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The Role of Telefonica: The Internationalization of Telecommunications in Spain, 1970-2000

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In this paper, I explore Telefonica's role in the technological and enterprise development of Spain. During the early formation of data transmission networks in the 1970s, Telefonica created an industrial group with its own companies and foreign technology partners (Fujitsu and American Telephone and Telegraph). Their significant technological achievement was the RETD (Special Data Transmission Network), conceived as a network of general-purpose universal access using packet switching. The recent privatization of Telefonica has influenced the evolution of telecommunications equipment suppliers. My primary objective is the study of the competitive advantages of Telefonica using data from *OECD Communications Outlook*. I also study the changes in the relationships between Telefonica and its old industrial companies and explain the internationalization of Telefonica as a process-based relationship of mutual trust between "technological groups" (similar to business groups).

The study of Telefonica is the study of the transformation of a business from one model into another, and the consequences of that transformation. The Spanish telecommunications carrier is receiving increasing international recognition because this process has been one of the most effective examples of internalization among the OPTS (Plain Old Telephone Services). Telefonica is among the top twelve telecommunications service providers in profits with one of the highest productivity indices in the world. In this article, I quantify and compare Telefonica's success to that of other telecommunications carriers.

From Closed Model to Open: The Endogenous or Domestic Model

Since of the end of the nineteenth century, the typical telephone carrier has fit the paradigm of natural monopoly theory and the concept of a

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URL: http://www.thebhc.org/publications/BEHonline/2003/Lopez.pdf

representative firm.[1] Two characteristics contribute to these qualities: the need for a major investment in fixed capital and a network telecommunication system where the costs decline as network connections grow. The context for this typology is the domestic market. Geography determines the economic scope of a country's telephone company. "Universal service obligations" justified economic policy and the franchising of a government monopoly to a private or state-owned company. However, the more dispersed the population, the more difficult it was to provide universal service.

These characteristics made telephone companies state monopolies. Telephone companies were associated in many countries with post and telegraphy activities, usually state owned, bringing about the PTT (post, telegraph, and telephone).

Telephone companies had three concerns about having their monopolies broken during the 70 years before that occurred. The first was that a communication technology based on electromagnetic waves would make communication possible without the use of cables. The second was that a competitor would design a cable with more capacity or much cheaper installation. The third was that a technology allowing increased traffic over the same cable would be developed. Such developments would diminish or eliminate the scope of a carriers' economies. This was true of the coast or the desert, especially where these coincided with the border of the operator's home country. Laying a long distance cable without intermediate links that fed the scale economies in the network was the most expensive investment.

During the Golden Age of Capitalism (1945-1973) telecommunications carriers controlled the suppliers of cable, switches, receptors, and COS (Central Office Switching). The carriers used suppliers to develop technologies to increase the width, flexibility, and length of the cables, also enhancing the quality and quantity of transmissions. This not only gave them advantages in the domestic market, but they used the control of technology to indirectly control operators in developing countries that were using the same telecommunications components. A strategy where telecommunications companies are public monopolies, technological developments are incremental, and where the operator controls a group of firms, had been termed an endogenous model.

This model started to wane in the mid-1970s when some countries reached the functional limits of their networks and existing intercontinental cables. Indeed, by the beginning of the 1980s the investment rate in telecommunication infrastructure had peaked in OECD

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[1] Alchian explained the problems of the idea of representative firm: "'representative firm' is not a typical of any one producer but, instead, is a set of statistics summarizing the various 'modal' characteristics of the population. Surely, this was an intended use of Marshall's 'representative firm.'" Armen A. Alchian, "Uncertainty, Evolution, and Economic Theory," *Journal of Political Economy* 58 (June 1950): 217.

countries with the highest line densities (fifty or greater for each hundred inhabitants). This was true of the Scandinavian countries, Japan, and the United States, where there were eighty lines for each hundred inhabitants.[2] At the same time, research and development (R&D) laboratories were updating multiplex technologies to increase transmission capacity. However, those technologies, although computerized, suffered from diminishing returns.[3] Although improving multiplex seemed an advantageous decision in 1980, when most companies were doing this, it was a technological dead end. What we characterize as an open or global model was taking off.

The Open or Global Model

The open model has two bases, one technical (fiber optics, microwaves, and packet switching) and the other institutional (the acceptance of communication using open standards—linking to packet switching—and economic policy that favors deregulation and privatization). From both technological and economic points of view, the universe of copper lines, multiplexing, and monopolistic OPTS was not competitive with the new open model.

In the first half of the 1970s, the leaders for change were the Japanese firms (the communication monopoly NTT and Fujikura, with the development of fiber optics), and the North American company MCI (Microwave Communications Inc.), with the first microwave networks (the beginnings of mobile telephony) and creators of packet switching. Two events in the United States changed the point of view of governments around the world:

a) MCI created pressure on American Telephone and Telegraph (AT&T) in 1972 by getting the first Federal Communication Commission (FCC) licenses for independent satellite networks for calls and television programs, breaking the monopoly AT&T had since 1932 over the interstate domestic and international network of the United States. In 1984 AT&T was broken up into a long distance operator (which retained the name AT&T, but which had competition form MCI and Sprint) and seven regional companies (the "Baby Bells" or RBOCs [Regional Bell Operating Companies]).
b) In 1973 and international connection signaled the beginning of the Internet (ARPANET) with Europe.

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[2] GHESA (Gibb and Hill Española, S.A.), *Diagnóstico de la situación actual española en investigación y desarrollo dentro del campo de las telecomunicaciones* (1985), Centro de Estudios del Transporte y las Comunicaciones del Ministerio de Fomento, Madrid, 12.

[3] The diminishing returns in technologies are known as Wolf's law; see Santiago López, "De exploración con Schumpeter" in, *¿Qué intenten ellos? Tecnología, empresa y cambio económico en la España contemporánea,* ed. Santiago López and Jesus Maria Valdaliso (Madrid, 1997), 85-118.

The first event had its origins in 1950 with the application of microwave technology to long distance communication. Marconi would have liked to have had this technology when he faced the Post Office. It was similar to having a transfer and receiver radio connected to a communication tower network, which at the same time was able to connect with the telephone network. By the end of the 1960s MCI had the technology that was responsible for the end of AT&T's monopoly in the United States, and as a result, of all telephone monopolies. With its microwave technology, MCI could "jump" AT&T's copper lines. AT&T (or any other OPTS that had installed a network) lost its natural monopoly, because its advantages of size and scale disappeared.

The second event actually dated to ARPANET, the origin of the Internet, which began in 1969. Packet switching was the alternative to service switching, where the carrier essentially rented a line in its network to offer services of data transmission between two or more points. Thus, the operator had total control of the network lines and administrated that service from a COS (Central Office Switching). Packet switching meant that data transmission (imagines, sounds, and text) could be broken into pieces and sent out though a network with a code indicating its point of arrival, where it is put together again in the terminals. The domestic and international distinction became meaningless in the telecommunication business. However, many companies kept acting like a "nearsighted grasshopper" in the world of copper lines and multiplexing, not wanting to see the light of the fiber optics and packet switching. The copper and coaxial cables and multiplexing were a physical framework that held the monopoly, the interventionist policy, and the domestic model. Some carriers eventually reacted and the first packet-switching networks arose in Europe 10 years after those in the United States.

Packet Switching and the End of the Domestic Model in Telefonica: An Economic Perspective

In the context of these technological changes it is important to understand the blueprint of the RETD (Special Data Transmission Network) and its follower Iberpac. In both cases, its design and the way in which Telefonica organized relations with its equipment suppliers were crucial.

RETD, 1970-1980: The Design

In the 1960s, in Spain as in the rest of the world, data transmission was available through telephone lines that used circuit or service switching (employing a line between a transmitter and the receptor). There were two technological requirements for offering this service: strong modems capable of quickly changing digital signals to analog ones (a simple technology soon used by Spanish companies) and a line capable of carrying huge quantities of bytes, dependent on the average quality of the cables the operator had installed. The first users in Spain were the U.S. Air Force (for data transmission between military bases), banks (in

particular, Banesto and La Caixa de Barcelona for sharing data between branches), Hidrola (the electrical company), and Iberia and Renfe (for booking tickets between offices or stations and their headquarters).[4]

By the end of the 1960s Telefonica worried that its telecommunication monopoly could be broken up if the main computer companies such as International Business Machines (IBM) and Sperry Univac, installed circuit-switching systems for their clients. Telefonica sent a team to the United States to study ARPANET, and soon learned about packet switching. Telefonica requested that the Spanish government allow it a data communication monopoly between computer terminals and networks because it had successfully tested this type of transmission.

Packet switching allowed Telefonica efficient use of the economies of scope of its entire network. The franchise awarded in 1970 was not exclusive, however, but shared with the state-owned company ENTEL, which Telefonica would later absorb. When that occurred, there was again a monopoly of Spanish telecommunications, but with an important technological improvement.[5]

The service started in 1971 under the name of RETD.[6] It was an immediate success and by 1974, demand exceeded all expectations. Telefonica had no incentive to reduce prices and costs by improving the RETD, because it was the first operator in the world to offer this service and the features exceeded consumers' expectations. However, by 1976, these advantages had disappeared and clients began to criticize the speed and flexibility of the service. Problems arose because, as a monopoly, Telefonica had not kept investing, and had paid little attention clients other than banks.

Banks demanded only simple data transmission (quick orders and annotations), and did not want high-speed transmission, or the transmission of a huge amount of information. Although Telefonica offered RETD to all users, they had designed it for the privileged commercial customer. In monopolistic situations demand preferences are unknown. Thus, the interests of lobbies that influence the market in different ways slow down technological improvement. Under the protection of out-dated regulations, Telefonica adjusted the RETD to the specific requests of the banks, betraying their obligation to provide

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[4] Telefonica, *25 años de transmisión de datos* (Madrid, 1998), 19-22.

[5] Order 35867/ 22 Dec. 1970.

[6] Gabriel Alarcia Ortíz, "Una solución integrada para los problemas de transmisión de datos," paper presented to the *Congreso Nacional de Informática y Automática*, Madrid, Oct. 1975; Carlos Alonso Segura, "En busca del tiempo perdido," *CHIP* (16 July 1982): 26, and Luis Lavandera, "Arquitectura, protocolos y prestaciones de la Red Española de Transmisión de Datos RETD," paper presented to the *CIL 79 Convención Informática Latina,* (July 1979), Barcelona.

common and universal service.[7] Small computer companies were the most displeased. These provided services such as program transmission and accounting, which needed faster switching and a network capable of transferring more information per second in time-sharing conditions. Thus, from 1976 to 1978 the RETD came to a standstill.[8] Without knowing all user preferences the monopoly's solution is to increase the scope economies in the way it was already developing: big users with a huge quantity of very small operations.

Telefonica had lost its initial worldwide advantage. It had to admit that its network was not an open and universal service and that it was not like a telephone line. The Government chose to allow switching data transmission networks, but with a penalty of 40 percent of the cost in favor of Telefonica. No one made alternative networks.

The Equipment Suppliers

From the beginning of Telefonica in 1924 until the end of the 1960s, International Telephone and Telegraph (ITT) was Standard Electrica's technological partner and main supplier.[9] In the 1960s, ITT was interested in improving telecommunications by using electro-mechanical systems. This was a complete disaster. These systems were not useful for data-switching. At the end of the 1960s, ITT was able to offer Telefonica a system for data transmission. Finally, in the 1970s ITT designed System 12. Although a digital technology, it was incapable of data transfer. In the meantime, Telefonica created an industrial group to diversify technological offerings with Intelsa (Telefonica with Ericsson), Telettra (Telefonica with Telettra Spa), Cables de Comunicación (with General Cable), and Elasa (which would later become part of Siemens). Telefonica united two important aspects of it operations to develop the RETD: first, its research and development (R&D) department, which would become important in deciding the firm's technological direction and the previously mentioned ENTEL (software and telecommunications).[10]

With this suppliers group Telefonica fulfilled its needs as a traditional operator and the small demand that initially prompted the

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[7] Strategies to skim the cream-business users appeared in Jean-Jacques Laffont and Jean Tirole, *Competition in Telecommunications* (Cambridge, Mass., 2000), 3.

[8] Even in 1976 Commercial Department in the United States considered the RETD as one of the most advanced network in the world.

[9] Standard Eléctrica, *Standard Eléctrica S.A. La primera empresa española de telecomunicación* (Madrid, 1966) and Carlos Alonso Ortíz, and Perú Erroteta, *Auge y caída del imperio ITT en España* (Madrid, 1982); Luis Arroyo, *La vida en un chip* (Madrid, 1985).

[10] Crisanto Plaza, "La Compañía Telefonica," *Papeles de Economía Española* 38 (Jan. 1989): 390-408; Luis Arroyo, *La vida en un chip,* 166-168; CTNE, *Los servicios telemáticos,* and Telefonica, *25 años de transmisión de datos* (Madrid, 1998).

RETD. However, increasing demand led Telefonica to create Secoinsa (hardware and computers) as well as INI (Instituto Nacional de Industria, the state-owned holding). Telefonica needed a firm to mass-produce the new terminals and components of the RETD. In 1960, Telefonica stopped depending on just one technological supplier, which led, in 1975, to an industrial group with its own technology.

Iberpac [11]

The Design. Telefonica reacted in 1978 to its out-of-date technology. It created a task force to redesign the RETD with the aim of being a genuine transmission network open to all kinds of clients. By then, they knew the network design they needed. The challenge was for the industrial group to make the network. However, they would not begin until 1982, which meant a certain delay for other European networks.

The Building. The technological base of the new network would be ENTEL's software and Secoinsa's hardware. Telefonica needed a large computer company; they absorbed Telesinco (the only Spanish one) through Secoinsa, but this was not enough. For the main equipment, they needed an international computer company and made an alliance with Fujitsu, which ultimately controlled Secoinsa. Most of the large Spanish banks became shareholders in this new project.

By 1982, Telefonica once again had an up-to-date data transmission network. This time it was supported by an industrial group with significant technological capacity. Telefonica R&D was gaining more importance in the firm's decisions on future projects.

The Iberpac served as the letter of introduction for the internationalization of Telefonica. In 1983, the ARPAC was installed in Argentina with Telefonica's technology. In the mid 1980s, Telefonica held 40 percent of Sintel, the Argentine telecommunication monopoly. They exported the Iberpac system to Chile, Mexico, and the USSR, and in 1988, Electronic Data Systems distributed it in the U.S. market.[12]

By the late 1980s, Telefonica's problem was Spanish demand, where the spread of service was low in relation to Iberpac's resources.[13] Telefonica, unlike the European carriers, had not undertaken the digitization of telephonic networks.[14] The R&D unit became so important

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[11] CNTE (Compañía Nacional Telefonica de España), *Los servicios telemáticos* (Madrid, 1984).

[12] Luis Solana, "La estrategia internacional de Telefonica de cara a los años noventa," *Nuevo Siglo* 3 (May 1988): 5-12; Manuel J. Prieto, "Edificios inteligentes, la clave está en las comunicaciones," *Nuevo Siglo* 7 (Jan. 1989): 133-146, and José L. Martín Palacín, "El plan de Telecomunicaciones, un instrumento de clarificación," *Nuevo Siglo* 13 (Jan. 1990): 8-9.

[13] Mikel Buesa and José Molero, *Innovación industrial y dependencia tecnológica en España* (Madrid, 1989).

[14] Mikel Buesa, "Los servicios de telecomunicación en España," *Revista de Economía* 2 (Spring 1989): 80-84; Mikel Buesa, "La difusión de las tecnologías

that it became a new firm: *Telefonica Investigación + Desarrollo* (TI+D). Fujitsu turned out to be a bad technological partner because it was unable to transfer technology, so Telefonica shifted its attention to the strongest supplier, AT&T. Through TI+D, Telefonica created the firm *AT&T Microelectrónica de España*.

Combining technological change with liberalized institutional change promotes mergers and alliances. Two characteristics make this process an open model: a carrier's need and capacity for expansion, and the end of stable relations with certain suppliers.[15]

The Open Model: The Deregulatory Movement and the Privatization of Telefonica

An ideological, academic discussion did not precede Spain's change from a closed to an open model. Institutional change occurred directly. The theoretical economic discussion began in the United States with Coase's article about the Federal Communications Commission (FCC).[16] This discussion, along with technological changes, led the U.S. Government and the FCC to support the liberalization of telecommunications in the 1970s. After 1975, assumptions about deregulation and liberalization began to be discussed in Spain.

In 1981 the Ministry of Tourism, Transports, and Telecommunication issued the *Estudio Básico*.[17] It was the first attempt to study possible changes in regulation, but even then, the bias was for keeping Telefonica a monopoly. The Ministry stated that the monopoly:

> ...can and must in many cases participate in the complementary service market [data transmission] to guaranty the user an integral service... Any competency which appeared in this matter would just be conceive in terms of equally in the Government regulation,

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de la información en España," *Información Comercial Española* 665 (Jan. 1989): 82-101.

[15] "Regulatory changes also play a fundamental role favoring innovation. On the one hand, market liberalization measures remove obstacles to the exploitation of technology and open up new market opportunities for service suppliers (equipment purchasers). On the other hand, changes in institutional frameworks may also positively influence the rate and direction of innovations, as was the case of technological evolution in the field of transmission equipment during the 1960's an early 1970's." Antonello Zanfei, "Changing Competitive Behaviour in the Telecommunications Industry," *Revue d'Economie industrialle* 62 (1992): 85. Quiros and Picazo also empirically checked the positive relation between productivity increase and scale efficiency in privatized operators and in markets without a monopoly, Cipriano Quiros, and Ándres Picazo, "Liberalización, eficacia y cambio técnico en telecomunicaciones,"*Revista de Economía Aplicada* 25 (Spring 2001): 77-113.

[16] Ronald H. Coase, "The Federal Communication Commission," *Journal of Law and Economics* 3 (Oct. 1959): 1-40.

[17] MTTC (Ministerio de Turismo, Transportes y Comunicaciones), *Estudio básico. Política de telecomunicaciones en Españ,* 1981, documento MTTC.

> universal service obligation, using national technology, optional franchises, networks need to be interconnected, etc. Only in this way it can be hoped to assume the risk which is united to the huge investment amounts needed for the introduction of the advanced range of new services.[18]

The justification for a monopoly was that Iberpac was an industry in its infancy. However, the infant industry had existed in the form of the RETD from 1970 and 1975, followed by a technological delay. By 1981, France, Germany, the United Kingdom, and Holland had similar pre-Internet networks and the connection with ARPANET from the United Kingdom had existed since1973. The *Estudio Básico* used this argument to defend the integral monopoly of all these services. They defended the French model, Minitel, a second-generation pre-Internet network. However, the Internet was spreading and was going to eliminate national borders. Its spread was global and unstoppable because no one owned this network of networks, into which anyone could enter through packet switching. The return of the monopoly and independence could occur only through circuit switching, which would mean isolation and a return to 20-year-old technology. The logical policy at that time was to connect with the Internet coming from the United States. This meant breaking down domestic monopolies.

Iberpac continued to develop and the *Estudio Básico* was forgotten. Packet switching already prevented the reinforcement of the monopoly. By 1985, the reality was so obvious that Spain took the first step to deregulation and liberalization of the monopoly, following in the footsteps of the United States and the United Kingdom by separating the operator from the regulator, which took place through creating the Secretaría General de Comunicaciones.[19] In the European Union, countries were already putting these measures into practice. Since the incorporation of Spain in 1986, the Administration had only to recognize the European commitments. The clearest example was the Law LOT 31/1987 (Ley de Ordenación de las Telecomunicaciones).

In 1987, the European Commission issued *The Green Book* covering the development of common market services and telecommunication equipment. Some of the ideas in *The Green Book* were included in the LOT. In the beginning only the so-called "added value services" and equipment supply were liberalized. It was the end of the monopoly and the beginning of a new phase of intense competition.

In 1992, with the modification of the LOT came the liberalization of mobile services. The issuing of new licenses for data transmission in 1993 ended the monopoly of Telefonica and its Iberpac. The period from 1994 to 1998 saw new franchises, regularization of cable communication, and creation of an organization independent of the Government to regulate the

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[18] MTTC, *Estudio básico,* 242.

[19] Rodrigo Keller, "Las telecomunicaciones: del monopolio a la competencia," *Información Comercial Española* 740 (April 1995): 31-45.

telecommunications market (the CMT—Comisión del Mercado de las Telecomunicaciones).[20] Finally, in 1998, the Law *Ley General de Telecomunicaciones* ended the liberalization of the sector from a normative point of view. It built a market with three basic operators: Telefonica, Retevisión (born of the divestiture of the monopoly of the domestic television network TVE) and Lince Telecomunicaciones Ltd. (Uni2). Thus, the main European operators behind these firms entered the Spanish market: France Télécom, Telecom Italia, and BT.

The privatization of Telefonica took place during this time of liberalization and deregulation. The sale of shares to private agents began in 1995 and ended in 1997. However, the Government gave Telefonica advantages in an oligopolistic market until 2005. These advantages stem from an exclusive concession to the "universal service obligation." This provides Telefonica with better conditions than other firms in dealing with the Government. In compensation, the Government decides who will be company president and approves any mergers that take place (gold share).[21]

The Globalization of Telefonica

The internationalization of Telefonica started at the beginning of the 1980s when the OPST's of Argentina, Chile, and Mexico bought the Spanish solution to data transmission. The innovation of RETD-Iberpac and Telefonica's ability to do business in Spanish created the competitive and comparative advantage that led to the foreign market. All old OPTS began a similar process of globalization. Perhaps what made Telefonica different (and stronger) was that it was not offering a whole communication system as the big European carriers did, but only data transmission with a cheap infrastructure, and in Spanish.

The systems were compatible because the equipment suppliers had become self-supporting with respect to a specific OPTS and were preparing for the global capability coming from the United States and Canada with Motorola, Cisco Systems, Lucent Technologies and Nortel. The multinational companies were organizing as global firms. They no longer wanted companies in different countries with stable agreements, as they had as multinationals. Now they wanted the same company to serve different businesses all over the world.[22] The old ways were not necessary in a world where the main economies were open markets.

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[20] Law 6/1996 and 12/1997, MCYT (Ministerio de Ciencia y Tecnología), *Los servicios de telecomunicaciones 1998*, 1998, URL: **http://www.mcyt.es/grupos/grupo_biblioteca.htm**.

[21] MCYT, *Los servicios de telecomunicaciones 1998*.

[22] Borreau and Doğan show the relationship between closed system and "predatory product innovations and complementary component incompatibility" and open system when "allow second-sourcing provisions of complementary products." Marc Bourreau, and Pinar Doğan, "Regulation and Innovation in Telecommunication Industry," *Telecommunications Policy* 25 (2001): 167-184.

However, as years passed, Telefonica could not maintain its technological success with Iberpac as its only leading industrial group, headed now by the firm Amper. Secoinsa was sold to Fujitsu and Bull, Elasa to Siemens, and Standard Eléctrica (ITT-Telefonica) to Alcatel.[23] Its past mergers or partnerships with Ericsson, AT&T, and Fujitsu became strategic ended with the companies just becoming clients. Telefonica in the mid-1980s carried out a clear outsourcing strategy. In these years, Telefonica and Telecom Italy began to catch up with the main European OPTS in productivity and efficiency ratios. Together with BT they improved their starting positions and became approached the efficiency of France Telecom and Deutch Telekom in some ways.[24]

At the end of the 1980s Telefonica was:

a) completing the spinoff off its industrial group,
b) giving priority to its company TID (Telefonica I+D) to design strategies associated with technological change,
c) changing the size of the staff to meet the new conditions associated with providing higher speed communications than other European OPTS.

In the beginning of the 1990s, the Spanish part of Telefonica (*Telefónica de España*) was a step behind the group Telefonica due to its low productivity. However, they began an intensive downsizing. Telefonica went from 74,500 workers in 1990 with a productivity of 167 lines for each employee to 41,000 at the end of the decade, with 490 fixed lines per employee, highest productivity of the European OPTS and comparable to U.S. companies[25]. This led to one of the best cost/ benefit ratios per employee among the main OPTS of the world (Figure 1).

In the mid-1990s Telefonica had several advantages: a cheap and compatible technology; many small Spanish companies that could go with Telefonica to the foreign market and offer solutions; productivity and proficiency ratios equal or better to the European OPTS (apart from its investment in R&D); and an investment capacity derived from its capital accumulation during its years as a monopoly and its good relationships with Spanish banks.

In discussing Telefonica's technological advantages, along with its potential as an investment we conclude by noting its great competitive advantage: the high investment capacity embedded in an acceptable

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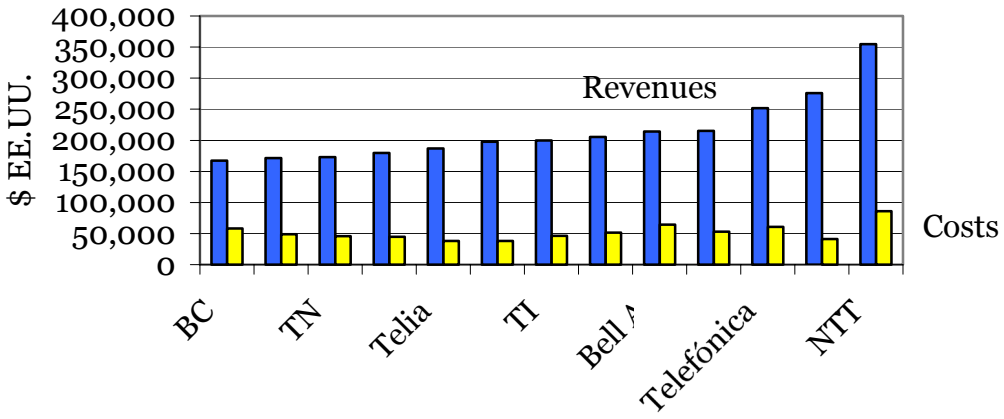
[23] About the technological problems of ITT in Antonello Zanfei, "Changing Competitive Behaviour in the Telecommunications Industry," *Revue d'Économie Industriaelle* 62 (1992): 83-105, 94.

[24] Giovanni Franquelli and Davide Vannoni, "Multidimensional Performance in Telecommunications, Regulation and Competition: Analysing the European major Players," *Information Economics and Policy* 12 (Mar. 2000): 27-46, 37.

[25] Cristano Plaza, "Análisis mundial 2000. Año de claroscuros," in *Informe anual de las telecomunicaciones y tecnologías de la información 2001*, ed. Cristano Plaza (Madrid, 2001), 11-70, 17-55.

FIGURE 1
Revenue and Cost by Employee in 1997



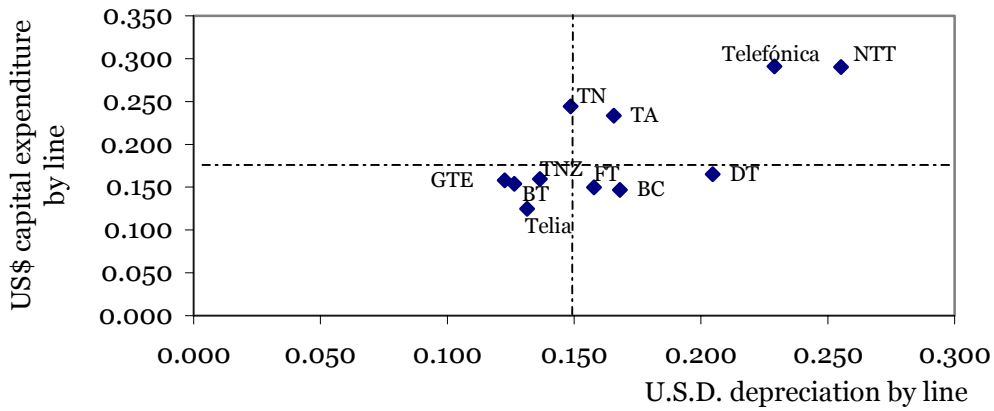
Source: OECD Communications Outlook BC (Belgacom), FT (France Télécom), TN (Telenor, Norway), TA (Telstra, Australia), Teleia (Sweden), DT (Deutsche Telekom), TI (Telecom Italia), BT (United Kingdom), Bell Atlantic (United States), Ameritech (United States), TNZ (New Zealand) Telefonica (Spain), and NTT (Japan).

technology derived first from the maintenance costs of its network (depreciation) (Figure 2), and, especially, its high productivity (Figure 3). We see from both indicators that Telefonica's behavior in the second half of the 1990s was surprising, with ratios typical of NTT, and much better than its European counterparts. In 1995, Telefonica was not in a better position than the rest, apart from NTT, although it was already surprising that its high productivity made it comparable to companies technologically more developed, such as Telia or BT. But the important point was its increase in productivity, where its 607 lines for employee was a figure that only some companies in the United States, such as Bell Atlantic, Bell South, Ameritech, or SBC Communications, could offer.

Conclusions: Possible Reasons for Success of the "Technological Group"

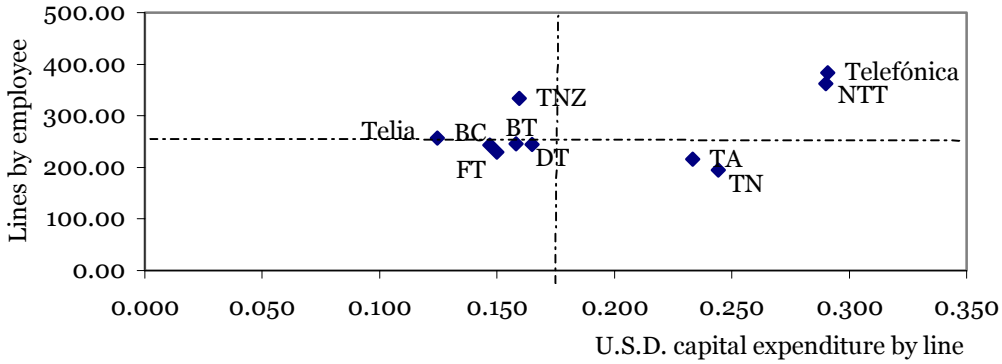
The Simple Answer: Productivity. The reasons for the technological group's success from 1970 to 2000 include: technological innovation (RETD), liberalization and globalization of the industry, an open model of relationships with the suppliers, and the high productivity and investment ratios of the operator. Of course, success is relative and depends on one's point of view.

FIGURE 2
Capital expenditure / depreciation (1995-1999)



Source: OECD Communications Outlook

FIGURE 3
Productivity / Capital expenditure (1995-1999)



Source: OECD Communications Outlook

From the managerial point of view, which was essential to the whole process, the reason for success was technological innovation. If innovation is the basis for success, how and where was the change instigated and organized? We maintain that this occurred the moment Telefonica bet on packet switching in the early 1970s, not when European norms incorporated it in 1987. This has not been a linear process with a constant increase.

The Complex Answer: The "Technological Group" TID. Who at Telefonica directed the change? We return to our conclusion that innovation is the basis for change and that it is led by direct innovators. At Telefonica, the innovators were in the R&D department until 1987 and thereafter in TID (Telefonica Investigación + Desarrollo).

TID is a research firm with a staff of 1234 workers (in 2002), most of whom have degrees and are researchers (93.6 percent). It is the largest concentration of researchers in the country dedicated to a specific task,

accounting for about nine percent of all the private research in Spain. Its most important strategies come from the Telefonica group and from domestic (Spanish) suppliers. In our opinion, these relationships are the base of a "technological group" generated from TID.

What does TID do in Telefonica? It fills a role similar that which Bell Laboratories performed for AT&T until the 1984 divestiture. TID identified the new products that the company was going to sell, and designed the business to maintain the monopoly. TID has also been the main source of Telefonica's top managers since the 1990s. TID transfers its routines and methods to Telefonica as a whole, where its managers lead all the units of the firm. For an R&D department TID is small. However, it also controls indirectly, through Telefonica's huge demand, the research done by the small domestic firms.

Secondly, what does TID have to do with the national firms? This group was formed from three kinds of firms: First, the old companies of the group Telefonica of the 1970s and 1980s that became private. Amper would be the most representative; second, small, innovative companies that have always been private but maintained a close relationship with Telefonica because it was the main source of demand for their products (for instance, Eliop, Teldat, and Mier); third, divisions of firms created in the 1970s by the international groups (AT&T– Lucent, Siemens, Ericsson and Alcatel – ITT-Standard Eléctrica) whose components were integrated into the previous groups.

The domestic companies accomplished the expansion of Telefonica by acting, in some ways, as business units in the production of specific components and services for the domestic market in which the operator is spreading. The important work of TID in the expansion of Telefonica was first in the implementation of the productive processes that needed renovated or to be put into practice by the domestic operators who were sold a solution or merged with the company. TID had two results: first it provided the mechanism for exporting solutions not of its own making, and second, it helped shape the exports of products and services of the domestic firms that wanted access to this opportunity. But, why did Telefonica and the Spanish firms collaborate with TID and assume its control?

The Theoretical Concept of "Technological Group"

A technological group is a business group where instead of members joining each other by family, ethnic, or religious links as happens in a business group, they join because they share the same concept of how to use a new technology. In our case, this new technology is the use of "open code" in telecommunications. The alliance in a technology group goes beyond the firms where the members work. Cooperation is not based on market prices, but on trust. As a result, as in a business group the technological group goes beyond the traditional ranking of market and

firm, but is more akin to the trust relationships of flexible production and industrial districts.

In a technological group, specific relations and organizational forms shape individual conceptions about technology. Thus, technology is more a social construction and less a result of exogenous impact from scientific advances.

To create a technological group one needs a trust network and something to trust. As for something to trust, here the technological group trusts the open communication systems as non-hierarchical. Trust in packet switching and in open codes makes vertical control of communications impossible. The philosophy behind technological groups is based on how a technology is understood.[26] With respect to a trust network, Mark Granovetter, in his description of what it means to be a business group, points out two characteristics: there must be a federation forming a network, although this is not explicit, and they must take part in the daily management of the firms.[27]

A technological group maintains these principles, but it never has a legally establish network, nor is associated with a permanent number of companies, so it works as a moving or evolving coalition. The advantage of a technological group is in maintaining market relations without losing trust.[28]

The technological group has smaller transactions costs in contrast to the cost of maintaining associations or contracts such as joint-ventures; it offers the advantages of market relations with a certain trust level among the companies involved. It is more efficient than collaborative ventures.

The Technological Group TID

TID was formed through subcontract relations (outsourcing), the creation of spin-offs, contracts with the industrial group's old firms, and agreements with multinational groups and from TID it was possible to create an informal network whose evolution answered the need for

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[26] In its more radical form, this philosophy defends the free circulation of the information (open code), Lawrence Lessing, *The Future of Ideas: The Fate of the Commons in a Connected World* (New York, 2001).

[27] Mark Granovetter, "Business Groups and Social Organization," forthcoming.

[28] The nature of the technological groups seems odd but Chandler, who is not impressed with theories of business groups, actually described a technological one in his description of the history of managerial capitalism. There he showed how the groups of managers who were being imposed on firms by analytical accounting systems were part of a network and developed their concepts, management routines, schools, and associations from their experiences in the creation and management of the rail system. Alfred D. Chandler, Jr., *The Visible Hand: The Managerial Revolution in American Business* (Cambridge, Mass., 1977).

external changes from technology, globalization, legislation, and internal changes in the companies.

This structure makes sure that individuals who are identified with the group in and out of the firm TID do not have to have a strong control over the technology and over the companies. Opportunistic behaviors among the companies are also mitigated because the TID is such a small influence, the market insures that no company acquires another, and individuals within the companies try not to damage the interests of the technological group.

Why would companies such as Telefonica sponsor a more structured relationship network than the one produced by the contracts in the market? The spread of such networks produces four benefits:

> a) Better control of technological information.
> b) Reduced uncertainty. The technological group's new structure gives it allies against changes in demand (this is especially attractive for one operator).
> c) They can face changes in the strategy of states in an atmosphere of regulation. Telefonica does not exist as a multinational company, but rather as a network of companies anxious for increasing the network with more contracts and more firms in domestic markets.
> d) Telefonica in supporting the technological group sends the market a signal that it wishes to collaborate with individuals in firms using similar technological concepts.

These benefits keep the group growing.

The group facilitates more efficient expansion by more effectively reducing cultural distance by relying on previous trust networks (based on individuals who share the same technology, in our case, open code), by playing down its importance to macroeconomic differences among the countries (grow rates, unemployment, inflation, etc.) by stressing the relationship among like-mined individuals, by being able to take on more risk, using its trust relations to reduce opportunistic behavior by companies in the network, and by having greater flexibility in dealing with the risks associated with changes in governmental policies, because it can use the market to quickly change interest networks inside the countries, rather than through negotiation as traditional allies do.[29]

This description is nothing more than a reflection of the way the group is organized. In the same way that managers and executives described by Chandler gave origin to modern firm forms, especially the multidivisional one, these managers and executives are creating other kinds of technological groups using analytical accounts.

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[29] Kashlak, Chadran, and Di Benedetto point out these costs and risks in the contracts among telecommunication companies and governments. Roger J. Kashlak, Rajan Chadran, and C. Anthonly Di Benedetto, "The Internet: a Paradigmatic Rupture in Cumulative Telecom Evolution," Journal of International Business Studies 29 (June 1998): 281-304.

Authors such as Hagström and Hedlund say that nowadays a new form (N-form) would be generated, less hierarchical, and closer to the knowledge economy associated with new industries such as telecommunications.[30] If this is true, there must be cases of technological groups that have created N forms and whose behavior will be similar to the technological group associated with TID.

Verification: Two Similar Cases of Technological Groups: Ellemtel and Biogen

Ericsson began development of the AXE system in 1960 in an attempt to use computers to replace electromechanical switching. This structure broke with the vertical telecommunication organization.[31] In 1970, the failure was notorious, and it took until 1976 when Ericsson and Swedish Telephone created a joint venture, called Ellemtel, to strengthen the AXE project. This time they were successful. The key factor was management of Ellemtel in accordance with the architecture of the AXE system [32]. It was this way, with firms changing and mixing the U and M forms, that the network was born. AXE was a revolutionary system because it established a communication network, which distributed different functions through the network, finally reaching the consumer. Similar to packet-switching, this was considered a substitute for an analogical telephone network. The system spread to fifty countries, resulting in Ericsson adopting the architecture of the AXE network as its organizational form.

TID and Ellemtel are too similar to be just the result of simple maximizing behavior of companies such as Telefonica or Ericsson. Technological groups create the N forms, which are also based on sub-contract networks, and spur the growth of their companies by introducing them to the open code concept and to intercommunication among individuals in a changeable network. In this way they transform the organizational structures and the contractual relations among the companies in the market and technological change brings new

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[30] P. Hagström, and G. Hedlund, "A Three-Dimensional Model of Changing Internal Structure in the Firm," in *The Dynamic Firm: The Role of Technology, Strategy, Organization, and Regions*, ed. Alfred D. Chandler, Jr., Peter Hagström, and Örjan Sölvell (New York, 1998), 166-91.

[31] Petros Kavassalis, Richard Jay Solomon, and Pierre-Jan Benghozi, "The Internet: a Paradigmatic Rupture in Cumulative Telecom Evolution," *Industrial and Corporate Change* 5 (1996), 1097-1126, 1103.

[32] H. Ledin, "Building a Dynamic Intelligent Network: Lessons From The Telecommunications Revolution for MNC Organization of the Future," in *Managing the Global Firm,* ed. Christopher A. Bartlett, Yves Doz, and Gunnar Hedlund (London, 1990), 326-53.

organization forms.[33] In our case packet-switching brought the N form and the technological groups associated with it.

In telecommunications, information technology, and biotechnology, alliances based on cooperation in order to share knowledge have been well known. Networks have been formed linking university centers and business units of companies, where the flow of academics and concomitant financial resources are typical. Powell illustrates such networks in biotechnology with the Biogen case.[34] In this case, as well as that of Ellemtel and TID, there is a common denominator, a motivation that encourages members to develop the network and fight for the field against the multidivisional company. In the case of biotechnology, making knowledge about the genome public and accessible is the same as the case of open codes in telecommunications. In times of uncertainty, the company is ready to sacrifice part of its hierarchical organization to get access to knowledge in the open network.[35] Thus, the *technological group* would create or participate in collaborative ventures, industrial districts, companies' networks, and in every kind of flexible organization.[36]

However, with time, technological uncertainty develops in a fixed system, options are reduced, and the multidivisional firm is reborn from collaborative networks and again imposes its optimization efficiency.[37] Thus, technological groups become out-dated or go into hibernation.

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[33] Richard R. Nelson, "The Role of the Firm: Differences in an Evolutionary Theory of Technical Advance" in *Evolutionary and Neo-Schumpeterian Approaches to Economics*, ed. Lars Magnusson, (Boston, 1994), 231-42.

[34] Walter W. Powell, "Inter-Organizational Collaboration in the Biotechnology Industry," *Journal of Institutional and Theoretical Economics* 152 (March 1996): 197-215. **URL: http://www.biogen.com/site/content/index.asp**.

[35] Powell says that in these situations the scientist-entrepreneur appears, who, in our opinion could be consider as an equivalent figure to the Chandlerian businessman. Powell, "Inter-Organizational Collaboration in the Biotechnology Industry," 200.

[36] Powell thinks about the nature of the collaboration based on Ronald H. Coase, "The Institutional Structure of Production," *American Economic Review* 82 (Sept. 1992): 713-19; Powell, "Inter-Organizational Collaboration in the Biotechnology Industry," 198-99.

[37] ABB had been used as an example of this. Margit Osterloh, Jetta Frost, and Bruno J. Frey, "The Dynamics of Motivation in the New Organizational Forms," *International Journal of Economics and Business* 1 (2002): 61-77, 62. The notion about how technologies can evolve into more rigid technological systems belongs to Thomas P. Hughes, "The Dynamics of Technological Change: Salients, Critical Problems, and Industrial Revolutions," in *Technology and Enterprise in a Historical Perspective*, ed. Giovanni Dosi, Renato Gianetti, and Pier Angelo Toninelli (Oxford, U.K., 1992), 97-118, and "Technological Momentum" in *Does Technology Drive History? The Dilemma of Technological Determinism*, ed. Merritt Roe Smith, and Leo Marx (Cambridge, Mass., 1994), 101-14. For the case of telecommunication Davies can be consulted. Andrew Davies, "Innovation in Large Technical Systems: The Case of Telecommunications," *Industrial and Corporate Change* 5 (1996): 1143-80.