. By 1970, it rose to 16.4 percent. Corresponding figures for 1980, 1985 and 1989 are 20.3, 27.1 and 30.4 percent (PECC, 1990: 26). These services are international in nature and thus their reliance on telecommunications is understandable. As a matter of fact, telecommunications is their life-line. The internationalization of the financial and producer services, especially of banking and securities, is a recent, yet potentially the most influential, phenomenon of our time. Tokuyama (1989) assessed that approximately US\$200 billion circulate daily throughout the financial market, totally ignoring national boundaries. The internationalization of financial markets, the integration of credit, and capital markets and developments in the securitization of credit and intermediaries, are the most powerful forces shaping the world economy today. Trading in thousands of separate issues takes place on a non-stop basis, weaving an almost seamless web of financial ties between the stock exchanges, brokerage firms and banks. David Held (1991), for obvious reasons, attached importance to this phenomenon. It would not be an exaggeration to say that if the 1960s are characterized by the internationalization of (commodity) production, the 1980s should be identified by the internationalization of capital. A closer look at Table 8 further shows that out of 123 corporate users, 80 were involved in foreign banking, securities business, gold, forex, commodities, etc. Combined, their share exceeded 27 percent of the total, while domestic banking units had a meagre 2.4 percent share.

How significant the international banking sector has become can be understood from the fact that SWIFT⁶ (Society for Worldwide Interbank Financial Telecommunications) established a regional centre in Singapore in 1991. SWIFT's move to have a regional base reflects the growing volume of transactions and recognizes the emergence of Singapore as a regional centre for finance.

The move by SWIFT is not a unique one; a number of multinational companies have shifted their regional headquarters recently, especially since 1986 when the government launched the OHQ scheme. In the banking sector, City Bank, Union Bank of Switzerland and Visa are the most prominent ones. British Telecom and Northern Telecom have also established their regional hub in Singapore. In the manufacturing sector,

Matshushita, Sony, Hitachi, Du Pont and Motorola have made similar moves.

Conclusion

At the end of this analytic journey, we can see that the experience of Singapore bears out the contention that there is a symbiotic relationship between technological development and the logic behind its proliferation. It also shows that the proposed framework can be employed in studying a specific case. What we have seen is that in Singapore, thus far, telecommunications infrastructure serves as a conduit of and catalyst in economic growth. During the past few decades, this city-state has become known for the attainment of high rates of growth and its economy has experienced remarkable transformations. But most importantly, it has been incorporated into the global economy. Domestic needs notwithstanding, the structural imperatives of the global capitalist system determined its mode of insertion into the global economy and the roles it played.

Clearly, over the last few decades, Singapore's economy has undergone two identifiable stages; in the beginning, the economy was more dependent upon producing goods for external markets, while in the second stage, it increasingly relied on services rather than on tangible products. Both these stages, not surprisingly, require an interchange of information in order to achieve and sustain further growth. But it is interesting to note that the needs of the first phase necessitated the upgrading of the telecommunications infrastructure, which consequently made it possible to move to the second stage, where information replaced the product as a commodity.

Here, one can identify the two-layered relationship between the economy and technology. At one level, the structural imperatives precipitate proliferation of the technology while, on the other level, technology unleashes numerous potentials for the economy. However, we must not lose sight of the fact that the actualization of these potentials is dependent upon the functioning of and participation in the broader global economic system. The proposed framework of analysis insists that these aspects should be taken into account while analysing the relationship between the telecommunications infrastructure and the economic growth of a given country.

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Notes

1. For a detailed description of Granger's causality test see Granger (1963, 1969). A brief description of the method is presented by Cronin et al. (1991: 534-5).

2. In similar vein, Mark Hukill (1990), in his study on telematics policy in the ASEAN countries, stated that, 'whether telecommunication development causes an increase in GNP is not established categorically. Rather than a direct causal relationship between telecommunication development and economic development, there appears to be a complementary and self-reinforcing process' (Hukill, 1990: 10).

3. International telecommunication networks can be divided into two categories, based on the degree of their accessibility: closed and open. Closed networks are those accessible only to a defined group of users, while the open networks are accessible to every terminal user with adequate technical and financial means. But, as I point out in the text, even closed networks generate open interchange of information through public telephone services.

4. The production of semi-conductors is usually divided into five stages: research and development; wafer production/fabrication; assembly; packaging; and testing. The first stage involves the design of chip circuitry and it takes a team of engineers one to two years to design a state-of-the-art microprocessor. This stage is highly capital-intensive and requires highly qualified engineers and scientists. At the second stage the moulds or masks are made, through a process where the circuit patterns are printed layer by layer on to the wafer. This is also a capital-intensive stage requiring highly skilled labour. The third stage involves soldering the wires on to the frame insulation and sealing of the chip. Capital requirements may vary from low to high, but compared to the previous two phases this stage is more labour-intensive than capital-intensive. Unskilled to semi-skilled labour is employed in this stage. Packaging is the most labour-intensive stage of the entire process as different packaging materials are used for different designs. Involvement of capital is minimal. The testing stage involves a battery of computerized tests on the circuits to ensure the performance reliability. For understandable reasons, it is highly technical in nature and capital-intensive, requiring skilled managerial and technical supervision. Usually the assembly and packaging stages of the semiconductor industry move into areas where labour is cheap and abundant. In Southeast Asia, a specific pattern of industry migration has taken place over recent decades wherein multinational semiconductor industries have moved from high-wage countries to low-wage countries. Although Singapore has succeeded in retaining the high value-added production stages, the most important part of the process (R&D) still remains with developed countries.

5. 'In 1986, Singapore adopted a policy to attract multinationals to locate regional headquarters activities in the island. Termed the Operational Headquarters (OHQ) scheme, a company is entitled to a total tax exemption in dividend income distributed in and flowing through Singapore, as well as a 10% concessionary tax rate for service income earned through the provision of headquarters services to the network of companies situated offshore.

To qualify for the OHQ status, the company has to have a minimum operating expenditure of S\$2 million, employ 4 to 5 senior managerial or professional personnel and manage at least 2–3 associate or subsidiary companies offshore. Companies granted the OHQ activities are expected to engage in administrative, planning and managerial control of the regional subsidiaries; funding and treasury activities; sourcing and marketing; warehousing and distribution; manpower training and research and product development' (Chong, 1991: 31–2).

6. SWIFT — Society for Worldwide Interbank Financial Telecommunication, is a network established in 1979 to provide banks with a means of handling interbank transactions. It is an important illustration of an international telecommunications network established for cooperation among a closed group of specific users. The SWIFT network consists of computer centres at various locations across the world connected by data transmission lines leased from public or private telecommunication carriers. The computer centres are linked to regional processing centres to which member banks connect by means of computer-based terminals on their premises. The network provides a wide range of services including customer transfers, credit/debit advices, foreign exchange and money market confirmations, account statements, documentary credits, interbank securities trading, balance reporting and payment systems. In addition to the original SWIFT I network, the SWIFT II network, with a capacity of processing over a million messages a day, was introduced in 1986.

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