DEREGULATION OF THE TELECOMMUNICATIONS INDUSTRY IN ARGENTINA: A SYSTEM DYNAMICS APPROACH

by

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Submitted to the Sloan School of Management
in Partial Fulfillment of the Requirements for the Degree of

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ABSTRACT

Argentina began the process of privatizing its telecommunication services at the end of 1989. Unfortunately, frequent changes in the rules during the privatization process generated insecurity and scared potential bidders, weakening the bargaining power of the government. As a consequence, the price paid for EN Tel was one of the lowest for a telecommunications company in the developing world. Moreover, the privatization of EN Tel has resulted in a legal duopoly, that allows two companies to manage the entire local, long-distance and international telephone service. Between 1997 and the year 2000 the Argentine government will begin the process of deregulation of the telecom industry.

The objective of this thesis is to develop a system dynamics model of the Argentine telecom industry deregulation process. The model will quantify dynamically the key sectors, macroeconomic, political and institutional environment. In addition, the model will represent and quantify dynamics of competition in the telecom industry and their interaction with the key sectors.

Essentially, the challenge of this thesis is to identify the regulation policies that would maximize the nation's welfare. This thesis will not intend to forecast the future of the telecom industry in Argentina; it will attempt to understand the dynamics involved in the telecom industry and how these dynamics can drive the nation to different prosperity outcomes.

Thesis Supervisor: Professor Donald R. Lessard
Title: Professor of International Management
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I can't adequately express with words how grateful I am to my family for accompanying me this year. Particularly, I will always be indebted with my wife, Claudia. She sacrificed one entire year of her career to come with me and constantly supported my study. Despite language barriers and an entire new culture, she gave the best of her to our family and facilitated my day-to-day life. I would like to thank specially my two kids, Lucía and Sebastián, who learnt to live with a father that was at home, but not available. It is not a coincidence that today, May 16, 1997, the day I submit this thesis, is Sebastián's first birthday. I want this thesis to be his best present, as a remainder of all the time that I would have loved to spend with him and I couldn't. Be prepared, Sebastián, we have a lot of catching-up to do!

I would like to thank my thesis advisor, Donald Lessard, for his time, support and valuable insights. He has been instrumental in giving conceptual direction to this thesis. I also owe enormous gratitude to my thesis reader, Henry Weil. His experience in telecommunications and system dynamics modeling has been key to achieve a conceptual understanding of the industry.

To all my MOT classmates with whom I had the opportunity to interact daily, my sincere appreciation for sharing your diverse experience and friendship with me. It would be unfair to mention some examples, but I feel the necessity to manifest publicly my thankfulness to Denise Spencer. I will never forget the uncountable hours that we spent together working out infinite papers due yesterday. However, I will always remember the sympathy and warmth she gave to all the members of my family.

To other Sloanies that uninterestedly helped me revising the concepts of this thesis, Eric Rosenblbaum and Rebecca Weil, thank you.

And last, but certainly not least, I thank my parents for their countless advise, continuous support and genuine enthusiasm during my studies at MIT. Thank you Dad for finding time in your busy schedule to gather some data for me.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>SECTION</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABSTRACT</td>
<td>2</td>
</tr>
<tr>
<td>ACKNOWLEDGEMENTS</td>
<td>3</td>
</tr>
<tr>
<td>TABLE OF CONTENTS</td>
<td>4</td>
</tr>
<tr>
<td>1. INTRODUCTION</td>
<td>7</td>
</tr>
<tr>
<td>2. RECENT REFORMS IN THE TELECOMMUNICATIONS INDUSTRY</td>
<td>10</td>
</tr>
<tr>
<td>2.1 Strategic Significance of Telecommunications</td>
<td>10</td>
</tr>
<tr>
<td>2.2 Technological Rationale for Deregulation</td>
<td>11</td>
</tr>
<tr>
<td>2.3 Privatization, Liberalization and Deregulation</td>
<td>12</td>
</tr>
<tr>
<td>2.4 Examples of Countries with Liberalized Telecom Industry: United States</td>
<td>15</td>
</tr>
<tr>
<td>2.4.1 A Historical Perspective</td>
<td>15</td>
</tr>
<tr>
<td>2.4.2 The Break-Up of the Bell System in 1984</td>
<td>16</td>
</tr>
<tr>
<td>2.4.3 The Era of Deregulation: The Telecommunications Act of 1996</td>
<td>17</td>
</tr>
<tr>
<td>2.5 Canada</td>
<td>20</td>
</tr>
<tr>
<td>2.5.1 Industry Structure</td>
<td>20</td>
</tr>
<tr>
<td>2.5.2 Regulatory Environment</td>
<td>21</td>
</tr>
<tr>
<td>2.5.3 The Threat of US Telecommunications Companies</td>
<td>22</td>
</tr>
<tr>
<td>2.6 United Kingdom</td>
<td>23</td>
</tr>
<tr>
<td>2.7 Japan</td>
<td>24</td>
</tr>
<tr>
<td>2.7.1 Industry Structure</td>
<td>24</td>
</tr>
<tr>
<td>2.7.2 Regulatory Environment</td>
<td>25</td>
</tr>
</tbody>
</table>
1. INTRODUCTION

Argentina began the process of privatizing its telecommunication services at the end of 1989. The model chosen by the government for privatizing the public services was that of free competition in the medium term, allowing a temporary monopoly for 7 to 10 years, depending on the licensees' performance. Unfortunately, frequent changes in the rules during the privatization process generated insecurity and scared potential bidders, weakening the bargaining power of the government. As a consequence, the price paid for ENTel was one of the lowest for a telecommunications company in the developing world. Moreover, to make the business more attractive for investors, the Argentine government had to sacrifice, or at least postpone, many of its original goals with regards to the liberalization of the industry. Consequently, the privatization of ENTel has resulted in a legal duopoly, that allows two companies to manage the entire local, long-distance and international telephone systems. Furthermore, the monopoly was extended to include international telecommunication services: international data transmission, international telex and international point-to-point links hired for telephony, data transmission and/or value-added services.

So far, the two operating companies, Telecom and Telefónica de Argentina, have more than exceeded the privatization goals in terms of network expansion and quality of service. Therefore, it seems unlikely that the Argentine government will deregulate any of the telecom services during 1997. However, the government is facing internal and
external pressures to deregulate at least the international service during 1997. In any case, in the year 2000, the entire industry will be deregulated.

Today, the situation of the telecommunications industry is characterized by active stakeholders and anxious potential players, who have begun to merge with other media companies and to lobby to influence the government’s decisions on telecom issues.

This thesis develops a system dynamics model of the Argentine telecom industry deregulation process. The model quantifies dynamically the key sectors, macroeconomic, political and institutional environment. In addition, the model represents and quantifies the dynamics of competition in the telecom industry and their interaction with the key sectors.

The model developed in this thesis allows many different deregulation scenarios to be run based on different combinations of exogenous variables and regulation mechanisms. Essentially, the challenge is to identify the regulation policies that maximize the nation’s welfare. This thesis does not intend to forecast the future of the telecom industry in Argentina; rather it attempts to understand the dynamics involved in the telecom industry and how these dynamics can drive the nation to different prosperity outcomes.

The results from this thesis should be of interest to governments, public and private sector enterprises, foreign and domestic investors, labor and academic institutions and
students who want to understand the applicability of system dynamics to issues that have been traditionally analyzed using static methods. This thesis contains ten chapters.

Chapter 1 provides an introduction, Chapter 2 discusses recent trends around the world in the reform of the telecom industry, Chapter 3 discusses the background of the privatization process of ENTel and its consequences, Chapter 4 describes the system dynamics modeling approach to the deregulation model, Chapter 5 describes in detail the deregulation model, the key sectors and their interaction with each other, Chapter 6 analyzes the model’s base case scenario, Chapter 7 analyzes a series of comprehensive scenarios, Chapter 8 provides the conclusion of the thesis, Chapter 9 contains appendices including the model’s diagrams and documentation and Chapter 10 provides the bibliography.
2. RECENT REFORMS IN THE TELECOMMUNICATIONS INDUSTRY

2.1 Strategic Significance of Telecommunications for a Country

In the last decade the technological revolution, in conjunction with radical transformations in the international economy, have brought the telecommunications industry to the center of the international political stage. Telecommunications is not only important as a communications medium, a provider of income, employment and related services, it also is a vital component of national infrastructure. The industry’s widespread transmission networks and the inexpensive, reliable service that telecommunication companies provide make them indispensable to the development of an economy. Telecommunications allows for the efficient exchange of ideas and data, offers ease in conducting complex business and commerce, and generally serves to keep societies cohesive. Moreover, telecommunications channels have been considered issues of national sovereignty and a key resource in periods of war.

In developing countries, where telecommunications networks are inadequate and incomplete, the telecommunications industry must, aside from continuously improving the services it provides, continually expand its reach. Politicians and decision makers in these countries are consequently faced with the challenge of balancing the interests of key participants (current and potential customers, employees, and shareholders) to guarantee the delivery of a service that is no longer a luxury, but a necessity.
2.2 Technological Rationale for Deregulation

The telecommunications industry in general has historically been an extremely capital intensive industry, with long periods of amortization. Therefore, the existence of competition makes it difficult for the players to recover initial investments and hinders their commitment to further investments. As a result, the idea of a single provider has dominated the industry worldwide.

Today, however, is a different story than a decade ago. The ways in which people communicate are undergoing the most profound changes since the invention of the telephone in 1876. Telecommunication is no longer confined to providing telephone services. Today, there is an ever-increasing (and bewildering) array of new services and new communication options embracing voice, data and video. With the advent of the digital era, there has been an emergence of more sophisticated transmission systems (both wired and wireless) and the development of new transmission channels with ever-increasing capacity (i.e. optic fibers). Most significantly, the merger of telephones with the world of computers and information systems, has expanded the boundaries of communications. The rapid convergence of voice, data and video expands the boundaries beyond the traditional services provided by a few companies. Today, the telecommunications industry includes sophisticated multimedia services offered by new entities that would have been considered outsiders not too long ago. Consequently, this explosion in telecom technological innovation has dramatically reduced the requirements
for large amounts of capital, which has created numerous new telecom companies, fierce competition and the breakup of telecom monopolies.

2.3 Privatization, Liberalization and Deregulation

Recent telecom reforms worldwide have been dominated by three main events: privatization, liberalization and deregulation.

- **Privatization** is a term that has been commonly used to refer to all developments in which public enterprises and operations are transferred from the government to the private sector. Vuylsteke defines privatization as “the transfer of commercially oriented State-Owned Enterprises (SOEs), activities or productive assets of the government to the total, majority, or minority private ownership or to private control”

- **Liberalization** refers to the lowering of entry barriers, to all or part of the market, allowing third parties to compete with established providers of goods or services.

- **Deregulation** was originally conceived as a process through which governments would reduce their intervention in the operation of markets. The dismantling of legal controls would presumably provide the adequate condition for a healthy competitive business environment operating under market laws. In telecommunications, however, experience has demonstrated that achieving fair competition requires the reregulation of the sector

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1 Ben A. Petrazzini, The Political Economy of Telecommunications Reform in Developing Countries
While privatization, liberalization and deregulation are closely linked, they are conceptually different and can be carried out separately.

Privatization is an extraordinary event that can never be indifferent to the stakeholders. From the unions to the SOE managers, the government and the society, all are involved in the process, as the transfer of a public utility to private owners is considered a matter of national sovereignty. Privatization of state-owned industries or services in general has an enormous impact in the social and political life of a country and is generally the starting point for major economic modernization programs.

Liberalization is in economic terms more important than the privatization of a SOE. It basically allows new entrants to compete with established companies. This competition brings enormous welfare for the society, such as reduction in tariffs, new and better services, and primarily the opportunity to choose from several service providers. Furthermore, the liberalization has longer lasting effects than privatization.

Potential private investors in privatization programs expect at least reasonable returns for their investments, to compensate them for the risk of entering a competitive market. Accordingly, the feasibility to privatize a SOE is diminished if the market is already liberalized and there is strong competition in it. On the other hand, the plausibility of liberalization is shallower if it does not precede privatization.
Privatization and liberalization have a strong effect on the degree of regulation. When the government transfers the service to private hands of a monopoly, it must prevent a non-predatory behavior of the firm. On the other hand, when the market is liberalized, the regulatory agent should try to prevent the dominant carriers to crowd out new entrants.

Many of the developing countries that have privatized their monopolic telecom SOE, didn’t liberalize the industry in one step. Instead, they admit an intermediate stage of regulated private monopoly, as shown is Figure 2.1

*Figure 2.1: The Three Stages of Telecommunications Reform*

<table>
<thead>
<tr>
<th>STAGE 1</th>
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<th>STAGE 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>State-owned monopoly</td>
<td>Regulated private monopoly</td>
<td>Regulated, privately owned, competitive market</td>
</tr>
</tbody>
</table>

Prior to Privatization  Immediately after privatization  Five to ten years after privatization

Source: Privatizing Monopolies, Ramamurti

Ramamurti argues that if countries move directly from stage 1 to stage 3, they wouldn’t have the chance to solve their fiscal problems through privatization or to signal
their commitment to market-oriented policies. Other authors like Giovanni De Fraja\textsuperscript{2} argue the opposite, that unless entry deterrence is profit maximizing for the new entrant, liberalization should always precede privatization.

2.4 Examples of Countries with a Liberalized Telecommunications Industry:

United States

2.4.1 A Historical Perspective

Ever since the invention of the telephone in 1876, and until late 1970s, one company overwhelmingly dominated the telecommunications industry in United States: American Telephone & Telegraph (AT&T). AT&T was started in 1885 by Theodore Vail as a wholly incorporated long-distance subsidiary of the pioneering Bell Company (started by Alexander Bell). The Bell System (as the combination of the Bell Companies was known) was the source of continual technological innovations; its interests were organized as a patent association. In 1881, Bell acquired Western Electric, then the largest manufacturer of electrical equipment. In 1899, AT&T took over the Bell System.

By the early 1930s, AT&T was close to a monopoly. The Bell companies served about 90% of the local traffic nationwide, Western Electric garnered 92% of all equipment sales and AT&T long distance lines provided virtually 100% of all long-distance services. In 1934, the Bell System became committed to providing universal

\textsuperscript{2} Giovanni de Fraja, Chicken or Egg, Which should come first, Privatization or Liberalization?
service. The Bell System essentially adopted vertical integration strategy to accomplish this goal economically. And until the 1980s, a unified Bell System with AT&T in control, dominated the whole telecom industry.

2.4.2 The break-up of the Bell System in 1984

AT&T's strategy of vertical integration was subject to a plethora of private lawsuits in addition to a major antitrust suit brought by the U.S. Department of Justice. This eventually led to the divestiture of AT&T from the Bell System by a consent decree in 1982. On January 1, 1984, AT&T Long Distance, Bell Labs (the research division) and Western Electric (Network Systems) were separated from the local Bell companies, thereafter known as the Bell Operating Companies, BOCs. The ruling, referred to as the Modified Final Judgment (MFJ), required the BOCs to operate in geographically defined areas, Local Exchange Areas, as regulated monopolies (referred as Local Exchange Carriers, LECs) while AT&T would operate in a competitive long-distance market. The BOCs were not supposed to compete in the long distance market and also, could not manufacture any equipment.

Since 1984, several new entrants joined the long-distance, most notably MCI and Sprint (referred as IXCs - Interexchange Carriers). While the long-distance industry grew significantly, AT&T's share dropped significantly. These three currently share 90% of the $76 billion long distance market.
2.4.3 The Era of Deregulation: The Telecommunications Act of 1996

The Telecommunication Act of 1996 is perhaps the most significant legislation in the history of U.S. telecommunications. It has unleashed a frenzy of restructuring, mergers and dealmaking, redefining the traditional telecommunications industry, which, according to DRI/McGraw Hill\(^3\), will account for $1 trillion in annual revenues by the year 2000.

The Telecommunications Act of 1996 envisions an industry structure that promotes competition in all markets: local, long distance, wireless cable, and so on. The main feature of the deregulation is that it allows local service companies to offer long-distance and cable TV service and it permits open competition in local area telephone services. Essentially, the deregulation invites open competition in the entire telecommunications industry, long-distance, local, cable and data transmission\(^4\).

With the telecommunication technology development, the boundaries between traditional communications media has became extremely diffused and, as a result, new sophisticated multimedia services are being offered. On the other hand, the pace of innovation is so explosive that many telecommunications companies are not able to follow each new development. In response to this situation, companies have begun to merge (i.e. NYNEX and Bell Atlantic), and acquire, and establish alliances and

\(^{3}\) Business Week, "Telecom’s New Age", April 8, 1996
\(^{4}\) The Wall Street Journal Articles, "It’s War", Special Section on Telecommunications, Sept 16, 1996
partnerships with other companies. For example, in September 1994, AT&T purchased McCaw Cellular Communications Inc., the largest cellular-phone company in the U.S. AT&T has also 2.5% stake in Hughes Electronics Direct TV satellite service. With 400,000 customers using its WorldNet service, AT&T has become the No.2 Internet-access provider. Additionally, AT&T has trivestitured into a telecommunications equipment manufacturer (Lucent Technologies), a telecommunications services provider (AT&T) and NCR⁵.

The Telecommunications Act of 1996 serves to enhance competitiveness in the market, while reducing substantially the entry barriers for small business. As it is stated in the Act: "...Within fifteen months of enactment, the FCC must conduct a proceeding to eliminate barriers to entry for small businesses into the market for telecommunications and information services. Every three years, the FCC must report on the effectiveness of any regulations adopted to eliminate entry barriers." The Act also promotes competition by permitting the resale on a nondiscriminatory basis. As a result, many smaller companies should emerge to cover specific market niches.

Telecom equipment suppliers are now expected to respond with one-stop-shops that provide all forms of communication including fixed and wireless networks that can support a host of multimedia applications⁶. AT&T (now Lucent Technologies), is working on the "Renaissance Network", a high-tech digital system that can support all

⁵ Business Week, “Telecom’s New Age”, April 8, 1996
⁶ 18. J. Hausman, "Competition in long Distance and Telecom Equipment Markets", Managerial and decision Economic 1995
sorts of futuristic services, such as getting your message to anyone, anywhere, and by using any form of communication.

The following is a summary, using Porter’s Five Forces, of the impact of the Telecom Act of 1996 in the competitiveness of the telecommunications industry:

- **Competitors**: huge competition. Big companies like AT&T can now offer local services and continue to compete in the long distance market. MCI, Sprint and over 200 resellers are competing in long distance and are able to compete in local markets. Cable TV and cellular companies will be offering local services. There will be many small niche players as a result of deregulation.

- **Suppliers**: Main suppliers are Lucent Technologies (AT&T), Nortel, Siemens and Alcatel. Due to the pace of technological change and the synergies created between various communications media, the suppliers have high power. The challenge to service providers is to install and maintain a state-of-the-art network. When any one of the equipment manufacturing companies reach a competitive advantage, they can negotiate with any service provider for exclusivity. Therefore, service providers are also in competition for networking equipment.

- **Buyers**: one of the objectives of deregulation is to enable customers to obtain the lowest possible rates in communication. Buyers will have tremendous bargaining power once there are choices for all their services. They can switch
long-distance provider easily today. Hopefully, in a few months, they will be able to do the same in local telephone and cable services

- **Entry barriers**: as explained above, with the ability to resell on a non-discriminatory basis, entry barriers are being lowered. Obviously, the main entry barrier, regulation, has been removed. The ability to offer ubiquitous service and "one stop shopping" for customers with an overwhelming number of options may become an entry barrier for small niche players

- **Substitutes**: enormous threats, primarily, Internet, which is already offering telephone services, as well as other value added services. Cable TV, satellite, point-to-point private networks, and cellular providers can also offer substitutes

2.5 **Canada**

2.5.1 **Industry Structure**

The Canadian telecommunications industry is currently dominated by two national systems: Telecom Canada and Unitel (ex CNCP). Telecom Canada is an association of the largest telephone companies operating in each province and Telesat, the domestic satellite carrier. It provides a range of facilities for the transmission and switching of the local and long-distance telecommunications traffic, including two coast-to-coast microwave relays routes. Unitel is a national facilities-based carrier. It provides a wide range of competitive private voice, data and messaging service. Unitel operates its own

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7 Walter Block and George Lermer, “Breaking the Shackles: Deregulating Canadian Industry”, 1991
microwave network. Since 1994, when the local market was liberalized, Unitel can connect their traffic to the switched telephone network operated by Telecom Canada. Both Unitel and Telecom Canada members can carry telex, computer data, fax and television broadcast in their network. There are also approximately 100 telephone companies operating in Canada that are not affiliated with Telecom Canada; they are mainly concentrated in Ontario and Quebec.

Teleglobe Canada has the monopoly on overseas communication and will keep it at least until the end of 1997. The network facilities of Telecom Canada and Unitel converge to this company.

While carriers not federally regulated can not connect their networks to the facilities of the federally regulated carriers, other non-carrier providers and public non-voice systems can. In particular, cable TV companies can interconnect with the public telephone network. This represents a potential competition to Telecom Canada, as the cable companies can expand the range of services they carry over optic fiber and compete directly with the telephone companies.

2.5.2 Regulatory Environment

The Canadian regulatory environment has evolved from a structure in which common telecommunications carriers were regulated by municipal councils, provincial cabinets, provincial government regulatory bodies, or federal regulatory agencies.
Currently, the federal government and its regulatory agency, the CRTC, hold the
dominant policy and decision-making positions, but federal jurisdiction over the
telecommunications sector is not absolute. Federally regulated carriers account for more
than 78% of the telecommunications service revenues, 83% of net income and
approximately 83% of the Canadian telecommunications industry. The telephone
companies are subject to rate-of-return regulation and rate regulation of individual
services.

Since 1994, the government has allowed competition in publicly switched voice
telephone service. There is open competition in the leasing of private lines for voice and
data, numerous value-added computer networks, and a numerous number of resellers of
telephone service.

2.5.3 The Threat of U.S. Telecommunications Companies

In the transition from monopoly to competition, the Canadian policy is at least 10
years behind the United States. As described in section 2.2, many U.S. long-distance
companies, AT&T, MCI, Sprint, have been exposed to open competition in the last 13
years and are eager to enter the Canadian long-distance market. There is a large attraction
because Canadian long-distance rates are significantly higher than U.S. rates.

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The main advantage for U.S. companies is that all of Canada’s international traffic can be served by current American networks, without any major investment. The reason is a matter of scale: to include the Canadian international traffic would represent an increase of about 10%, which is less than the growth experienced annually in the last years.

2.6 United Kingdom

The reform of the British telecommunications industry began in 1981 when British Telecom, the national telecom company, was separated from the British Post Office. In 1984, under the 1984 Telecommunications Act, the British government privatized British Telecom, selling 50.2% of the shares to private investors. However, the British government remained the main shareholder. In addition, the long-distance market was liberalized by allowing a second carrier, Mercury, to offer the service. Mercury was not required to provide universal service.

In 1982, Britain’s Value Added Network Service Licensing Act provided the necessary legal framework to permit an explosive growth of value-added services. By 1986, more than 200 VANs existed in Britain. The potential of these service opportunities seduced many international companies operating in Europe, thus motivating a considerable pressure to other European governments to imitate the British reform.

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9 Ben A. Petrazzini, “The Political Economy of Telecommunications Reform in Developing Countries”
In 1991 most of the entry barriers were abolished. More than 70 firms have been licensed since then to provide telecommunications infrastructure, including MFS, Colt, ACC, Ionica, Sprint and AT&T. There is still a duopolic provision of international service. However, simple resale is allowed with a number of countries including USA, Sweden and Australia. There are also many companies offering cable TV telephony including foreign investors such as NYNEX, US West and Videotron.

Mobile telephony is also in competition. In 1985, Vodaphone received the first license. Since 1993, other mobile service providers have become operational: Mercury One2One and Orange in personal communications system (PCS).

2.7 Japan

2.7.1 Industry Structure

The history of the telecommunications industry in Japan can be divided in two periods: before and after 1985. Before 1985, there was a monopolistic local service provided by the state-owned NTT, the Nippon Telegraph and Telephone Corporation, and KDD, Kokusai Denden Corporation, which was the monopoly common carrier for international communication. In April 1985, NTT was privatized and competition was introduced, allowing three new common carriers (NCCs) to operate long-distance telephony, and other new carriers to operate regionally or with mobile telephony. The

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companies that provide long-distance service are DDI, TeleWay Japan and Japan Telecom.

Two additional international operators were allowed to compete: IDC and ITJ. In mobile telephony, there are regional duopolies, like IDO and KTC and subsidiaries of NTT, such as NTT DoCoMo. There is full competition, today, in value added services and leased line resale.

2.7.2 Regulatory Environment

The 1985 Telecommunications Business Law of Japan recognizes two categories of carriers: type I and type II. Type I carriers are those operating with physical transmission circuits; type II carriers are those without circuits. A type I carrier can offer every service that a type II can, but not vice versa. Type I carriers are regulated by the Ministry of Posts and Telecommunications (MPT). Foreign owners are allowed to obtain, in total, one-third of the shares of type I carriers. The market for type II carriers was liberalized in 1985. No restriction is imposed on foreign ownership of a type II carrier.

Immediately after the deregulation of the market in 1985, it was clear that the MPT’s intent to promote competition was not succeeding. NTT continued to carry enormous power, as it was considered by the MPT to be the main conductor of the modernization of Japan’s Telecommunications industry. Moreover, in all markets except paging, NTT was a de facto monopoly, having strategic marketing and technological
advantages over the NCCs. For instance it was impossible for some NCCs to subscribe new customers because the interface provided by NTT did not permit it.

MPT realized that with this structure, the effective competition would never be achieved. In October 1989, the government announced three plans to divide NTT. However, business community and political opposition frustrated the intent and the MPT gave up the idea until 1997.

In general it can be argued that the liberalization policy of 1985 benefited users. The main outcome is a substantial reduction in tariffs due to the competition of NTT, KDD and the NCCs. However, even today, Japan’s telecommunication industry is an oligopoly. During this year, probably, there might be a definition about the division of NTT.

2.8 Chile

2.8.1 Privatization Process in Chile

In 1981, Chile telecommunications industry was dominated by two big SOEs: ENTel (Empresa Nacional de Telecomunicaciones) and CTC (Compañía de Teléfonos de Chile). CTC was the main competitor in the local market and accounted for approximately 95% of the lines and traffic of the local service. Two other small regional SOEs also provided local service, comprising the remaining 5%.

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11 Eduardo Bitran and Raul Saez, “Privatization and Regulation in Chile”, 1994
In the long-distance market, the main incumbent was ENTel. It had the monopoly for the international traffic and 80% of the local long-distance traffic. The other 20% was accounted for by CTC, which had a long-distance link between Santiago and Valparaiso, in competition with ENTel.

In 1981, the government privatized two regional companies. The process to privatize CTC begun in 1985 with the sale of stock to the market. In 1987, the government launched an Employee Stock Ownership Plan (ESOP) through which employees received their severance payment in advance with the condition of investing 80% in CTC shares. Finally in 1988, 30% of CTC's equity was sold to Bond, an Australian investor. The privatization process was completed between 1988 and 1990 with the sale of the rest of the shares on the open market.

The privatization process of ENTel began similarly as CTC’s process, with the sale of 30% of the shares to the market in 1986. The main buyers were Pension Funds. In 1988, CORFO, the government entity that owned ENTel, lost control of the company as private shareholders, including employees with 12.5% of the shares, gained majority. In 1990, a subsidiary company of Telefónica de España bought 20% of company’s shares, thus becoming the largest shareholder.

In 1990, Bond sold its stake of CTC to Telefónica de España motivating the participation of the antitrust commission that ruled that the Spanish company should sell its stake in one of the companies.
2.8.2 Liberalization of the Market in 1994

In 1994 the Chilean government liberalized the market allowing new entrants in the industry. Since then, rapid changes have taken place in the Chilean telecommunications industry that have affected the services offered and the ways in which they are provided. These changes are primarily the result of continuous technological development and the accelerated growth of demand for these services.

Increased liberalization and deregulation has attracted many competitors to this market. This is demonstrated by the participation, both directly and indirectly, of many foreign telecommunications companies in the Chilean market. Examples of these companies are Alcatel, AT&T and Bell South. In addition, there has been a growing tendency toward market consolidation, particularly since 1996, in the areas of cable television and mobile communications.

Local companies are, today, also providing long-distance service. For example, CTC has created a subsidiary, CTC Mundo, that provides international and long-distance services.

The present regulatory framework in Chile favors competition in all markets of the telecommunications industry by awarding free concessions and facilitating the entry of new competitors into the market. However, CTC remains a de facto monopolistic local service provider. This is a technical advantage that has forced the reaction of some of the
long-distance competitors, as their customers have experienced technical problems while trying to reach their long-distance carrier.

In 1996, new elements were introduced in the Chilean telecommunications sector that will influence the structure of the industry as a whole. One important issue was the public contest for three Personal Communications Service (PCS) licenses in the 1900 MHz frequency. A second important event was the development by SUBTEL, the Chilean Undersecretary of Telecommunications, of a new body of regulations for the industry. SUBTEL sent proposed regulations to all the industry participants requesting their observations and comments. The regulatory body is now in the process of approving these proposed regulations. The third important event was the opening of the second round of bidding for the development of rural telephony through the Telecommunications Development Fund.\(^{12}\)

2.9 Summary of Other Countries with Liberalized Markets\(^ {13}\)

**Australia:** market liberalization began in early 1990s and involved combining Telecom Australia and OTC into one new company, Telstra, and awarding a license to a competitor, OPTUS, with further liberalization expected at the end of 1997. Three mobile service operators were licensed. Full competition was introduced in other telecom services including Public Access Cordless Telephone Services.

\(^{12}\) Compañía de Telecomunicaciones de Chile, Annual Report, 1996  
**New Zealand:** progressive and now the full liberalization of the telecommunications market began in the late 1980s. Unrestricted market entry and capacity resale. Spectrum licenses auctioned allowing multiple firms to enter mobile markets. Major new entrants include Clear Communications, owned by Bell Canada, MCI, TV New Zealand, New Zealand Rail and other local investors, which offers long-distance and international services, and Bell South New Zealand, a subsidiary of Bell South USA.

**Sweden:** full liberalization of the telecommunications market began in 1992 including international simple resale and cable TV/telephony. There has been competition in mobile services since 1981. Major competitor is Tele2, a subsidiary of Cable & Wireless and Swedish investors.

**Hong Kong:** before July 1995, local public wire-line voice telephonic services were provided by the Hong Kong Telephone Company (HKTC) by virtue of an exclusive concession. On 1 July, 1995 four new Fixed Telecommunication Network Services (FTNS) licenses were issued to provide local service on a competitive base. The three new entrants were Hutchison Communications Limited, New T&T HK Limited and New World Telephone Limited. Additionally, four companies were licensed to provide mobile communications. International service, however, will remain a monopoly until 2006.
2.10 Benefits of the Liberalization of the Telecommunications Industry

In February 1997, 68 countries belonging to the Group of Basic reached a consensus during the World Trade Organization (WTO) negotiations to bring basic telecommunications into the framework of the General Agreement on Trade in Services (GATS). This is significant because it extends the coverage of the GATS to virtually the entire US$ 600 billion telecommunication service sector. Traditionally, international telecommunication services were traded under a system of bilateral agreements between nations. The WTO telecommunication agreement opens the way to a multilateral framework for freer trade, market opening and competition.

The following, is a paragraph extracted from the World Telecommunication Development Report of the International Telecommunications Union (ITU)\(^\text{14}\), about the implications of these agreement and the meaning of liberalization of the telecom industry:

“Freer trade in telecommunications promises to deliver at least three economic gains: new and improved products and services, lower prices and additional investment. Open trade in telecommunication services should result in more competition, lowering prices for most businesses and for many consumers and providing both with a choice of different service providers.

\(^{14}\) International Telecommunications Union, Web Page, http://www.itu.ch/
Probably the clearest evidence comes from the market segment where competition is currently the most keen: in international telephone services. Those markets where direct competition is permitted have achieved higher rates of growth than countries that have retained a monopoly. For developed economies, this difference is significant; competition has raised the growth rate of traffic per subscriber from 5.6 percent to 9.3 percent per year since 1990. However, for emerging markets the difference is much more striking: over the same period competitive markets grew their international traffic per subscriber by 11.7 percent per year compared with just 5.2 percent per year in monopoly markets. This suggests that the potential benefits of trade liberalization might actually be greater for emerging markets than for developed ones.

Why should this be so? One part of the answer is because of unmet demand. Some 43 million people are on registered waiting lists for telephone connection in emerging markets and the average waiting time is more than a year. By introducing new investment in the market, waiting lists can be sharply reduced, as has been the case in developing markets that have privatized their public telecommunication operators at the start of the 1990s.

What about the potential costs of trade liberalization? Some governments are afraid that they will lose the ability to control entry and ownership in their domestic markets. The truth is that, at the international level, governments
have practically lost the power to dictate who can provide services. For example, the development of alternative calling procedures such as call-back has occurred at a much faster rate than had been expected over the past few years. As a result, almost all markets are now open to some degree of competition.

By making commitments to open their markets, governments are merely acknowledging what is already happening. In particular, it is necessary to reflect on the changing role of government, from being a direct player in telecommunications to a policy maker and regulator. Even though their direct operational influence may be greatly diminished, there will be more work for governments to do under a competitive market environment than was the case under monopoly service provision. That is because existing market players as well as potential new entrants will be looking for clear guidance on what sort of regime will be established for issues such as interconnection, numbering, universal service obligations and tariff policy.”

As a confirmation to the concept illustrated in the paragraph above, the following graphs show the effect of competition in network development, tariffs, traffic and network digitization for OECD countries.
Figure 2.2: Competition boosts network development

Source: ITU World Telecommunications Indicators Database, OECD 1995 Communications Outlook

Figure 2.3: Competition reduces telecommunication tariffs

Source: ITU World Telecommunications Indicators Database, OECD 1995 Communications Outlook
Source: ITU World Telecommunications Indicators Database, OECD 1995 Communications

Outlook

**Figure 2.4: Competition promotes traffic growth**

Source: ITU World Telecommunications Indicators Database, OECD 1995 Communications

Outlook
Figure 2.5: Competition promotes Digitization

Source: ITU World Telecommunications Indicators Database, OECD 1995 Communications Outlook
3. PRIVATIZATION PROCESS IN ARGENTINA’S TELECOM INDUSTRY

As recently as the early 1980s, the world’s telecommunications industry remained heavily regulated and controlled by state-owned monopolies. By the late 1980s, deregulation in Japan, the UK, and the U.S. introduced competition into this industry, once thought by economists to be a perfect "natural monopoly". Latin America has not escaped this trend. In many countries in the region, the telecommunications sector has also become the centerpiece of far reaching privatization programs.

3.1 The Argentine Telecommunications Industry in 1989

The telecommunication service, at that time provided by the state-owned Empresa Nacional de Telecomunicaciones (ENTel), was undergoing a crisis without precedent because of the negative interference of politicians, unions and contractors. The existence of the state-owned ENTel resulted in an overstaffed organization that invested inefficiently in building its network, while never matching potential demand. The prevalence of powerful trade unions in the sector has contributed to the preservation of the status-quo at the expense of potential telephone users.¹⁵

The maintenance of the network was unmanageable, as very old equipment from the beginning of the century complemented last-generation digital switching. The quality of service was unsustainable: repair time largely exceeded one month’s of wait and
hundreds of complaints of subscribers were received daily, on the deficient quality of the telephone service. Moreover, it was not surprising that a user had to wait from 5 to 10 years to get a telephone line.

As a result of such deficient management, ENTel’s productivity was very poor by international standards. (Figure 3.1)

**Figure 3.1: Comparison of ENTel’s performance with international companies, 1989**

<table>
<thead>
<tr>
<th></th>
<th>Lines/Employee</th>
<th>Lines/100 People</th>
</tr>
</thead>
<tbody>
<tr>
<td>Southwestern Bell (U.S)</td>
<td></td>
<td>208</td>
</tr>
<tr>
<td>France Telecom</td>
<td>173</td>
<td>48</td>
</tr>
<tr>
<td>Telmex (Mexico)</td>
<td>105</td>
<td>6</td>
</tr>
<tr>
<td>British Telecom</td>
<td>102</td>
<td>44</td>
</tr>
<tr>
<td>CTC (Chile)</td>
<td>91</td>
<td>6</td>
</tr>
<tr>
<td>ENTel (Argentina)</td>
<td>75</td>
<td>11</td>
</tr>
</tbody>
</table>

Source: Privatizing Monopolies, Ramamurti

3.2 The Privatization of ENTel

In 1989, President Menem, instead of implementing promises made in the campaign, opted instead for austerity and a major structural reform program involving

privatization, trade liberalism and market deregulation. At the time of President’s Menem takeover, Argentina was struggling with a hyperinflation which surpassed 195% in July. The federal reserves were insignificant and the fiscal deficit was out of control.

The aggressive privatization program, launched in the early 1990s served two purposes, first, to provide the embattled public sector with fresh cash or debt reduction to reduce the fiscal deficit and second, to raise efficiency.

The privatization of ENTeI played a central role in this turnaround process. The compressed sales timetable of 14 months aimed to rapidly improve the government’s fiscal position and to send the Argentine population and the world a clear message that the restructuring process was for real and that Argentina planned to become an important international player.

The original plan to privatize ENTeI had been part of a larger plan to deregulate the entire market. The main features of the original plan were:

1. Divest ENTeI, dividing it into several regional operating companies,

2. Liberalize the telecommunications market by allowing competition from the beginning in value added services and international service,

3. Attract foreign direct investment, by selling 60% of the company to private investors,

4. Eliminate subsidization of local service by high rates in international service,

---

5. Tailoring the source and nature of capital by excluding state-owned European telephone companies as potential bidders and attracting the Baby Bells of the USA

Unfortunately, structural factors jeopardized the original plan. The privatization process hindered by economic chaos and political instability. Hyperinflation and political opposition resulted in frequent changes of the rules. As a consequence, the government lost credibility and many of the potential bidders retreated.

As the Argentine government became committed to the privatization process at any cost, it realized that the deal needed to be made more attractive to investors. Thus, many of the following features contemplated in the original plan were discarded or altered. First, the exclusivity period was extended from 5 to 10 years. Second, the liberalization of value added and international services was canceled. Lastly, the service tariffs were increased 50% in real terms.

The country was then divided in two regions, North and South, including the area of Buenos Aires, with two main purposes:17

- to create two companies of the same size which would begin to compete between themselves at the end of the exclusivity term.

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• to allow a comparison of the performance of both companies during the
exclusivity terms, in order to encourage operating efficiency.

At the end of the privatization process, in July 1990, two companies were
adjudicated the monopolic right to provide the local, international and value-added
services for seven years with an option of another three years, depending whether they
achieve certain goals. Figures 3.2 and 3.3 illustrate the final decision and the divestiture
scheme.

Figure 3.2:  Details of the Bid Winners and Price Paid

Source: Figures, Privatizing Monopolies, Ramamurti, Graph, Diego Luzuriaga
As a counterweight to the exclusivity granted to Telefónica and Telecom, the monopolistic companies offering basic services were required to attain quality service and penetration goals and set up a minimum plan for expanding public and semipublic services, under the penalty of license loss. However, when compared with other privatized companies, these requirements were extremely modest. The following table shows a comparison between Argentina and Mexico’s expansion and quality goals after privatization:
<table>
<thead>
<tr>
<th></th>
<th>Mexico</th>
<th>Argentina</th>
</tr>
</thead>
<tbody>
<tr>
<td>Network growth</td>
<td>12 % per year</td>
<td>6.5 % per year</td>
</tr>
<tr>
<td>Allowed Line Failure Rate</td>
<td>5% by 1996</td>
<td>35% by 1995</td>
</tr>
<tr>
<td>Maximum Delay for new connections</td>
<td>6 months by 1994</td>
<td>8 months by 1994</td>
</tr>
<tr>
<td>Required number of digital networks</td>
<td>22</td>
<td>No specification</td>
</tr>
<tr>
<td>Requirements of fiber-optic networks</td>
<td>9,000 miles</td>
<td>No specification</td>
</tr>
</tbody>
</table>

Source: Privatizing Monopolies, Ramamurti

Due to the frequent changes in the rules and the retreat of many of the potential bidders, the price paid per line was one of the lowest for a privatization initiative in a developing country. (Figure 3.4)

*Figure 3.4: International comparison of price paid per phone line (US$ per line)*

![Bar chart showing price paid per line in various countries](chart.png)

Source: Privatizing Monopolies, Ramamurti; Price in US$ per line
Although President Menem succeeded in obtaining international recognition with the swift privatization of ENTel, the price paid in terms of liberalization policies was too high and reduced dramatically the potential benefits for the Argentine society and economic development. The most important benefit of ENTel's privatization was that it stimulated an unprecedented period of turnaround and restructuring.

3.3 Cellular Mobile Telephony\textsuperscript{18}

The provision of the mobile telephone service has not been included in the privatization of 1990. The provision of the service of mobile telephony is in competition, having been assigned for that service two bands within the country. Movicom, a private company which was awarded the bid in 1988, is rendering services in Buenos Aires region and its surroundings since 1989; it has approximately 260,000 subscribers. The second band in this area was awarded to Movistar, a company equally owned by Telefónica de Argentina and Telecom Argentina. This company started operating in February, 1993 and has, at present, approximately 210,000 subscribers.

Today, the mobile telephone service has also begun to be offered in the rest of the country. The government awarded the first band to a consortium of companies including G.T.E., AT&T and local partners. The second band was awarded to Telefónica and

\textsuperscript{18} Comisión Nacional de Telecomunicaciones, CNT, Web Page, gopher://proteus.secyt.gov.ar:70/11/cnt/
Telecom in their respective areas, yet they were not able to initiate the service rendering before two years had elapsed since the pre-award of the first band.

The competition allowed in cellular telephony has had the effect of an explosive growth in the number of users, as the graph below illustrates.

**Figure 3.5: Cellular Telephony, Number of Users**

![Graph showing cellular telephony growth in thousands from 1989 to 1996 with a CAGR of 104%]

Source: Comisión Nacional de Telecomunicaciones, CNT

### 3.4 Results of the Privatization of ENTel

While the price paid in terms of liberalization, as explained above, was too high, the improvement of both the infrastructure and the quality of service accomplished by both, Telecom and Telefónica was significant. Despite some original discontent of the population, triggered mainly by some “injured nationalism” rather than objective problems, the telecommunications industry in Argentina has been dramatically improved.
as a result of the privatization of ENTel. Figure 3.6 shows a summary of the impact of the privatization with some key variables.

**Figure 3.6 Results of the privatization of ENTel in some key variables**

<table>
<thead>
<tr>
<th>At Privatization Nov 1990</th>
<th>As of Dec 1996</th>
<th>% of Change</th>
<th>CAGR % 90-96</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exchange Lines (millions)</td>
<td>3.5</td>
<td>111</td>
<td>13</td>
</tr>
<tr>
<td>Public telephones ('000)</td>
<td>22.0</td>
<td>239</td>
<td>27</td>
</tr>
<tr>
<td>Employees ('000)</td>
<td>40.8</td>
<td>289</td>
<td>23</td>
</tr>
<tr>
<td>Lines per employee</td>
<td>85.0</td>
<td>18.5</td>
<td>9</td>
</tr>
<tr>
<td>Lines in service per 100 inhabitants</td>
<td>11.0</td>
<td>18.5</td>
<td>9</td>
</tr>
<tr>
<td>% network digitalization</td>
<td>13.3</td>
<td>80.0</td>
<td>35</td>
</tr>
<tr>
<td>Average repairmen time (days)</td>
<td>12.0</td>
<td>1.6</td>
<td>-29</td>
</tr>
<tr>
<td>Installation delay (months)</td>
<td>48.0</td>
<td>0.4</td>
<td>-55</td>
</tr>
</tbody>
</table>

Source: Telecom and Telefónica Annual Reports; Diego Luzuriaga analysis

As Figure 3.5 depicts, the telecommunications industry in Argentina greatly developed due to the privatization. The telephone network has been expanded at a rate of 13.3% per year since 1990. While the digitalization of the network has increased by about 35% per year, installation delays have been reduced at a rate of 55% per year, from 48-months average wait for service (it could take more than 10 years to get a line) to just 2 weeks. Moreover, in places like Buenos Aires, lines are now installed in less than 48 hours.
3.5 Creation of a New Regulatory Body: CNT

Complementary with the divestiture of ENTel, the Argentine government decided to create a new relatively autonomous regulatory body, the CNT (Comisión Nacional de Telecomunicaciones). The main function of the CNT is to “apply, interpret, and enforce laws, decrees and other norms in the telecommunications sector”. Among other responsibilities, the CNT is supposed to monitor the achievement of established goals by the new carriers, to resolve conflicts among companies and between them and consumers, and the approval of equipment standards. The tariff regulation is responsibility of the Ministry of Economy, not of the CNT. The CNT is financially supported by 0.5% of net profits of the private companies.

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19 Ben A. Petrazzini, “The Political Economy of Telecommunications Reform in Developing Countries”, 1995
4. SYSTEM DYNAMICS MODELING APPROACH

4.1 Systems Thinking

The advantage of using System Dynamics to simulate the model consists mainly in the possibility to analyze the feedback involved among the different sectors. Conventional models usually work in an “open loop”, mainly transaction-based, dynamic. This type of simulation do not address the endogenous interactions that provoke the stability or instability of a system. On the other hand, system dynamics allows also to consider the positives and negatives influences that a particular variable has on other variable. For example, a modern and sophisticated telecommunications network has a positive impact on the economy, as it promotes economic activity with its excellent service and low prices. On the other hand, however, the more modern the network, the less people that requires to be operated. Therefore, a modern network has a marginal contribution to the unemployment, while, at the same time, it promotes economic activity that contributes to the decrease of unemployment. System dynamics allows to understand how big the positive and the negative contribution to unemployment are and to determine the resultant.

Generalizing, the system thinking approach implicates to shift\textsuperscript{20}:

- From static to dynamic thinking: this means that every variable is cause and effect at the same time. It also means that variables are related in a closed-loop causality and not in a straight-line relationship,
• From system as effect to system as cause: this means that the traditional view is that the system’s performance is driven by some external forces outside the control of the system, whereas Systems Thinking considers the system as more of a cause. In other words, the system itself is responsible for its performance,

• From correlational to operational thinking: this means that Systems Thinking aims to answer the question of how the variables interact to achieve specific outcome. The traditional system analysis aims to identify what factors will influence a particular outcome.

### 4.2 Basic System Structure

The telecommunications model developed in this thesis used *ithink* software developed by High Performance Systems Inc. The model is based mainly on four structural elements: stocks, flows, converters and connectors. An overview of each element is discussed below based on the simplified version how the prices are determined in the model.

*Figure 4.1: Price Determinants*

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**Stocks:** Stocks are accumulations. In Figure 4.1, the stock represents the price of telecommunication services. The original value is set to 100, representing the starting stock. The *Price* stock varies depending on the input generated by the flow *Change in Price*.

**Flows:** Flows are used to depict changes in stock. In Figure 4.1, *Change in Price* regulates the flow into the *Price* stock. The model of this thesis is based on bi-directional flows; the flow can be either positive or negative.

**Converters:** Converters can represent either information or material quantities. Frequently, they are used as “score-keeping” variables; unlike stocks, converters do not accumulate. Therefore, they don’t introduce any endogenous dynamic. In Figure 4.1, *Price Cap, Competition* and *Loading Effect on Price* are converters that together determine the flow *Change in Price*.

As mentioned above, a key advantage in using the system dynamics modeling approach lies in its ability to facilitate the analysis of the interaction between negative and positive factors like competition and loading effect: the higher the competition the stronger the pressure to reduce prices, where as the higher the capacity load, the higher the price that companies are willing to charge.
4.3 Model Fundamentals

**Simulation Period:** The simulation period for this model is set at 20 years, beginning with the year of deregulation. At this time, this year is likely to be the year 2000.

**Representation of the Elements of the Model:** In order to simplify representing the elements of the model with their own units, e.g. $ million for revenues, the model represents each variable with indexes, assuming that the state of each variable is 100 at time 0. As a result, the model will represent increases or decreases in the value of the variables rather than their absolute value. It is important to note that the index selected are arbitrary and have no effect on the simulation as long as this selection is consistently used throughout the model.
5. DEREGULATION MODEL

5.1 Elements of a Successful Communications Policy

Ideally, the Argentine government should opt for competition policies in telecommunications that assure maximum political, social, cultural and economic welfare. The regulation should be favorable to the public interest, defined in terms of freedom of communication, opportunities for social interaction and economic production. The following graph illustrates these concepts.

*Figure 5.1: Elements of a Successful Communications Policy*

As Figure 5.1 depicts, the communications policy should involve not only the regulation of the communications infrastructure (telephone network), but also the regulation of information and transport services. Information, transport and infrastructure are the three levels of the communication system.

5.2 Basic Structure of the model

The model that I propose to use to analyze the dynamics of the telecommunications industry in Argentina is depicted in the following figure.

Figure 5.2: Proposed Structure of the Model
As Figure 5.2 shows, the model is divided into 4 main sectors that interact with each other: Macroeconomic, Welfare, Market Competition and Institutional environment. The regulation is exogenous to the model and will determine the behavior of the system.

5.3 Market Competition Sector

The market competition sector is formed by two subsections: the dynamics of competition and the dynamics of commoditization, which are respectively depicted in figures 5.3 and 5.4.

*Figure 5.3: Causal Loop Diagram Representing the Dynamics of the Market*
The basic dynamics of the market competition sector is equivalent to a “diffusion process” in which there are two stocks: one is empty, Competitors’ Customers, and the other, Incumbent Customers, represents the current number of customers and it is initially set at 100.

The flow between the two stocks is controlled by the Relative Attractiveness (RA) valve. If the value of RA is greater than 0, then there is a migration from Incumbent Customers to Competitors Customers and vice versa. RA also controls the adoption rate of new customers, Unmet Demand, for both incumbent players and competitors.

The attractiveness of each player, incumbents and competitors, is a function of the price, the quality of service and the offer of new features. The price is determined in other part of the model, the dynamics of commoditization, which is described later. The Service Quality and the New Features, depend on the investments of each competitor. The behavior of these factors of the model is determined by several reinforcing loops: the more customers, the higher the revenues and therefore, the higher the profits. High profits drive higher investments in new features and improvements in quality of service. At the same time, this improves the operational efficiency which reduces operating costs and increases profits. All this makes the service more attractive and as result, the number of customers increases and the dynamics of the loop begins to start.
Figure 5.4: Causal Loop Diagram Representing The Dynamics of Commodityization

Source: Adapted from “Commoditization of Technology-Based Products and Services: A Generic Model of Market Dynamics”, Henry Birdseye Weil. MIT Sloan School of Management WP #3887

Figure 5.4 describes the dynamics of commoditization. Basically, an industry becomes a commodity industry when there is persistent excess capacity and players become involved in price war to differentiate their products/services. There are many factors that produce this excess capacity:

- Over-estimation of demand growth
- Proliferation of players that invest in new capacity
- Amplification of planning errors
- Lapse of financial constraints
As in the dynamics of competition described previously, there are many reinforcing and balancing loops. As capacity increases, the load factor decreases, reducing the prices which in turn increases demand and therefore, the desired capacity, which increases capacity orders. In this way, the dynamics of the loop begins to start.

On the other hand, a reduction in prices implies a reduction in revenues and, consequently, in profits. As the profits decrease, the profit gap grows, resulting in an increase in prices. This is a balancing loop.

Another balancing loop is related to capacity orders. As the profits increase, capacity orders increase, resulting in a higher capacity. This higher capacity implies higher operating costs, which diminishes the profits, thus balancing the original increase in profits.

The last reinforcing loop is related to the amplification of planning errors. The higher the demand, the higher the projected demand. This is true for two reasons: first, because the sum of all players’ projected market share is much higher than one. Second, due to the delays in the delivery of new capacity, companies tend to order in excess. The higher the projected demand, the higher the desired capacity, which results in new capacity orders thus augmenting the installed capacity. This diminishes the load factor, resulting in a decrease in prices that drive more demand. In this way the dynamics begins again.
5.4 Macroeconomic Sector

The Macroeconomic Sector is a simplification of the interactions of the telecommunications industry and macroeconomic variables. The purpose of this part of the model is not to represent the dynamics of the macroeconomy, but to understand how some of its variables relate to the telecommunications industry. The causal loop diagram of this sector is depicted in Figure 5.5.

*Figure 5.5: Causal Loop Diagram of the Macroeconomic Sector*

The dynamics of this sector are dominated by reinforcing loops. First, it is known that the growth of the GDP is reflected in an increase in consumption; demand in this
particular case. As the demand grows, the revenues and the profits grow, resulting in new investments in infrastructure to improve the service quality and to develop new features. New features means modern equipment with new and sophisticated features. These three variables, capacity, service quality and new features, make the environment more attractive for existing business to expand and for new businesses to emerge, which is the economic objective of the communications policy described in section 5.1. This positive environment contributes helps to expand business and, therefore, serves to increase the GDP, thus closing the reinforcing loop. Obviously, these are not the only variables that affect the GDP. However, no other variables are consider to influence the GDP, since GDP growth is considered to be an exogenous variable. In Summary, the impact of the telecommunications in the GDP is considered in marginal terms.

As players invest in new equipment and in operational efficiency, productivity rises, having a positive marginal impact in unemployment. On the other hand, in expanding capacity, companies promote employment thus contributing negatively to the unemployment. The dominant variable of these two factors depends on the timing of each: when the capacity expands faster than productivity, then there is a marginal decrease in unemployment and vice versa.

5.4.1 Elasticity of the Telephone Service Penetration to GDP per Capita

As mentioned in the prior section, the GDP has a bottom-line impact in installed capacity. One of the ways to measure how elastic this relationship is, is to perform a
regression analysis for different countries using these two variables: GDP per capita and telephonic penetration (measured as lines per 100 inhabitants.)

The form of the equation is the following:

\[ \text{PEN} = K \times \text{GDP}^e \] where PEN is telephone service penetration, GDP is GDP per capita and e is the elasticity. K is a constant factor.

The aim is to perform a logarithmic regression; applying logarithms to both sides of the equation:

\[ \log(\text{PEN}) = \log(K) + e \times \log(\text{GDP}) \]

In this way, the coefficient of the regression is directly the elasticity.

The result of this regression can be misleading, depending on the data used to perform such regression. One of the ways is to make the regression including Argentina with developed countries, like the members of the OECD. Except for Turkey and Mexico, all other members of the OECD have higher GDP per capita. On the other hand, the regression can be carried out using less developed countries, like other South American countries. The last case can simply use all available countries.

Figure 5.5, a scatter diagram, shows the distribution of the countries along these two variables.
Figure 5.6: Correlation Between GDP per capita and Telephonic Penetration

![Graph showing correlation between GDP per capita and telephonic penetration for OECD and LDC countries, with a focus on Argentina.]

Source: OECD, International Telecommunications Union; Diego Luzuriaga Analysis

Figure 5.6 clearly shows the different groups of countries: OECD and Less Developed Countries (LDC). Argentina lies in the middle, as is the developing country with the highest GDP per capita (around US$ 8,500). Using the coefficients of the regression, it is possible to calculate the required telephone service penetration to match, at the country’s GDP per capita, the telephone service penetration of the regression. The following table summarizes the $R^2$, elasticity and expected telephonic penetration for Argentina for the GDP per capita, based on the three possible regressions: Argentina and OECD countries (Regression 1), Argentina and Less Developed countries (Regression 2) and Argentina and all countries (Regression 3).
Table 5.1: Summary of the Outcomes of the Regressions

<table>
<thead>
<tr>
<th></th>
<th>Regression 1</th>
<th>Regression 2</th>
<th>Regression 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elasticity (e)</td>
<td>0.52</td>
<td>0.98</td>
<td>0.86</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.78</td>
<td>0.92</td>
<td>0.91</td>
</tr>
<tr>
<td>Expected Penetration</td>
<td>28.6</td>
<td>22.8</td>
<td>21.1</td>
</tr>
<tr>
<td>Additional Lines</td>
<td>3,374</td>
<td>1,335</td>
<td>710</td>
</tr>
</tbody>
</table>

Regression 1 shows two key differences with the other two: The quality of the regression is lower and the elasticity is lower. However, this was an expected result, since in developed countries there is some degree of “saturation” of telephone lines and therefore, the market is less influenced by increases in GDP. Additionally, based on this regression, Argentina should have a telephone penetration of 28.6 instead of the current 19.0. In additional lines, this translates to about 3.4 million, almost 50% of the existing lines.

In Regression 2, the elasticity is the highest, which is also an expected outcome, since in less-developed countries the telephone penetration is low or very low and, therefore, is highly influenced by increases of GDP. The expected telephone penetration for Argentina is 22.8, higher than expected from Regression 3; when compared with the group of LDC countries, Argentina has a much higher GDP per capita.

Regression 3 was used to plot the solid line in Figure 5.6., using all the data available; furthermore, the quality of the regression is very good. Since it combines LDC and OECD countries, the elasticity lies between the elasticities of Regression 1 and 2. In
this sense, Argentina is today very close to the expected telephone penetration of 21.1 line per 100 inhabitants, that represents about 710,000 additional lines.

Appendix A contains all the data used to perform the regressions.

5.5 The Welfare Sector

The Welfare Sector is depicted in Figure 5.7.

*Figure 5.7: Causal Loop Diagram of the Welfare Sector*

The causal loop diagram represents the concept presented in Figure 5.1. The welfare sector is the combination of social, economic and political prosperity.
Economic welfare is described in the macroeconomic sector. It basically includes the following variables: marginal contribution to GDP, the marginal contribution to unemployment and the attractiveness to develop businesses.

Social welfare is described as the possibility for citizens to access reliable and cheap service, which will facilitate social interaction. This service does not necessary need to be a telephone service; it can be any type of communications media, like Internet. Additionally, unemployment rates negatively influences social welfare.

Political welfare is related to the freedom to communicate, one of the pillars of the democracy. For the purpose of this model, political welfare is influenced by two factors: the availability of diverse media services and institutional support. The availability of different media services depends on competition, represented by the Herfindhal Index. This index is calculated as follows:

\[ \text{HF Index} = 10,000 \times \sum MS_i^2 \]  
where \( MS_i \) is the market share of the \( i^{th} \) competitor

In perfect competition, where all market shares tend to zero, the Herfindhal Index also approaches zero. On the other hand, when there is a monopoly, the HF Index is 10,000. In Argentina today, each of the two telephone companies hold around 50% of the market. In this case the HF Index would be 5,000. However, since both companies are not

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21 Sharon M. Oster, "Modern Competitive Analysis", 1994
allowed to compete with each other, there is a de facto monopoly in each region and, consequently, the HF Index is 10,000.

The institutional support will be described later in the following section

5.6 Institutional Environment Sector

The causal loop diagram of the Institutional Environment Sector is represented in Figure 5.8.

*Figure 5.8: Causal Loop Diagram of the Institutional Environment Sector*

Institutional support represents the interaction of the Legislative and Judicial Powers in relationship to Executive Power (henceforth Executive). Institutional support depends, in the long-term, on the welfare of the citizens, assuming that Argentine legislators really care about citizens, something that, today, can not be assured. In the short-term, much more in the Argentine style of doing things, the institutional support
depends on the prices and the marginal contribution to unemployment. These are the first variables that capture legislators’ and judges’ attention.

The success of the “Plan de Convertibilidad” can be attributed to the extraordinary commitment of President Menem to maintain the full convertibility of the peso against the dollar. However, due to the unpopularity of the new economic rules, many of the transformation laws were issued by decree. In other words, to achieve such transformation, Menem needed to concentrate enormous power in the Executive. There is an implicit feedback loop between the variables concentration of power in the executive and institutional support: the more concentration of power, the less institutional support. When the government is committed at any cost to succeed, the decrease in institutional support will increase the government’s willingness to concentrate more power. Presumably, as Argentina’s democracy matures, there will be no need for such huge concentrations of power in the Executive. On the other hand, high concentrations of power in the Executive promotes corruption, which reduces the guarantee for external investors to invest strategically in the country. This drives another loop: without foreign investments, the telecommunications infrastructure will not be improved. As a consequence, through the different dynamics described in the welfare sector, the welfare of the society will be negatively impacted, thus undermining the institutional support.

The best way for the Executive to gain the institutional support in favor of foreign investments is to reduce its power, which will trigger the reinforcing loop. In this way, with a clear legal framework for foreign investors, the welfare sector can be activated and
convince the legislators, with facts, that liberalization policies are positive for the country.

5.7 Regulation

One of the objectives of developing a model that represents the dynamics of the market is to simulate as many scenarios as necessary to understand the key drivers of these dynamics. The regulation of the industry is represented in this model with a series of “switches” that are able change many of the conditions that affect the dynamics of the model. As described in the introduction, one of the goals of this thesis is to identify the most convenient way to liberalize the market; the model will permit to achieve this goal. Another goal of this thesis is to identify the best “role” of the Regulatory Body (CNT). Throughout the years, the role of the state in the telecommunications sector has evolved from participant to regulator and now, in many countries, to promoter of competition.

5.7.1 Three Possible Ways to Deregulate the Market

Despite the fact that countries have chosen different ways to liberalize their telecommunications sector, there are three main methods to do so:

1. To allow full competition in both infrastructure and services,

2. To allow full competition in services but keep a monopoly in infrastructure,

3. To allow competition in value-added services and maintain a monopoly in infrastructure and services.

The following table summarizes the pros and cons of each scenario.
<table>
<thead>
<tr>
<th>Market Structure</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full Competition in both infrastructure and services</td>
<td>The countries that are following this path, Chile, New Zealand, Sweden and UK, are experiencing faster rates of growth in subscribers, investment, revenues and traffic. Ease of market entry and exit is a critical factor in developing multimedia. The threat of competition acts to bring prices more closely with costs.</td>
<td>Due to the almost infinite bandwidth capabilities of fiber, it seems not necessary to have more than a single information pathway into the home or the office. Some argue that infrastructure competition will duplicate investments. There is also concern of the damage to the visual environment.</td>
</tr>
<tr>
<td>Monopoly in Infrastructure; full competition in services</td>
<td>The monopoly should guarantee the technical integrity of the network and ought to ensure that the network provider carries out common carrier obligations, as well as providing universal service at affordable prices. Full competition in services should deliver the benefits of improved customer service and lower prices. The model would work better if the infrastructure provider was separated from the service providers. Example of EU countries.</td>
<td>Few monopolies have managed to achieve universal service. Furthermore, most infrastructure providers are also service providers. It is almost impossible to prevent the incumbent service provider from having privileged access to the network and to subscriber information that is available to competitive service providers.</td>
</tr>
<tr>
<td>Monopoly in infrastructure and services; competition in value added services</td>
<td>This was the case of US during the 80s. There was the concept of natural monopoly in the old telephone services. Competition was excluded because it would lead to cherry-picking, or concentration of investments in the most profitable markets.</td>
<td>As telecommunications networks move from analogue to digital, it is increasingly difficult, if not irrelevant, to separate real-time voice telephony from other services. It is relatively easy for the incumbent, as in case 2, to hide the overlap between their activities in monopoly and competitive markets.</td>
</tr>
</tbody>
</table>

Source: International Telecommunications Union (ITU)
For the purpose of the model, the third alternative is not considered, because it makes no technological sense to do so.

5.7.2 Special Regulation Mechanisms of this Model

This model has been developed to simulate different scenarios. These scenarios are based on the different values of the main driving variables. Some of these variables are simulated based on three outlines: a base case, an optimistic case and a pessimistic case. Examples of this type of variable are the macroeconomic and political sectors. Other variables are simply binary switches that turn one particular feature on or off. For example, the allowance of interconnection charges, the price regulation, etc. Lastly, some variables can adopt a continuous range of values from a minimum to a maximum. The X factor of the price cap regulation, i.e., can vary from 0 to 4%. The following section describes each of these variables.

The Macroeconomic Sector is represented by estimations of GDP growth expressed in percentage. The pessimistic case assumes that in the next 20 years the GDP will fluctuate around 0% growth and that there will be as many increases as decreases in the GDP. The base case is the best estimate of GDP increase in the next 20 years, based on the work of some economists in Argentina. The optimistic case assumes a 20-year continuous growth period in GDP.
The Political Sector is represented by the concentration of power in the executive branch of government. The variable is symbolized with an index with a starting value of 100. The Low-Concentration of Power scenario assumes that the Executive will dramatically reduce its willingness to concentrate decision-making power. The base case assumes that there will be a “natural” decrease in the concentration of power mainly driven by the maturing of Argentine’s democracy. The High-Concentration of Power scenario assumes that the Executive will actually increase the concentration of decision-making power.

The Type of Deregulation switch determines whether the international, long distance and local service will be liberalized now or in 3 years, or any combination of these. The following graph represents the concept:

*Figure 5.9: Type of Deregulation*

```
<table>
<thead>
<tr>
<th>LD and International Service</th>
<th>Now</th>
<th>In 3 Years</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>
Local Service                |      |            |
```
The Interconnection Charges switch determines whether the new entrant players will pay interconnection charges to the incumbent players for the use of the network. This is a binary variable, where 0 means no charge and 1 means a charge.

The Price Regulation switch determines whether there will be a price cap or a regulation based on marginal cost, the Rate-of-Return regulation.

The X factor: determines the factor by which the average price of telecommunications services falls in real terms. Its domain comprises the interval 0%-4%.

5.7.3 Control Panel of the Model

To ensure clear access to the regulation levers described in the last section, the model has been developed with a “control panel” that allows the user of the model to “play” with the model without the need to search in the entire model structure. The following graph shows the control panel.
Figure 5.10: Control Panel of the model

<table>
<thead>
<tr>
<th>Macro Scenario</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Political Scenario</td>
<td>1</td>
</tr>
<tr>
<td>Type of Deregulation</td>
<td>1</td>
</tr>
<tr>
<td>Interconnect</td>
<td>1</td>
</tr>
<tr>
<td>Price Regulation</td>
<td>0</td>
</tr>
<tr>
<td>X Factor</td>
<td>0.02</td>
</tr>
</tbody>
</table>

| Welfare | 1,444 |
| Theoretical Index | 2.653 |
| Commodity Index | 205 |
6. MODEL ANALYSIS: BASE CASE

The base case deregulation model will be analyzed by sectors, their dynamics can be understood by examining the behavior of the main variables.

6.1 Market Competition

The behavior of the market will be analyzed through the market share, profits, prices and the Herfindhal Index. The following graph illustrates the market share.

Figure 6.1: Base Case Results: Market Share

As Figure 6.1 depicts, in the 20th year of the simulation, the competitors reach 50% of market share. During the first 5 years, there is a slow gain in market share. The market
share represents the share in Argentina’s telecommunication services in general. In other words, the share represents a mix of capacity, traffic (usage) and customers. The model does not assess the number of competitors. However, for the purpose of this analysis, it is assumed that there are two competitors. Knowing the number of competitors, it is possible to calculate the Herfindhal Index, which is described in the following figure.

**Figure 6.2: Base Case Results: Herfindhal Index**

![Graph showing the Herfindhal Index over time](image)

As can be extracted from the graph, the Herfindhal Index decreases from 5,000 to 2,500 over time. It is essential to note, that at the moment of liberalization, the HF index is 10,000. For the purpose of this model, it is assumed that the incumbent companies compete with each other once the market is liberalized. In other words, they do not follow cartel behavior. Additionally, it is assumed that both incumbent companies lose the same
amount of market share over time. All this assumptions have no particular impact in the
dynamics of the rest of the model.

The base case considers the price cap to be the price regulation. The X factor for the base case is 2%. The following graph illustrates the behavior of the prices in the simulation.

Figure 6.3: Base Case Results: Prices Behavior

![Graph showing prices behavior over years.]

Figure 6.3 shows that players, incumbents and competitors follow the same pattern and, due to competition, they decrease the average prices beyond the price cap requirements. The model assumes that there is also a limit to the magnitude of the price reduction in order to maintain competition and avoid early commoditization of the market. This lower limit of the price reduction is assumed to be 4%. It is important to
remember that the values showed in the graphs are real constant prices. Therefore, a 4% reduction means a 4% real reduction. As an example, if the consumer price index in one particular year is 8%, the price cap with X factor 2% means that the companies can be allowed to increase the prices up to 6%.

The competition introduced in the market creates a steady reduction in the telecom service prices of the telecommunication services. As a result, despite increases in the demand of these services, the profits also decline. The following graph illustrates this concept.

Figure 6.4: Base Case Results: Profits
As it can be seen from the graph, the incumbents’ profits decline relative to their initial value, despite temporal overshoot. However, during the period of the simulation, profits remain positive. Competitors’ profits on the other hand, also decline. However, they decrease more rapidly than the incumbents’ profits, for several reasons. First, the base case assumes that competitors pay interconnection charges to the incumbents. These charges are proportional to competitors’ demand and represent the fee for the usage of competitors’ networks. Second, competitors need time to build their customer base and, therefore, they can not obtain profits immediately. Third, the reduction in prices impact directly in competitors’ profits. Again, it is important to remember that these are real constant numbers. Profits may increase perfectly in nominal terms, depending on inflation. In any case, even from the beginning of the simulation, competitors have slimmer margins of profit than established players. The process of profit reduction that affect both incumbents and competitors is the result of the commoditization of the market due to competition. The meaning of the initial value of 100, which represents competitors’ profits is derived from the fact that competitors may already be providing, among other services, cellular telephone and personal communication systems, a technological substitute for universal service.

The model follows the common logic in determining the dynamics of competition: the base case assumes that the local, long distance and international markets are liberalized now. Since this was not taken into account in the original privatization plan, it makes sense that competitors should pay some interconnection charges to the incumbents for the sunk costs that they have not yet recovered. The model also assumes that the
competitors can either buy capacity or build it. Nonetheless, when deciding what strategy to pursue, competitors will avoid competing in the universal service. They will probably opt to offer new services with higher quality and special new features. In this segment, competitors can differentiate themselves from the incumbents. However, the price cap puts pressure on prices and incumbents react with additional investments in the same segment, creating a situation of excess capacity that commoditizes the market. Furthermore, incumbents have the advantage of the strategic information, such as data on the network and interconnection points which can be a strategic advantage over competitors.

In Argentina today, the incumbents make the profits mainly in the long-distance and international markets. The government imposed high prices on these services originally from the time of ENTel, to subsidize the universal service. Since the weighted average of the tariffs must be maintained, the only way the incumbents can reduce long-distance and international tariffs is to increase the local tariffs. This has proved to be very unpopular, despite the fact that universal service in Argentina is cheap comparing with international benchmarks. As a result, if competition is introduced today in the entire market, as the base case proposes, it is likely that competitors will choose the long-distance and international markets to enter the market. To avoid the massive loss of market share, incumbents will counterattack by reducing prices. Therefore, the noticeable detriment in profits is an expected outcome.
Summarizing this section, the model predicts that under the base-case scenario, deregulation of the telecom industry will succeed in the introduction of competition, represented in the reduction of prices and the investments in network, service quality and new features. On the other side, however, the profits for the players will decrease under this scenario and the market will eventually become commoditized. The following graph illustrates the commoditization concept.

*Figure 6.4: Base Case Results: Commoditization Index*
6.2 Macroeconomic Sector

The macroeconomic sector is represented with an exogenous estimation of GDP, of population and several endogenous variables, such as marginal contribution to unemployment, marginal contribution to GDP, GDP per capita and telephonic penetration. The GDP expected growth for this base case has been extracted from some economic analysis performed by well-known economists in Argentina. However, those estimations have only a 5-year time horizon. The estimation for the remaining 15 years of the simulation are my best estimation. The estimation of population growth is based on the population compound annual growth rate extracted from the last census, carried out in 1991.

The following graph represents the estimated growth of GDP over the next 4 years, which was used for the base case.

*Figure 6.5: Base Case Results: Estimated GDP Real Growth until year 2000*

![GDP Growth Graph]

Source: Arriazu Analysts
The actual GDP is formed by this exogenous GDP and a marginal contribution of the telecommunications industry. The marginal contribution is considered proportional to revenues and is represented with an index variable with a starting value of 100. The following graph represents this marginal contribution.

*Figure 6.6: Base Case Results: Marginal Contribution to Argentina's GDP*

As the graph depicts, the marginal contribution follows a diminishing trend after a temporary overshoot. The reason for this reduction is tied to the constant reduction in telecom service tariffs, which is not entirely counterweighted by the increase in demand. Therefore, in real terms, the marginal contribution to the GDP is expected to decrease 15% approximately in 20 years.
By consolidating the expected GDP growth and the marginal contribution of the telecommunications industry, it is possible to assess the future GDP and GDP per capita. The following figure illustrates this variables.

Figure 6.7: Base Case Results: Estimations of GDP and GDP per capita

As the graphic represents, in the base case scenario, the GDP is expected to increase on an average of 4% per year for the next 20 years. Since this growth is higher than the net population growth, the GDP per capita is also expected to grow from a current value of around US$ 8,500 to a value of US$ 12,900, which represents an average of 2.1% per year.
As mentioned earlier, the limit to the unmet demand is the limit of purchasing power represented in this case with the GDP per capita. At each level of GDP per capita, the country should be “expected” to have a corresponding telephonic penetration. When the actual penetration is smaller than the expected, there is unmet demand, according to the regression explained in section 5.4.1. The following graph depicts these concepts.

*Figure 6.8: Base Case Results: Actual and Expected Telephonic Penetration*

The graph shows that during the simulation period, actual telephone penetration lags always behind the expected penetration with an increasing gap. The basic reason is that the GDP per capita, as an indication of purchasing power, increases more quickly than the network expansion. The network does not expand more rapidly because the
financial position of the companies is weaken by the lower profits that result from the price competition, thus limiting the amount of investments in the infrastructure.

The investment in infrastructure contributes marginally to the decrease in unemployment, since network expansion requires manpower. On the other side, however, the competing companies invest in operating efficiency and can become, over time, more productive. This improvement in productivity results in excess personnel, who are eventually laid off, which contributes to the unemployment. The following graph depicts this effect.

Figure 6.9: Base Case Results: Marginal Contribution to Unemployment
As it can be seen from the graph, the marginal contribution to unemployment has an initial oscillation, ranging from a maximum of 111 to a minimum of 85, which matches the period of more intensive investments in infrastructure, between years 4 to 6 of the simulation. From this moment on, the marginal contribution to unemployment increases as the result of less investments, until it reaches a steady state, with slower growth, mainly as the result of improvements in productivity.

6.3 Institutional Environment Sector

The analysis of this sector will clarify the dynamics that lead to a healthy political environment. The main variables represented are institutional support, as a measure of the alignment of the legislative and judicial branches of government with the executive, and the concentration of power in the Executive, as the measure of the maturity of Argentina’s democracy. There is also an exogenous variable, the “estimated concentration of power in the Executive”, which forecasts the evolution of this variable as democracy matures. In this base case, this variable is expected to decrease. Institutional support depends on the general welfare and the previously mentioned concentration of power. The following graph shows the behavior of these two variables.
The dynamics represented in Figure 6.10 above show a continuous improvement in the relationship between the Executive Branch-Legislators. This is due mainly to two reasons: first, the natural decline in the concentration of power and second, the improvements in the general welfare that legislators perceive, even with some delay. This perception allows the legislators to understand that the deregulation process in general is effective and is healthy for the country. The institutional perception of welfare is affected primarily with the unemployment and second with prices. Last, in third place and after some delay, the welfare impact positively the institutional support.

One of the main effects of the concentration of power in the Executive, is the marginal contribution to corruption. Eventually, political corruption has a negative
impact on the image of the country and negatively affects guarantees for the confidence of foreign investors. The following graph illustrates this variable.

\textbf{Figure 6.11: Base Case Results: Guarantee for Foreign Investors}

The graph clearly depicts that, while in relative terms there is not an outstanding increase in the guarantee for foreign investors (just 10%), it definitely increases over time and in an exponential pattern. This is the result of a slow decrease in the concentration of power and a slow increase in institutional support. All in all, the improvements in the guarantee for foreign investors results very healthy result for the country.

\subsection*{6.4 Welfare Sector}

The welfare sector is represented by four variables: on one side, individual components of the welfare index: social, economic and political welfare. On the other
side, the general welfare index represents the global impact of the deregulation in the prosperity of the Argentina.

The following graph depicts the expected behavior of these individual components.

**Figure 6.12: Base Case Results: Political, Social and Economic Welfare**

As the graph illustrates, there is a constant increase in all the components of the welfare index. First, the economic welfare, the slowest growing of the three components, grows steadily but slowly, mainly due to the decrease in the contribution to GDP and the increase in the contribution to unemployment. Nevertheless a modern infrastructure, able to provide high-quality and cheap telecom service, encourages the development of new businesses. Political welfare grows rapidly because due to the decay in the concentration of power in the Executive, which elevates the health of the democracy. The political welfare is also positively influenced by the availability of new media services, such as Internet, since the more the availability of media service is, the bigger the multiplicity of opinions. Last but not least, the social impact is the main winner as a result of the
deregulation. Modern infrastructure, high-quality service and low relative prices are the principal factors that promotes the social interaction, the key component of the social welfare. The following graph illustrates the general welfare index.

Figure 6.13: Base Case Results: Welfare Index

As the above graph clearly shows, the general welfare index increases dramatically, at a rate of approximately 14% per year. To understand this number, it is necessary to understand the equation of the welfare index:

\[ \text{Welfare index} = \frac{SWi \times Pwi \times Ewi}{10000} \]

The equation shows that there is an amplification effect of the individuals benefits, social, economic and political. If the three components grow 10% one particular year, the result is that the general welfare index increases by 33.1%, not 10%.
7. **MODEL ANALYSIS: ALTERNATIVE SCENARIOS**

This model can analyze hundreds of different scenarios, which result from the combination of all the possible values that the variables included in the control panel can adopt. In order to simplify this process, it is essential to identify the most far-reaching scenarios. In this way, it is possible to preview the potential range of outcomes of the simulations.

First, we will analyze the different deregulation sequences that involve local and long-distance service, based on the same exogenous macroeconomic and political scenario. Afterwards, we will analyze the most optimistic and most pessimistic of the feasible scenarios. Last, we will analyze the consequences of different price regulations, such as rate-of-return.

7.1 **Analysis of the Different Sequences in the Liberalization**

As was explained in section 5.8.2, there are four different ways for Argentina to deregulate the telecom services: to open the market for competition now in both local and long-distance (including international) service, to open both in three years, and to open one of these services now and the other in three years. In order to make a clear assessment of the outcomes of these scenarios, we will analyze the Herfindhal Index as an indication of the level of competition of the market, the welfare index as an indication of how prosperous the scenario is for the country and the commoditization index, as an
indication of how helpful the regulation is for the players involved. The following figure illustrates the results.

**Figure 7.1: Outcomes of the different sequences of liberalization**

<table>
<thead>
<tr>
<th>Welfare Index:</th>
<th>Local Service</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Now</td>
</tr>
<tr>
<td>LD and International Service</td>
<td>Now</td>
</tr>
<tr>
<td></td>
<td>In 3 Years</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Herfindhal Index:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local Service</td>
</tr>
<tr>
<td>Now</td>
</tr>
<tr>
<td>LD and International Service</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Commoditization Index:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local Service</td>
</tr>
<tr>
<td>Now</td>
</tr>
<tr>
<td>LD and International Service</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
The figures above show that the highest social welfare is obtained by liberalizing the entire market now. Carrying out the same sequence, the commoditization index is also one of the lowest, which benefits the players. These outcomes are not unexpected. Today, there is an important unmet demand for telecom services and, therefore, although the market pie is divided, the size of the pie continues to grow, thus slowing the commoditization effect consequence of the competition. The prosperity of the country is maximized with the introduction of competition as early as possible. Nevertheless, the simulation also shows that this difference is not overwhelming. On the contrary, all sequences notably increase the welfare of the country.

The results explained in the last paragraph are valid in the base case. In the base case, the expected growth in the GDP and the GDP per capita are generous and, as a consequence, there will be a market for many players. What will happen if the actual macroeconomic conditions are not so positive and there are serious income constraints in the population? The following section explains this scenario.

7.2 Pessimistic Macroeconomic Scenario

This scenario assumes that the GDP growth will oscillate around 0% with a slightly positive trend over 20 years. Under these conditions, and maintaining the remaining variables fixed, these are the expected results.
**Figure 7.2: Outcomes of the liberalization sequences with a pessimistic macro scenario**

**Welfare Index:**

<table>
<thead>
<tr>
<th></th>
<th>Local Service</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Now</td>
<td>In 3 Years</td>
</tr>
<tr>
<td>LD and International Service</td>
<td></td>
<td>1,352</td>
<td>1,326</td>
</tr>
<tr>
<td>In 3 Years</td>
<td></td>
<td>1,093</td>
<td>963</td>
</tr>
</tbody>
</table>

**Herfindhal Index:**

<table>
<thead>
<tr>
<th></th>
<th>Local Service</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Now</td>
<td>In 3 Years</td>
</tr>
<tr>
<td>LD and International Service</td>
<td></td>
<td>2,500</td>
<td>2,500</td>
</tr>
<tr>
<td>In 3 Years</td>
<td></td>
<td>3,604</td>
<td>5,000</td>
</tr>
</tbody>
</table>

**Commoditization Index:**

<table>
<thead>
<tr>
<th></th>
<th>Local Service</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Now</td>
<td>In 3 Years</td>
</tr>
<tr>
<td>LD and International Service</td>
<td></td>
<td>273</td>
<td>286</td>
</tr>
<tr>
<td>In 3 Years</td>
<td></td>
<td>195</td>
<td>191</td>
</tr>
</tbody>
</table>
The figures above illustrate how the market can behave differently compared to the base case. The first and the most important conclusion, the gap between the different sequences increases noticeably. Sequence number one, the liberalization of the entire market now, is again the sequence that has the highest positive impact on the general welfare of Argentina. While in the base case the difference between the sequence one and sequence four was only 6%, under this scenario this difference increases dramatically to 29%. The main reason is that real competition is not achieved, because the competitors eventually go bankrupt and the incumbent players recover 100% of the market, represented under the Herfindhal Index of 5,000. The following graph represents this case.

*Figure 7.3: Assessment of the Market Share under a Pessimistic Macro Scenario and Sequence of Deregulation Number 4*
Again, there is not much difference between sequences 1 and 2, but there is a very important difference between sequences 3 and 4. Secondly, as was expected, there is a faster commoditization of the market. At the 20th year of the simulation, the commoditization index is 37% higher than in the base case for sequence 1.

7.3 Rate-of-Return Price Regulation

The rate-of-return price regulation basically establishes the tariffs that will allow the players to have a “reasonable” rate of return of their investments. This type of regulation is generally used under monopolic markets. While under the price cap regulation the players can decrease prices more than the requirements of the X factor, under rate-of-return regulation is not possible. The method for determining the reasonable rate of return is closely linked to the marginal costs of the incumbents. In general, since to establish prices it is necessary to know a company’s operating costs, the efficiency of this type of regulation is jeopardized with the asymmetric information. For the purpose of the model, it is assumed that the players will invest in operational improvements, and as a result, the marginal costs will decrease. However, it is also assumed that the companies will not recognize the entire magnitude of this improvement until approximately the 20th year. In other words, there will be a reduction in prices but not at the same pace of operational improvements.

Under this scenario, the results of the four liberalization sequences are:
Figure 7.4: Rate-of-Return Price Regulation: Behavior of the 4 liberalization sequences

<table>
<thead>
<tr>
<th>Welfare Index:</th>
<th>Local Service</th>
<th>Now</th>
<th>In 3 Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>LD and</td>
<td></td>
<td>1,233</td>
<td>1,222</td>
</tr>
<tr>
<td>International</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Service</td>
<td></td>
<td>1,273</td>
<td>1,264</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Herfindhal Index:</th>
<th>Local Service</th>
<th>Now</th>
<th>In 3 Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>LD and</td>
<td></td>
<td>2,616</td>
<td>2,564</td>
</tr>
<tr>
<td>International</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Service</td>
<td></td>
<td>2,503</td>
<td>2,500</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Commoditization Index:</th>
<th>Local Service</th>
<th>Now</th>
<th>In 3 Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>LD and International</td>
<td></td>
<td>115</td>
<td>115</td>
</tr>
<tr>
<td>Service</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>119</td>
<td>118</td>
</tr>
</tbody>
</table>
As the figures above illustrate, when comparing the key variables with the base case, under the rate-of-return price-regulation scenario, there is a lower general welfare achievement. The main reason for this is that the reduction in prices is not so dramatic. The sequence number 1 is not any more the best solution. However, the differences in achievement of welfare of the 4 sequences are minimal, just 4% between the maximum and the minimum value (1,273 vs. 1,222). In terms of competition, it is possible to achieve a good rivalry under any of the sequences as the Herfindhal Index shows. Since reduction in prices are not so dramatic, the commoditization effect is much slower, reaching a maximum of 119, 72% less than in the base case. The following graphs illustrate some of these variables.

*Figure 7.5: Evolution of Prices Under Rate-of-Return Price Regulation, Sequence 3*
7.4 The Most Optimistic Case

The most optimistic case is obtained when the two exogenous variables, the macroeconomic and political scenarios, achieve their highest expected value together. Under this condition, it is necessary also to identify under which sequence of deregulation and what type of price regulation maximize the nation’s general welfare.

Based on the conditions described above on welfare maximization, the following is the most optimistic scenario:

- Macroeconomic Scenario: the most optimistic
- Political Scenario: lowest concentration of power in the Executive
- Type of Deregulation: Sequence 3, Local Service now, LD Service in 3 years
- Price Regulation: Price Cap
- Interconnection Charges: No
- X factor: independent, always that \( X \leq 4\% \)

Under this scenario, the welfare index reaches its maximum of 1,703, as the graph below depicts:

*Figure 7.7: General Welfare Index Under the Most Optimistic Scenario*

A welfare index of 1,703 in the 20th year of the simulation implies a compound annual growth of 15.3% in the general welfare index. This is the maximum possible growth under all the assumptions of this model.
The competition under the most optimistic case is also assured, as it is demonstrated by the Herfindhal Index of 2,617. Additionally, the commoditization of the industry is slower than in the base case, an expected outcome. The following graph shows the commoditization index.

Figure 7.8: Comoditization Index Under the Most Optimistic Scenario

7.5 The Most Pessimistic Scenario

This scenario identifies the combination of exogenous variables and regulatory mechanisms that minimize the general welfare index. To achieve this result, the appropriate state of each variable is:
- Macroeconomic Scenario: the most pessimistic
- Political Scenario: highest concentration of power in the Executive
- Type of Deregulation: Sequence 2, Local Service in 3 years, LD Service now
- Price Regulation: Rate-of-Return
- Interconnection Charges: Yes
- X factor: not applicable

Under these conditions, the general welfare index reaches its maximum in the 6th year of the simulation and then it declines. After four years it begins to rise again, reaching a value of 509 in the 20th year. The following graph depicts the welfare index.

*Figure 7.9: General Welfare Index Under the Most Pessimistic Scenario*
A final value of 509 in the welfare index means a compounded annual growth rate of 8.4%, almost half of the growth in the most optimistic case. Competition between players is also assured under this pessimistic scenario, as a Herfindhal Index of 2,501 confirms.

In terms of commoditization, this scenario is relatively harmless. A final index of 109 implies a compounded annual growth rate of 0.43%. The following graph represents the evolution of the commoditization index throughout the simulation period under the most pessimistic scenario.

*Figure 7.10: Commoditization Index Under the Most Pessimistic Scenario*
8. CONCLUSION

The deregulation of the telecommunications industry represents a unique opportunity for Argentina to regain at the end of the 20th century the privileged international position that it used to have at the beginning of this century. The privatization process carried out in 1990 was far from optimum. However, it is a worthless exercise to think what the situation that the telecommunications industry in Argentina would be today if the privatization had resulted better for the country. What matters now are the steps that Argentina takes in the future. The medium and long term consequences of the potential deregulation are of a great importance to Argentina. Due to the multiplier effect of telecom across almost every economic activity, mistakes in the design of new telecom regimes are quickly felt throughout the productive system, affecting Argentina’s ability to compete in the global economy.

This thesis made an assessment of the trends in the telecommunications industry worldwide, concentrating particularly in countries with liberalized markets. After discussing the problems encountered in the privatization process of ENTel, the thesis proposed the utilization of a system dynamics modeling approach that allows to understand the dynamics of the industry and its relationship with the macroeconomic situation, political stability and the prosperity of the nation, represented by an index called Welfare. This approach led to the development of a model that described the interaction of its four components: dynamics of the market (competition and
commoditization), macroeconomy, political sector and the welfare or prosperity of the country.

After defining the key levers of the regulation policy, like sequence of deregulation, price regulation and some exogenous variables like GDP growth and concentration of power in the Executive, the thesis described the behavior of the base case. Afterwards, alternative scenarios were developed, mixing regulatory policies with exogenous conditions.

The dynamics presented by the model determined the importance of the macroeconomic conditions in the evolution of the telecom industry. When the country experiences periods of economic growth, there are increases in demand for telecom services and the commoditization effect slows down. On the contrary, when the economy stagnates, the commoditization effect accelerates. However, it is important to note that this conclusion applies under the assumption of the model that competitors can not delay the entry once the market is liberalized. The same conclusion may not be applicable under different assumptions. The regulatory body should consider the described importance of the economic conditions when deciding the type of deregulation to pursue. The model showed that under the pessimistic macro scenario, the real competition can never be achieved if both the local and long-distance market are liberalized in three years.

The model also assessed the importance of a cohesive legal framework, represented by the institutional support. Anytime the "rules of the game" change, like during the privatization process, the government loses credibility and it takes time to regain it. The
The telecom industry in Argentina needs enormous sums of foreign investments. To attract these investors, the government needs to show a clear policy that guarantees these investments. The model also concluded that the way to do it is to decentralize the power of the Executive, assuming that the institutions will actually work for the prosperity of the country.

Under the base case scenario, any of the sequences of deregulation brings prosperity to the country. Additionally, real competition can also be achieved under any of the sequences of deregulation. However, the general welfare of the country is maximized when all markets are liberalized today. In other words, unless legal restrictions apply, there are no benefits to delay the liberalization of the market.

The model also proved the benefits of the price cap regulation over the rate-of-return price regulation. First, price cap regulation ensures sustained real price decreases. This ensures that productivity gains are shared with customers in the form of lower real prices. Second, price cap regulation permits price flexibility, including price rebalancing. This represents also an advantage for incumbents players, who don’t have the flexibility to decrease prices and are consequently exposed to higher threats from competitors. Third, price cap regulation provides sustained incentives for improving economic performance, ensuring that higher profits are not earned through raising overall prices but through operating efficiently. The more a firm reduces its costs, the higher the profits it can earn. Lastly, the price cap regulation avoids the problematic of the “asymmetric information” typical from the rate-of-return price regulations, providing incentives for
technological change and innovation. The thesis assumed that overall prices were impacted by the price cap regulation. It is possible however, to apply price cap regulation to the long-distance market, for example and use another regulation for the local service. The model determined that the price cap regulation is much more wealthy for the country than the rate-of-return price regulation.

The model showed the well-known trade-off that involves the consumer surplus, represented by the general welfare index, and the rate-of-return for the companies, represented by the commoditization index. A successful telecom policy should avoid this trade-off and promote differentiation among competitors. There is enough room to compete in prices in Argentina because the high tariffs in long-distance and international markets. However, once the prices of the telecom services decrease to a “reasonable” level in social terms, price differentiation will not be a competitive advantage. The offer of new and more sophisticated services will be essential to differentiate competitors. A modern telecom policy should avoid the trade-off represented in the vertical axis of the following graph and promote differentiation:

```
Consumer Surplus

Commoditization ← Product Differentiation

Rate-of-Return
```

106
It is clear that the world-wide trend in telecommunications is the multimedia. Multimedia is composed by three different segments of the information industry: telecommunications, broadcasting and computing. Each of these segments have quite different regulatory traditions. Argentina has experience in the first two. Information Technology, Internet in particular, is a brand new concepts in Argentina. The incredible technological innovation has transformed the role of the state from participant to regulator. The future role of the government will be promoter. The Argentine government should be prepared for the incoming challenges and benefits of multimedia.

In a world economy built by technology, the world is becoming more dependent on electronic communications, altering businesses, lifestyles and societies. If Argentina aims to regain a dominant international position in the global economy of the 21st century, it can not make mistakes in the design of the new telecom policies. It may never recover.
9. APPENDICES

APPENDIX A: Correlation Between GDP per Capita and Telephone Penetration

Source: OECD, ITU, 1995 Figures, Diego Luzuriaga Analysis

<table>
<thead>
<tr>
<th>Country</th>
<th>GDP per Capita US$/Hab</th>
<th>Telephone Penetration Lines/100H</th>
<th>Estimated Penetration 1</th>
<th>Estimated Penetration 2</th>
<th>Estimated Penetration 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>19,501</td>
<td>49.6</td>
<td>44.2</td>
<td>44.9</td>
<td>53.0</td>
</tr>
<tr>
<td>Austria</td>
<td>29,287</td>
<td>46.5</td>
<td>62.8</td>
<td>55.6</td>
<td>79.2</td>
</tr>
<tr>
<td>Belgium</td>
<td>26,611</td>
<td>44.9</td>
<td>57.8</td>
<td>52.9</td>
<td>72.1</td>
</tr>
<tr>
<td>Canada</td>
<td>19,302</td>
<td>57.5</td>
<td>43.8</td>
<td>44.7</td>
<td>52.5</td>
</tr>
<tr>
<td>Denmark</td>
<td>33,653</td>
<td>60.4</td>
<td>70.8</td>
<td>59.8</td>
<td>90.8</td>
</tr>
<tr>
<td>France</td>
<td>26,729</td>
<td>54.7</td>
<td>58.0</td>
<td>53.0</td>
<td>72.4</td>
</tr>
<tr>
<td>Germany</td>
<td>29,733</td>
<td>48.3</td>
<td>63.6</td>
<td>56.0</td>
<td>80.4</td>
</tr>
<tr>
<td>Greece</td>
<td>10,723</td>
<td>47.8</td>
<td>26.3</td>
<td>32.8</td>
<td>29.4</td>
</tr>
<tr>
<td>Italy</td>
<td>19,079</td>
<td>42.9</td>
<td>43.3</td>
<td>44.4</td>
<td>51.9</td>
</tr>
<tr>
<td>Japan</td>
<td>39,698</td>
<td>47.8</td>
<td>81.6</td>
<td>65.2</td>
<td>106.9</td>
</tr>
<tr>
<td>Mexico</td>
<td>2,656</td>
<td>9.2</td>
<td>7.9</td>
<td>15.7</td>
<td>7.4</td>
</tr>
<tr>
<td>Netherlands</td>
<td>25,803</td>
<td>50.9</td>
<td>56.3</td>
<td>52.0</td>
<td>69.9</td>
</tr>
<tr>
<td>Norway</td>
<td>34,056</td>
<td>60.8</td>
<td>71.5</td>
<td>60.2</td>
<td>91.9</td>
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<tr>
<td>Portugal</td>
<td>10,424</td>
<td>35.0</td>
<td>25.7</td>
<td>32.3</td>
<td>28.6</td>
</tr>
<tr>
<td>Spain</td>
<td>14,238</td>
<td>37.1</td>
<td>33.6</td>
<td>38.1</td>
<td>38.9</td>
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<tr>
<td>Sweden</td>
<td>26,022</td>
<td>68.3</td>
<td>56.7</td>
<td>52.2</td>
<td>70.5</td>
</tr>
<tr>
<td>Switzerland</td>
<td>43,752</td>
<td>59.7</td>
<td>88.8</td>
<td>68.6</td>
<td>117.7</td>
</tr>
<tr>
<td>Turkey</td>
<td>2,830</td>
<td>20.1</td>
<td>8.3</td>
<td>16.3</td>
<td>7.9</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>18,839</td>
<td>48.9</td>
<td>42.9</td>
<td>44.1</td>
<td>51.3</td>
</tr>
<tr>
<td>United States</td>
<td>26,786</td>
<td>59.5</td>
<td>58.1</td>
<td>53.0</td>
<td>72.5</td>
</tr>
<tr>
<td>Argentina</td>
<td>8,291</td>
<td>19.0</td>
<td>21.1</td>
<td>28.6</td>
<td>22.8</td>
</tr>
<tr>
<td>Singapore</td>
<td>22,500</td>
<td>47.3</td>
<td>50.0</td>
<td>48.4</td>
<td>61.1</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>21,650</td>
<td>54.0</td>
<td>48.3</td>
<td>47.4</td>
<td>58.8</td>
</tr>
<tr>
<td>Korea</td>
<td>8,260</td>
<td>39.7</td>
<td>21.0</td>
<td>28.6</td>
<td>22.7</td>
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<td>Israel</td>
<td>14,530</td>
<td>39.4</td>
<td>34.2</td>
<td>38.5</td>
<td>39.7</td>
</tr>
<tr>
<td>Malaysia</td>
<td>3,480</td>
<td>14.7</td>
<td>10.0</td>
<td>18.1</td>
<td>9.7</td>
</tr>
<tr>
<td>Chile</td>
<td>3,520</td>
<td>11.0</td>
<td>10.1</td>
<td>18.3</td>
<td>9.8</td>
</tr>
<tr>
<td>Brazil</td>
<td>2,970</td>
<td>7.4</td>
<td>8.7</td>
<td>16.7</td>
<td>8.3</td>
</tr>
<tr>
<td>Venezuela</td>
<td>2,760</td>
<td>10.9</td>
<td>8.1</td>
<td>16.1</td>
<td>7.7</td>
</tr>
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<td>South Africa</td>
<td>3,040</td>
<td>9.5</td>
<td>8.9</td>
<td>16.9</td>
<td>8.5</td>
</tr>
<tr>
<td>Thailand</td>
<td>2,410</td>
<td>4.7</td>
<td>7.2</td>
<td>15.0</td>
<td>6.7</td>
</tr>
<tr>
<td>China</td>
<td>530</td>
<td>2.3</td>
<td>2.0</td>
<td>6.7</td>
<td>1.5</td>
</tr>
<tr>
<td>Philippines</td>
<td>950</td>
<td>1.7</td>
<td>3.2</td>
<td>9.2</td>
<td>2.7</td>
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<td>Indonesia</td>
<td>880</td>
<td>1.3</td>
<td>3.0</td>
<td>8.8</td>
<td>2.5</td>
</tr>
<tr>
<td>India</td>
<td>320</td>
<td>1.1</td>
<td>1.3</td>
<td>5.2</td>
<td>0.9</td>
</tr>
</tbody>
</table>
APPENDIX B: Deregulation Model Diagram

The following is the complete system dynamics model diagram using the *ithink* software for the telecommunications deregulation process.

The Dynamics of Competition
The Dynamics of Commoditization
Prioritization of Investments

Table to Identify Priority

<table>
<thead>
<tr>
<th>First</th>
<th>Cap</th>
<th>Cap</th>
<th>SQ</th>
<th>SQ</th>
<th>NF</th>
<th>NF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Second</td>
<td>SQ</td>
<td>NF</td>
<td>Cap</td>
<td>NF</td>
<td>Cap</td>
<td>SQ</td>
</tr>
<tr>
<td>Third</td>
<td>NF</td>
<td>SQ</td>
<td>NF</td>
<td>Cap</td>
<td>SQ</td>
<td>Cap</td>
</tr>
</tbody>
</table>

Number | 1 | 2 | 3 | 4 | 5 | 6 |

Incorporate investments

Effect of Guarantee in foreign investments

Initial proportion of profits to CF

Inc Profits

Cum Inc Cash Flow

Comp Investments

Comp Profits

Inc Investments

Comp Initial Op Eff Prop

Type of Deregulation
Welfare Sector

[Diagram of relationships between various factors such as Prices, Service Quality, Facility for social interaction, Capacity, New Features, Inc Revenues, Incremental Revenues, Marginal contribution to GDP, Attractiveness to develop business, Delay in the Perception, Social Welfare, Marginal Contribution to unemployment, Economic Welfare, Effect of Inv in Umemp, Exogenous GDP Growth, Investments, Welfare, Herfindhal Index, Availability of Media Services, Political Welfare, Institutional Support, and New Features.]
Macroeconomic Sector
Regulatory Mechanisms

Key For Price Regulation
0  Price Cap
1  Marginal Cost

Table to determine the type of deregulation

<table>
<thead>
<tr>
<th>Local Service</th>
<th>Now</th>
<th>In 3 Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>International &amp; LD Service</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>In 3 Years</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>
Exogenous Scenarios

APPENDIX C: DEREGULATION MODEL DOCUMENTATION

The following is the complete documented set of equations and data used for the base case model. The documentation is presented by sectors which are alphabetically classified.

**Auxiliary Variables**

\[
\begin{align*}
\text{Capacity} &= \text{Inc\_Capacity} \cdot \text{Inc\_Market\_Share} + (1 - \text{Inc\_Market\_Share}) \cdot \text{Comp\_Capacity} \\
\text{Capacity\_Loading} &= \text{Inc\_Market\_Share} \cdot \text{Inc\_Capacity\_Loading} + (1 - \text{Inc\_Market\_Share}) \cdot \text{Comp\_Capacity\_Loading} \\
\text{Cash\_Flows} &= \text{Inc\_Cash\_Flow} \cdot \text{Inc\_Market\_Share} + (1 - \text{Inc\_Market\_Share}) \cdot \text{Comp\_Cash\_Flow} \\
\text{Commoditization\_Index} &= 1/2 \cdot 100 \cdot 100/\text{Prices} + 1/3 \cdot 100 \cdot \text{Inc\_Initial\_Capacity\_Loading}/\text{Capacity\_Loading} + 1/6 \cdot 100 \cdot 100/(\text{IF(Profits}<0)\text{THEN}(5)\text{ELSE(Profits)})) \\
\text{Comp\_Market\_Share} &= \text{Competitors\_Customers}/\text{Total\_Customers} \\
\text{Cumulative\_Cash\_Flow} &= \text{Cum\_Inc\_Cash\_Flow} \cdot \text{Inc\_Market\_Share} + (1 - \text{Inc\_Market\_Share}) \cdot \text{Cum\_Comp\_Cash\_Flow} \\
\text{Inc\_Market\_Share} &= \text{Incumbents\_Customers}/\text{Total\_Customers} \\
\text{Investments} &= \text{Inc\_Investments} \cdot \text{Inc\_Market\_Share} + (1 - \text{Inc\_Market\_Share}) \cdot \text{Comp\_Investments} \\
\text{New\_Features} &= \text{Inc\_New\_Features} \cdot \text{Inc\_Market\_Share} + \text{Comp\_New\_Features} \cdot (1 - \text{Inc\_Market\_Share}) \\
\text{Prices} &= \text{Comp\_Price} \cdot \text{Comp\_Market\_Share} + (1 - \text{Comp\_Market\_Share}) \cdot \text{Inc\_Price} \\
\text{Profitability} &= \text{Comp\_Profitability} \cdot \text{Comp\_Market\_Share} + (1 - \text{Comp\_Market\_Share}) \cdot \text{Inc\_Profitability} \\
\text{Profits} &= \text{Inc\_Profits} \cdot \text{Inc\_Market\_Share} + (1 - \text{Inc\_Market\_Share}) \cdot \text{Comp\_Profits} \\
\text{Service\_Quality} &= \text{Comp\_Service\_Quality} \cdot \text{Comp\_Market\_Share} + (1 - \text{Comp\_Market\_Share}) \cdot \text{Inc\_Service\_Quality} \\
\text{Total\_Customers} &= \text{Competitors\_Customers} + \text{Incumbents\_Customers}
\end{align*}
\]

**Dynamics of Commoditization**

\[
\begin{align*}
\text{Comp\_Capacity}(t) &= \text{Comp\_Capacity}(t - dt) + (\text{Comp\_Capacity\_Delivery\_Rate} - \\
\text{Comp\_Capacity\_Deprec\_Rate}) \cdot dt \\
\text{INIT\ Comp\_Capacity} &= 100
\end{align*}
\]

**INFLOWS:**
- \text{Comp\_Capacity\_Delivery\_Rate} = \text{MIN(Comp\_Installation\_Rate,Comp\_Capacity\_Order\_Backlog/Comp\_Min\_Installation\_Time)}

**OUTFLOWS:**
- \text{Comp\_Capacity\_Deprec\_Rate} = \text{Comp\_Capacity} \cdot \text{Comp\_Dep\_Rate}
- \text{Comp\_Capacity\_Order\_Backlog}(t) = \text{Comp\_Capacity\_Order\_Backlog}(t - dt) + \\
  \text{(Comp\_Capacity\_Order\_Rate} - \text{Comp\_Capacity\_Delivery\_Rate}) \cdot dt \\
\text{INIT\ Comp\_Capacity\_Order\_Backlog} &= \text{Comp\_Capacity} \cdot .1
Comp_Capacity_Order_Rate =
(MAX(((Effect_of_Guarantee_in_foreign_investments*(MAX(0,(Comp_Desired_Capacity-
Comp_Capacity)/2)))+Comp_Capacity_Deprec_Rate))*MAX(0,Comp_Loading_Effect_on_Orders*
(Comp_Inv_in_Cap/Comp_py_Inv_Cap)),Comp_Capacity_Deprec_Rate))
OUTFLOWS:
Comp_Capacity_Delivery_Rate =
MIN(Comp_Installation_Rate,Comp_Capacity_Order_Backlog/Comp_Min_Installation_Time)
Comp_Demand_per_user(t) = Comp_Demand_per_user(t - dt) +
(Changes_in_Comp_Demand_per_User) * dt
INIT Comp_Demand_per_user = 100

INFLOWS:
Changes_in_Comp_Demand_per_User =
SMTH1(((1+Welfare/1000)*((Comp_Demand_per_user*(.2*Elasticity_to_GDP*GDP_Growth+
.2*Price_Elasticity*Comp_Perc_Change_in_Price+2*Comp_Per_Change_in_Serv_Quality+.4*
Comp_Perc_Change_in_NF)*Comp_Loading_Effect_on_Demand)),Comp_Delay)
Comp_Price(t) = Comp_Price(t - dt) + (Changes_in_Comp_Price) * dt
INIT Comp_Price = 100

INFLOWS:
Changes_in_Comp_Price = (1-Price_Regulation)*(SMTH1((MAX(-
0.04*Comp_Price,((1+Comp_Perc_Change_in_NF)*MIN((Price_Cap-
Comp_Price),Comp_Price*(Comp_Loading_Effect_on_Price*Comp_Profit_Effect_on_Price-
1)))),Comp_time_to_change_Price)))+Price_Regulation*(SMTH1((Price_Cap-
Comp_Price,Comp_time_to_change_Price))
Inc_Capacity(t) = Inc_Capacity(t - dt) + (Inc_Capacity_Delivery_Rate -
Inc_Capacity_Deprec_Rate) * dt
INIT Inc_Capacity = 100

INFLOWS:
Inc_Capacity_Delivery_Rate =
MIN(Inc_Installation_Rate,Inc_Capacity_Order_Backlog/Inc_Min_Installation_Time)
OUTFLOWS:
Inc_Capacity_Deprec_Rate = Inc_Capacity*Inc_Dep_Rate
Inc_Capacity_Order_Backlog(t) = Inc_Capacity_Order_Backlog(t - dt) +
(Inc_Capacity_Order_Rate - Inc_Capacity_Delivery_Rate) * dt
INIT Inc_Capacity_Order_Backlog = Inc_Capacity*.1

INFLOWS:
Inc_Capacity_Order_Rate =
(MAX(((Effect_of_Guarantee_in_foreign_investments*(MAX(0,(Inc_Desired_Capacity-
Inc_Capacity)/2)))+Inc_Capacity_Deprec_Rate))*MAX(0,Inc_Loading_Effect_on_Orders*(Inc_Inv_in_Cap/Inc_Pevious_Year_Inv_in_Cap)),Inc_Capacity_Deprec_Rate))
OUTFLOWS:
Inc_Capacity_Delivery_Rate =
MIN(Inc_Installation_Rate,Inc_Capacity_Order_Backlog/Inc_Min_Installation_Time)
Inc_Demand_per_user(t) = Inc_Demand_per_user(t - dt) +
(Changes_in_Inc_Demand_per_User) * dt
INIT Inc_Demand_per_user = 100
INFLOWS:
Changes_in_Inc_Demand_per_User =
SMTH1(((1+Welfare/1000)*(((Inc_Demand_per_user*(.2*Elasticity_to_GDP*GDP_Growth+.2
*Price_Elasticity*Inc_Perc_Change_in_Price+.2*Inc_Change_in_Serv_Quality+.4*Inc_Perc_C
hange_in_New_Features))*Inc_Loading_Effect_on_Demand)),Inc_Delay)
Inc_Price(t) = Inc_Price(t - dt) + (Changes_in_Inc_Price) * dt
INIT Inc_Price = 100

INFLOWS:
Changes_in_Inc_Price = (1-Price_Regression)*(SMTH1((MAX(-
0.04*Inc_Price,((1+Inc_Perc_Change_in_New_Features)*(MIN((Price_Cap-
Inc_Price),Inc_Price*(Inc_Loading_Effect_on_Price*Inc_Profit_Effect_on_Price-
1)))))),Inc_time_to_change_Price)) + Price_Regression*(SMTH1((Price_Cap-
Inc_Price),Inc_time_to_change_Price))
Comp_Capacity_Loading = Comp_Initial_Capacity_Loading*Comp_Demand/Comp_Capacity
Comp_Delay = 1.5
Comp_Dep_Rate = .035
Comp_Desired_Capacity =
Comp_Projected_Demand/Comp_Target_Utilization*Comp_Capacity_Loading
Comp_Initial_Capacity_Loading = .65
Comp_Initial_Profitability = .3
Comp_Installation_Rate = 70
Comp_Min_Installation_Time = .5
Comp_Perc_Change_in_Price = Changes_in_Compare_Price/Comp_Price
Comp_Previous_Year_Inv_Cap = DELAY(Comp_Inv_in_Cap,1.0)
Comp_Profitability = Comp_Initial_Profitability*Comp_Profits/Comp_Revenues
Comp_Profit_Gap = SMTH1(Comp_Profitability,1.5,0.001)/Comp_Target_Profitability
Comp_Projected_Demand = FORCST(Comp_Demand,1.0,0.05)
Comp_py_Inv_Cap =
if(Comp_Previous_Year_Inv_Cap=0)then(1)else(Comp_Previous_Year_Inv_Cap)
Comp_Target_Profitability = .35
Comp_time_to_change_Price = .8
Elasticity_to_GDP = IF(SMTH1(GDP_Growth,0.5)>0)THEN(0.85)ELSE(0.7)
Inc_Capacity_Loading = Inc_Initial_Capacity_Loading*Inc_Demand/Inc_Capacity
Inc_Delay = 1.5
Inc_Dep_Rate = .035
Inc_Desired_Capacity = Inc_Projected_Demand/Inc_Target_Utilization*Inc_Capacity_Loading
Inc_Initial_Capacity_Loading = .7
Inc_Initial_Profitability = .38
Inc_Installation_Rate = 30
Inc_Min_Installation_Time = .5
Inc_Perc_Change_in_Price = Changes_in_Inc_Price/Inc_Price
Inc_Previous_Year_Inv_in_Cap = DELAY(Inc_Inv_in_Cap,1.0)
Inc_Profitability = Inc_Initial_Profitability*Inc_Profits/Inc_Revenues
Inc_Profit_Gap = SMTH1(Inc_Profitability,1.5,0.001)/Inc_Target_Profitability
Inc_Projected_Demand = FORCST(Comp_Demand,1.0,0.05)
Inc_Target_Profitability = .35
Inc_time_to_change_Price = .8
Comp_Loading_Effect_on_Demand = GRAPH(SMTH1(Comp_Capacity_Loading, 1))
(0.00, 1.00), (0.1, 1.00), (0.2, 1.00), (0.3, 0.92), (0.4, 0.76), (0.5, 0.54), (0.6, 0.3), (0.7, 0.00),
(0.8, -0.44), (0.9, -0.76), (1, -1.00)
Comp_Loading_Effect_on_Orders = GRAPH(SMTH1(Comp_Capacity_Loading, 1))
(0.00, 0.00), (0.1, 0.3), (0.2, 0.6), (0.3, 0.9), (0.4, 1.20), (0.5, 1.50), (0.6, 1.80), (0.7, 2.10), (0.8,
2.40), (0.9, 2.70), (1, 3.00)
Comp_Loading_Effect_on_Price =
GRAPH(SMTH1(Comp_Capacity_Loading/Comp_Target_Utilization, 1))
(0.75, 0.7), (0.8, 0.82), (0.85, 0.9), (0.9, 0.95), (0.95, 0.98), (1.00, 1.00), (1.05, 1.02), (1.10,
1.05), (1.15, 1.10), (1.20, 1.18), (1.25, 1.30)
Comp_Loading_Effect_on_Service_Quality = GRAPH(Comp_Capacity_Loading)
(0.00, 1.50), (0.1, 1.50), (0.2, 1.46), (0.3, 1.39), (0.4, 1.29), (0.5, 1.15), (0.6, 1.03), (0.7, 0.825),
(0.8, 0.543), (0.9, 0.1), (1, -1.00)
Comp_Profit_Effect_on_Price = GRAPH(SMTH1(Comp_Profit_Gap, 1))
(0.00, 1.15), (0.2, 1.10), (0.4, 1.06), (0.6, 1.03), (0.8, 1.01), (1, 1.00), (1.20, 0.99), (1.40, 0.97),
(1.60, 0.94), (1.80, 0.9), (2.00, 0.85)
Comp_Target_Utilization = GRAPH(Time)
(0.00, 0.85), (2.00, 0.86), (4.00, 0.87), (6.00, 0.88), (8.00, 0.88), (10.0, 0.88), (12.0, 0.88), (14.0,
0.88), (16.0, 0.88), (18.0, 0.88), (20.0, 0.88)
Inc_Loading_Effect_on_Demand = GRAPH(SMTH1(Inc_Capacity_Loading, 1))
(0.00, 1.00), (0.1, 1.00), (0.2, 1.00), (0.3, 0.955), (0.4, 0.76), (0.5, 0.483), (0.6, 0.235), (0.7,
0.00), (0.8, -0.238), (0.9, -0.388), (1, -0.47)
Inc_Loading_Effect_on_Orders = GRAPH(SMTH1(Inc_Capacity_Loading, 1))
(0.00, 0.00), (0.1, 0.3), (0.2, 0.6), (0.3, 0.9), (0.4, 1.20), (0.5, 1.50), (0.6, 1.80), (0.7, 2.10), (0.8,
2.40), (0.9, 2.70), (1, 3.00)
Inc_Loading_Effect_on_Price =
GRAPH(SMTH1(Inc_Capacity_Loading/Inc_Target_Utilization, 1))
(0.75, 0.7), (0.8, 0.82), (0.85, 0.9), (0.9, 0.95), (0.95, 0.98), (1.00, 1.00), (1.05, 1.02), (1.10,
1.05), (1.15, 1.10), (1.20, 1.18), (1.25, 1.30)
Inc_Loading_Effect_on_Service_Quality = GRAPH(Inc_Capacity_Loading)
(0.00, 1.50), (0.1, 1.50), (0.2, 1.41), (0.3, 1.28), (0.4, 1.16), (0.5, 0.938), (0.6, 0.738), (0.7,
0.488), (0.8, 0.238), (0.9, -0.0375), (1, -1.00)
Inc_Profit_Effect_on_Price = GRAPH(SMTH1(Inc_Profit_Gap, 1))
(0.00, 1.15), (0.2, 1.10), (0.4, 1.06), (0.6, 1.03), (0.8, 1.01), (1, 1.00), (1.20, 0.99), (1.40, 0.97),
(1.60, 0.94), (1.80, 0.9), (2.00, 0.85)
Inc_Target_Utilization = GRAPH(Time)
(0.00, 0.85), (2.00, 0.88), (4.00, 0.885), (6.00, 0.89), (8.00, 0.9), (10.0, 0.91), (12.0, 0.92), (14.0,
0.93), (16.0, 0.94), (18.0, 0.95), (20.0, 0.96)
Price_Elasticity = GRAPH(Herfindhal_Index)
(0.00, -1.87), (500, -1.86), (1000, -1.80), (1500, -1.54), (2000, -1.21), (2500, -0.88), (3000, -0.65),
(3500, -0.53), (4000, -0.44), (4500, -0.4), (5000, -0.38)

Dynamics of Competition

Competitors_Customers(t) = Competitors_Customers(t - dt) + (Relative_Attractiveness +
Comp_Adoption_Rate) * dt
INIT Competitors_Customers = 0

INFLOWS:
Relative_Atractivityness = SMTH1(((Comp_Atractivityness-
Inc_Atractivityness)*((Incumbents_Customers/Initial_Customers)^2)),Adjusting_Time)
Comp_Adoption_Rate =
SMTH1(Unmet_Demand*Comp_Marginal_Market_Share/10,Time_to_meet_demand)
Comp_Atractivityness(t) = Comp_Atractivityness(t - dt) + (Changes_in_Company_Atractivityness)*
dt
INIT Comp_Atractivityness = Inc_Atractivityness+(-.5*(Comp_Price-
Inc_Price)+.75*(Comp_Service_Quality-Inc_Service_Quality)+.75*(Comp_New_Features-
Inc_New_Features))

INFLOWS:
Changes_in_Company_Atractivityness = -
1*Price_Weight*Changes_in_Company_Price+NF_Weight*Changes_in_Company_New_Features+SQ
_Weight*Changes_in_Company_Service_Quality
Comp_New_Features(t) = Comp_New_Features(t - dt) + (Changes_in_Company_New_Features-
Comp_New_Features_Impact_Loss) * dt
INIT Comp_New_Features = 100

INFLOWS:
Changes_in_Company_New_Features =
SMTH1(MAX(Comp_New_Features_Impact_Loss,(Comp_Inv_in_NF/Comp_py_inv_NF*5)),
Comp_New_Features_Delay)
OUTFLOWS:
Comp_New_Features_Impact_Loss = Comp_New_Features*CompNF_Perception_Loss
Comp_Service_Quality(t) = Comp_Service_Quality(t - dt) +
(Changes_in_Company_Service_Quality) * dt
INIT Comp_Service_Quality = 100

INFLOWS:
Changes_in_Company_Service_Quality =
SMTH1((Comp_Inv_in_SQ*5/(IF(Comp_Previous_Year_Inv_SQ=0)THEN(1)ELSE(Comp_Pre-
vious_Year_Inv_SQ))*Comp_Loading_Effect_on_Service_Quality),Comp_Service_Perc_Delay)
Incumbents_Customers(t) = Incumbents_Customers(t - dt) + (Inc_Adoption_Rate -
Relative_Atractivityness) * dt
INIT Incumbents_Customers = Initial_Percentage_of_Customers

INFLOWS:
Inc_Adoption_Rate =
SMTH1(Unmet_Demand*Inc_Marginal_Market_Share/10,Time_to_meet_demand)
OUTFLOWS:
Relative_Atractivityness = SMTH1(((Comp_Atractivityness-
Inc_Atractivityness)*((Incumbents_Customers/Initial_Customers)^2)),Adjusting_Time)
Inc_Atractivityness(t) = Inc_Atractivityness(t - dt) + (Changes_in_Inc_Atractivityness) * dt
INIT Inc_Atractivityness = 100
Changes in Inc Attractiveness = 
\[ 1 \times \frac{\text{Changes in Inc Price} \times \text{Price Weight} + \text{NF Weight}}{\text{Changes in Inc New Features} + \text{SQ Weight}} \times \text{Inc Change in Serv Quality} \]
Inc New Features(t) = Inc New Features(t - \(dt\)) + (Changes in Inc New Features - Inc New Features Impact Loss) \(\times dt\)
INIT Inc New Features = 100

INFLOWS:
Changes in Inc New Features = 
\[ \text{SMTH1(MAX(Inc New Features Impact Loss, (Inc Inv in NF/Inc py Inv in NF*5)), Inc New Features Delay)} \]
OUTFLOWS:
Inc New Features Impact Loss = Inc New Features \times Inc NF Perception Loss
Inc Service Quality(t) = Inc Service Quality(t - \(dt\)) + (Inc Change in Serv Quality) \(\times dt\)
INIT Inc Service Quality = 100

INFLOWS:
Inc Change in Serv Quality = 
\[ \text{SMTH1((Inc Inv in SQ*5/(IF(Inc Prior Year Inv SQ=0)THEN(1)ELSE(Inc Prior Year Inv SQ))) \times Inc Loading Effect on Service Quality, Inc Service Perc Delay)} \]
Unmet Demand(t) = Unmet Demand(t - \(dt\)) + (Change in UD - Inc Adoption Rate - Comp Adoption Rate) \(\times dt\)
INIT Unmet Demand = Perc Unmet/Lines per customer \times 100

INFLOWS:
Change in UD = Unmet Customers/Time to meet demand
OUTFLOWS:
Inc Adoption Rate = 
\[ \text{SMTH1(Unmet Demand*Inc Marginal Market Share/10, Time to meet demand)} \]
Comp Adoption Rate = 
\[ \text{SMTH1(Unmet Demand*Comp Marginal Market Share/10, Time to meet demand)} \]
Adjusting Time = 2
Comp Demand = 100+Competitors Customers*Comp Demand per user/100
Comp Initial Dep Prop = .9
Comp Marginal Market Share = Comp Attractiveness/Total Attractiveness
Comp New Features Delay = 1
Comp NF Perception Loss = .005
Comp Operating Costs = 
\[ 100 \times (\text{Comp Capacity/100} \times \text{Comp Initial Dep Prop} \times \text{Comp Op Cost Trend Factor}/100 + \text{Comp Demand/100} \times (1-\text{Comp Initial Dep Prop)))} \]

Comp Perc Change in NF = Changes in Comp New Features/Comp New Features
Comp Per Change in Serv Quality = 
Changes in Comp Service Quality/Comp Service Quality
Comp Previous Year Inv SQ = DELAY(Comp Inv in SQ, 1.0)
Comp Prior Year Inv NF = DELAY(Comp Inv in NF, 1.0)
Comp Profits = (100/Comp Initial Profitability)*(Comp Revenues/100 - (Comp Operating Costs/100*(1-Comp Initial Profitability)))-Interconnect Charges
Comp py inv NF = if(Comp Prior Year Inv NF=0)then(1)else(Comp Prior Year Inv NF)
Comp Revenues = Comp Price*Comp Demand/100

122
Comp_Service_Perc_Delay = .6
Herfindhal_Index =
5000*((Incumbents_Customers/(Incumbents_Customers+Competitors_Customers))^2)+((Competitors_Customers/(Competitors_Customers+Incumbents_Customers))^2))
Inc_Demand = Incumbents_Customers*Inc_Demand_per_user/Initial_Percentage_of_Customers
Inc_Initial_Dep_Proportion = .9
Inc_Marginal_Market_Share = Inc_Attractiveness/Total_Attractiveness
Inc_New_Features_Delay = 1
Inc_NF_Perception_Loss = .005
Inc_Operating_Costs =
100*(Inc_Capacity/100*Inc_Initial_Dep_Proportion*Inc_Op_Cost_Trend_Factor/100+Inc_Demand/100*(1-Inc_Initial_Dep_Proportion))
Inc_Perc_Change_in_New_Features = Changes_in_Inc_New_Features/Inc_New_Features
Inc_Per_Change_in_Serv_Quality = Inc_Change_in_Serv_Quality/Inc_Service_Quality
Inc_Previous_Year_Inv_in_NF = DELAY(Inc_Inv_in_NF,1,0)
Inc_Prior_Year_Inv_QO = DELAY(Inc_Inv_in_QO,1,0)
Inc_Profits = (100/Inc_Initial_Profitability*(Inc_Revenues/100-(Inc_Operating_Costs/100*(1-Inc_Initial_Profitability))))+Interconnect_Charges
Inc_py_inv_in_NF =
IF(Inc_Previous_Year_Inv_in_NF=0)THEN(1)ELSE(Inc_Previous_Year_Inv_in_NF)
Inc_Revenues = Inc_Price*Inc_Demand/100
Inc_Service_Perc_Delay = .6
Initial_Customers = 100
Initial_Percentage_of_Customers = 80
Time_to_meet_demand = 3
Total_Attractiveness = Comp_Attractiveness+Inc_Attractiveness

Exogenous_Scenarios

Exogenous_GDP_Growth =
IF(Macro_Scenario=0)THEN(GDP_Pessimistic)ELSE((IF(Macro_Scenario=1)THEN(GDP_Base_Case)ELSE(GDP_Optimistic)))
Expected_Concentration_of_Power =
IF(Political_Scenario=0)THEN(Low_Power_Concentration)ELSE((IF(Political_Scenario=1)THEN(Base_Case_Power_Concentration)ELSE(High_Power_Concentration)))
Macro_Scenario = 1
Political_Scenario = 1
Base_Case_Power_Concentration = GRAPH(TIME)
(0.00, 100.00), (5.00, 99.00), (10.00, 95.00), (15.00, 87.00), (20.00, 78.00), (25.00, 73.00), (30.00, 69.00), (35.00, 66.00), (40.00, 65.00), (45.00, 63.00), (50.00, 62.00)
GDP_Base_Case = GRAPH(Time)
(0.00, 0.072), (2.00, 0.059), (4.00, 0.048), (6.00, 0.028), (8.00, 0.049), (10.00, 0.02), (12.00, 0.024), (14.00, 0.0245), (16.00, 0.0245), (18.00, 0.025), (20.00, 0.027)
GDP_Optimistic = GRAPH(time)
(0.00, 0.08), (2.00, 0.07), (4.00, 0.065), (6.00, 0.08), (8.00, 0.08), (10.00, 0.07), (12.00, 0.07), (14.00, 0.08), (16.00, 0.07), (18.00, 0.08), (20.00, 0.07)
GDP_Pessimistic = GRAPH(time)
Institutional Environment

Concentration_of_Power_in_the_Executive(t) = Concentration_of_Power_in_the_Executive(t - dt) + (Changes_in_Concentration) * dt
INIT Concentration_of_Power_in_the_Executive = 100

INFLOWS:
Changes_in_Concentration = SMTH1(((0.15*(Previous_Year_Inst Support - Institutional Support))/5+0.85*(Expected_Concentration_of_Power - Concentration_of_Power_in_the_Executive)/5),Time_to_adjust_concentration)
Institutional Support(t) = Institutional Support(t - dt) + (Changes_in_Institutional_Support) * dt
INIT Institutional_Support = 100

INFLOWS:
Changes_in_Institutional_Support = SMTH1(((0.1*(Institutional_Perception_of_Welfare - Previous_Year_Inst Percep))/5+0.9*(Previous_Year_Power_Conce - Concentration_of_Power_in_the_Executive)/5),Time_to_adjust_institutional_support)
Guarantee_for_foreign_investors =
0.1*Institutional_Support+0.9*100*100/Marginal_contribution_to_corruption
Institutional_Perception_of_Welfare =
0.4*100*100/Prices+0.3*100*100/Marginal_Contribution_to_unemployment+0.3*(DELAY(Welfare,1.0))
Previous_Year_Inst_Percep = DELAY(Institutional_Perception_of_Welfare,1.0)
Previous_Year_Support = DELAY(Institutional_Support,1.0)
Previous_Year_Power_Conce = DELAY(Concentration_of_Power_in_the_Executive,1.0)
Time_to_adjust_concentration = 5
Time_to_adjust_institutional_support = 1
Effect_of_Guarantee_in_foreign_investments = GRAPH(Guarantee_for_foreign_investors)
(0.00, 0.015), (20.0, 0.025), (40.0, 0.08), (60.0, 0.2), (80.0, 0.5), (100, 1.00), (120, 1.14), (140, 1.22), (160, 1.28), (180, 1.31), (200, 1.33)
Marginal_contribution_to_corruption = GRAPH(Concentration_of_Power_in_the_Executive)
(0.00, 42.0), (20.0, 48.0), (40.0, 57.0), (60.0, 68.0), (80.0, 81.0), (100, 100), (120, 165), (140, 192), (160, 198), (180, 199), (200, 200)
Macroeconomic Sector

GDP(t) = GDP(t - dt) + (Changes_in_GDP) * dt
INIT GDP = 300e9

INFLOWS:
Changes_in_GDP = GDP_Growth*GDP
Population(t) = Population(t - dt) + (Net_population_Growth) * dt
INIT Population = 35e6

INFLOWS:
Net_population_Growth = Population*Population_Increase_Rate
Expected_Telephonic_Penetration = 10^(-2.06323+0.864386*(LOG10(GDP_per_Capita)))
GDP_Growth = Exogenous_GDP_growth*(1+Marginal_contribution_to_GDP/800)
GDP_per_Capita = GDP/Population
Initial_Capacity = 7e6
Lines_per_customer = 1
Perc_Unmet = Unmet_Capacity/Telephonic_Lines
Population_Increase_Rate = 0.019
Telephonic_Lines = Initial_Capacity*Capacity/100
Telephonic_Penetration = Telephonic_Lines*100/Population
Unmet_Capacity = Unmet_Penetration*Population/100
Unmet_Customers = Perc_Unmet*Total_Customers/Lines_per_customer
Unmet_Penetration = MAX(0,Expected_Telephonic_Penetration-Telephonic_Penetration)

NPV

Discount_Factor(t) = Discount_Factor(t - dt) + (- Reducing_Discount_Factor) * dt
INIT Discount_Factor = 1

OUTFLOWS:
Reducing_Discount_Factor = Discount_Factor*Discount_Rate
PV_of_Investments(t) = PV_of_Investments(t - dt) + (Incr_PV) * dt
INIT PV_of_Investments = 0

INFLOWS:
Incr_PV = Original_Investment*Investments/100*Discount_Factor
PV_of_Profits(t) = PV_of_Profits(t - dt) + (Increasing_PV) * dt
INIT PV_of_Profits = 0

INFLOWS:
Increasing_PV = Original_Profit*Profits/100*Discount_Factor
Discount_Rate = .15
Original_Investment = 800e6
Original_Profit = 200e6
ROI = PV_of_Profits/PV_of_Investments
Prioritization of Investments

Cum_Comp_Cash_Flow(t) = Cum_Comp_Cash_Flow(t - dt) + (Comp_Cash_Flow) * dt
INIT Cum_Comp_Cash_Flow = 100

INFLOWS:
Comp_Cash_Flow = Initial_Comp_Proportion_Profits to CF * Comp_Profits -
(Comp_Investments * (Initial_Comp_Proportion_Profits to CF - 1))
Cum_Inc_Cash_Flow(t) = Cum_Inc_Cash_Flow(t - dt) + (Inc_Cash_Flow) * dt
INIT Cum_Inc_Cash_Flow = 100

INFLOWS:
Inc_Cash_Flow = 100 * (Initial_Proportion_Profits to CF * Inc_Profits / 100 -
(Inc_Investments / 100 * (Initial_Proportion_Profits to CF - 1)))
Comp_Cap_Priority =
IF(Comp_Priority < 3) THEN(1) ELSE (IF(Comp_Priority = 3) THEN(2) ELSE ((IF(Comp_Priority = 4)
) THEN(3) ELSE ((IF(Comp_Priority = 5) THEN(2) ELSE (3)))))
Comp_initial_cap_prop = 1/4
Comp_initial_NF_prop = 1/4
Comp_Initial_Op_Eff_PROP = 1/4
Comp_initial_SQ_prop = 1/4
Comp_Investments =
Max(0, Comp_Investment_Proportion * Comp_Profits * Effect_of_Guarantee_in_foreign_investments)
Comp_Init_in_Cap =
Comp_Investments / Comp_initial_cap_prop * (Comp_x_proportion * (IF(Comp_Cap_Priority = 1)
THEN(1) ELSE (0)) + Comp_y_proportion * (IF(Comp_Cap_Priority = 2) THEN(1) ELSE (0)) +
Comp_z_proportion * (IF(Comp_Cap_Priority = 3) THEN(1) ELSE (0)))
Comp_Init_in_NF =
Comp_Investments / Comp_initial_NF_prop * (Comp_x_proportion * (IF(Comp_NF_Priority = 1)
THEN(1) ELSE (0)) + Comp_y_proportion * (IF(Comp_NF_Priority = 2) THEN(1) ELSE (0)) +
Comp_z_proportion * (IF(Comp_NF_Priority = 3) THEN(1) ELSE (0)))
Comp_Init_in_SQ =
Comp_Investments / Comp_initial_SQ_prop * (Comp_x_proportion * (IF(Comp_SQ_Priority = 1)
THEN(1) ELSE (0)) + Comp_y_proportion * (IF(Comp_SQ_Priority = 2) THEN(1) ELSE (0)) +
Comp_z_proportion * (IF(Comp_SQ_Priority = 3) THEN(1) ELSE (0)))
Comp_Init_Op_Eff = Comp_Investments * Comp_Init_Op_Eff_PROP / Comp_Initial_Op_Eff_PROP
Comp_Init_Op_Eff_PROP = 1 - Comp_z_proportion - Comp_y_proportion - Comp_x_proportion
Comp_NF_Priority =
IF(Comp_Priority > 4) THEN(1) ELSE (IF(Comp_Priority = 1) THEN(3) ELSE ((IF(Comp_Priority = 2)
) THEN(2) ELSE ((IF(Comp_Priority = 3) THEN(3) ELSE (2)))))
Comp_Priority =
IF(Type_of_Deregulation = 1) THEN(6) ELSE ((IF(Type_of_Deregulation = 2) THEN(6) ELSE
(IF(Type_of_Deregulation = 3) THEN(2) ELSE (6)))
Comp_SQ_Priority =
IF(Comp_Priority = 3) THEN(1) ELSE (IF(Comp_Priority = 4) THEN(1) ELSE (((IF(Comp_Priority =

126
1) THEN(2) ELSE (((IF(Comp_Priority=3) THEN(3) ELSE (((IF(Comp_Priority=5) THEN(3) ELSE(2)))))

Inc_Cap_Priority =
if(Inc_Priority<3) THEN(1) ELSE (((IF(Inc_Priority=3) THEN(2) ELSE (((IF(Inc_Priority=4) THEN(3) ELSE(((IF(Inc_Priority=5) THEN(2) ELSE(3)))))

Inc_initial_cap_prop = 1/4
Inc_initial_NF_prop = 1/4
Inc_Initial_Op_Eff_Prop = 1/4
Inc_initial_SQ_prop = 1/4

Inc_Investments =
MAX(0, Inc_Profits*Inc_Investments_Proportion*Effect_of_Guarantee_in_foreign_investments)

Inc_Inv_in_Cap =
Inc_Investments/Inc_initial_cap_prop*(Inc_x_proportion*(IF(Inc_Cap_Priority=1) THEN(1) ELSE(0)))+Inc_Y_proportion*(IF(Inc_Cap_Priority=2) THEN(1) ELSE(0))+Inc_z_proportion*(IF(Inc_Cap_Priority=3) THEN(1) ELSE(0))

Inc_Inv_in_NF =
Inc_Investments/Inc_initial_NF_prop*(Inc_x_proportion*(IF(Inc_NF_Priority=1) THEN(1) ELSE(0)))+Inc_Y_proportion*(IF(Inc_NF_Priority=2) THEN(1) ELSE(0))+Inc_z_proportion*(IF(Inc_NF_Priority=3) THEN(1) ELSE(0))

Inc_Inv_in_SQ =
Inc_Investments/Inc_initial_SQ_prop*(Inc_x_proportion*(IF(Inc_SQ_Priority=1) THEN(1) ELSE(0)))+Inc_Y_proportion*(IF(Inc_SQ_Priority=2) THEN(1) ELSE(0))+Inc_z_proportion*(IF(Inc_SQ_Priority=3) THEN(1) ELSE(0))

Inc_Inv_Op_Eff = Inc_Investments*Inc_Inv_Op_Eff_Prop/Inc_Initial_Op_Eff_Prop

Inc_Inv_Op_Eff_Prop = 1-Inc_x_proportion-Inc_Y_proportion-Inc_z_proportion

Inc_NF_Priority =
IF(Inc_Priority>4) THEN(1) ELSE(((IF(Inc_Priority=1) THEN(3) ELSE((IF(Inc_Priority=2) THEN(2) ELSE(((IF(Inc_Priority=3) THEN(3) ELSE(2))))))

Inc_Priority =
IF(Comp_Priority<2) THEN(1) ELSE(((IF(Comp_Priority=1) THEN(1) ELSE(6))

Inc_SQ_Priority =
IF(Inc_Priority=3) THEN(1) ELSE(((IF(Inc_Priority=4) THEN(1) ELSE(((IF(Inc_Priority=5) THEN(1) ELSE(2)) ELSE(((IF(Inc_Priority=6) THEN(2) ELSE(((IF(Inc_Priority=5) THEN(3) ELSE(3)))))

Initial_Comp_Proportion_Profits_to_CF = 1.5

Initial_Proportion_Profits_to_CF = 1.59

Comp_Investment_Proportion = GRAPH(Comp_Profits)

(0.00, 1.00), (20.0, 1.00), (40.0, 1.00), (60.0, 1.00), (80.0, 1.00), (100, 1.00), (120, 1.26), (140, 1.40), (160, 1.50), (180, 1.55), (200, 1.55)

Comp_x_proportion = GRAPH(time)

(0.00, 0.333), (2.00, 0.41), (4.00, 0.49), (6.00, 0.555), (8.00, 0.59), (10.0, 0.63), (12.0, 0.67), (14.0, 0.7), (16.0, 0.715), (18.0, 0.725), (20.0, 0.73)

Comp_y_proportion = GRAPH(time)

(0.00, 0.25), (2.00, 0.25), (4.00, 0.25), (6.00, 0.25), (8.00, 0.248), (10.0, 0.246), (12.0, 0.245), (14.0, 0.24), (16.0, 0.23), (18.0, 0.225), (20.0, 0.21)

Comp_z_proportion = GRAPH(time)

(0.00, 0.235), (2.00, 0.215), (4.00, 0.195), (6.00, 0.155), (8.00, 0.115), (10.0, 0.085), (12.0, 0.065), (14.0, 0.045), (16.0, 0.035), (18.0, 0.03), (20.0, 0.03)

Inc_Investments_Proportion = GRAPH(Inc_Profits)
(0.00, 1.00), (20.0, 1.00), (40.0, 1.00), (60.0, 1.00), (80.0, 1.00), (100, 1.00), (120, 1.25), (140, 1.47), (160, 1.60), (180, 1.65), (200, 1.65)
Inc_x_proportion = GRAPH(time)
(0.00, 0.333), (2.00, 0.38), (4.00, 0.43), (6.00, 0.485), (8.00, 0.53), (10.0, 0.575), (12.0, 0.605),
(14.0, 0.64), (16.0, 0.665), (18.0, 0.68), (20.0, 0.7)
Inc_y_proportion = GRAPH(time)
(0.00, 0.25), (2.00, 0.25), (4.00, 0.25), (6.00, 0.245), (8.00, 0.24), (10.0, 0.225), (12.0, 0.19),
(14.0, 0.155), (16.0, 0.13), (18.0, 0.115), (20.0, 0.105)
Inc_z_proportion = GRAPH(time)
(0.00, 0.25), (2.00, 0.23), (4.00, 0.2), (6.00, 0.19), (8.00, 0.18), (10.0, 0.15), (12.0, 0.14), (14.0, 0.12), (16.0, 0.11), (18.0, 0.1), (20.0, 0.1)

**Regulation Mechanisms**

\[
\text{Comp\_Op\_Cost\_Trend\_Factor}(t) = \text{Comp\_Op\_Cost\_Trend\_Factor}(t - dt) + (\text{-}\text{Comp\_Yearly\_Improvement\_Rate}) \times dt
\]
INIT \text{Comp\_Op\_Cost\_Trend\_Factor} = 100

**OUTFLOWS:**

\[
\text{Comp\_Yearly\_Improvement\_Rate} = \text{Comp\_Op\_Cost\_Trend\_Factor} \times \text{Comp\_MC\_Yearly\_Reduction}
\]
\[
\text{Inc\_Op\_Cost\_Trend\_Factor}(t) = \text{Inc\_Op\_Cost\_Trend\_Factor}(t - dt) + (\text{-}\text{Yearly\_Improvement\_Rate}) \times dt
\]
INIT \text{Inc\_Op\_Cost\_Trend\_Factor} = 100

**OUTFLOWS:**

\[
\text{Yearly\_Improvement\_Rate} = \text{Inc\_Op\_Cost\_Trend\_Factor} \times \text{Inc\_MC\_Yearly\_Reduction}
\]
\[
\text{Price\_Cap}(t) = \text{Price\_Cap}(t - dt) + (\text{-}\text{Real\_Price\_Cap\_Decrease}) \times dt
\]
INIT \text{Price\_Cap} = 100

**OUTFLOWS:**

\[
\text{Real\_Price\_Cap\_Decrease} = \text{Price\_Cap} \times \text{Price\_Reduction}
\]
\[
\text{Comp\_MC\_Yearly\_Reduction} = \text{Eff\_Comp\_MC}
\]
\[
\text{Inc\_MC\_Yearly\_Reduction} = \text{Eff\_Inv\_MC}
\]
Interconnect = 1
\[
\text{Interconnect\_Charges} = \text{SMTH1}((\text{Comp\_Demand} \times \text{Interconnect\_Regulation}) / (100 \times \text{Interconnect} + 1))
\]
\[
\text{MC\_Reduction} = \text{Recognition\_Percentage} \times (\text{Inc\_MC\_Yearly\_Reduction} \times \text{Inc\_Market\_Share} + (1 - \text{Inc\_Market\_Share}) \times \text{Comp\_MC\_Yearly\_Reduction})
\]
\[
\text{NF\_Weight} = \text{IF}((\text{Type\_of\_Deregulation} = 1) \text{THEN}(\text{NF\_Weight\_1}) \text{ELSE}((\text{IF}((\text{Type\_of\_Deregulation} = 2) \text{THEN}(\text{NF\_Weight\_2}) \text{ELSE}((\text{IF}((\text{Type\_of\_Deregulation} = 3) \text{THEN}(\text{NF\_Weight\_3}) \text{ELSE}(\text{NF\_Weight\_4}})))))
\]
NF\_Weight\_1 = 0.4
NF\_Weight\_2 = \text{STEP}(0.4, 3)
NF\_Weight\_3 = 0.4
NF\_Weight\_4 = \text{STEP}(0.4, 3)
\[
\text{Price\_Reduction} = \text{X\_Factor} \times (1 - \text{Price\_Regulation}) + \text{MC\_Reduction} \times \text{Price\_Regulation}
\]
Price Regulation = 0 
Price Weight =
IF(Type of Deregulation=1) THEN(Price Weight 1) ELSE ((IF(Type of Deregulation=2) THEN (Price Weight 2) ELSE (IF(Type of Deregulation=3) THEN(Price Weight 3) ELSE (Price Weight 4))))
Price Weight 1 = 0.3 
Price Weight 2 = STEP(0.6,0) - STEP(0.3,3) 
Price Weight 3 = STEP(0.4,0) - STEP(0.1,3) 
Price Weight 4 = STEP(0.3,3) 
SQ Weight = IF(Type of Deregulation=4) THEN(STEP(0.3,3)) ELSE(1-NF Weight - Price Weight) 
Type of Deregulation = 1 
X Factor = 0.02 
Eff Comp MC = GRAPH(Comp Inv Op Eff) (0.00, 0.0243), (10.0, 0.0258), (20.0, 0.0288), (30.0, 0.0328), (40.0, 0.038), (50.0, 0.0433), (60.0, 0.046), (70.0, 0.0478), (80.0, 0.049), (90.0, 0.0495), (100.0, 0.05) 
Eff Inv MC = GRAPH(Inc Inv Op Eff) (0.00, 0.0195), (10.0, 0.0198), (20.0, 0.0225), (30.0, 0.0263), (40.0, 0.0313), (50.0, 0.0363), (60.0, 0.0403), (70.0, 0.0443), (80.0, 0.0465), (90.0, 0.0485), (100.0, 0.05) 
Interconnect Regulation = GRAPH(Time) (0.00, 0.00), (2.00, 0.00), (4.00, 10.0), (6.00, 10.0), (8.00, 10.0), (10.0, 10.0), (12.0, 10.0), (14.0, 10.0), (16.0, 10.0), (18.0, 0.00), (20.0, 0.00) 
Recognition Percentage = GRAPH(time) (0.00, 0.005), (2.00, 0.05), (4.00, 0.1), (6.00, 0.17), (8.00, 0.305), (10.0, 0.53), (12.0, 0.715), (14.0, 0.84), (16.0, 0.925), (18.0, 0.965), (20.0, 0.995)

**Welfare Sector**

Attractiveness to develop business = .15*New Features + .15*Service Quality + .7*100*100/Prices 
Availability of Media Services = .7*100*5000/Herfindhal Index + New Features*.3 
Delay in the Perception = 0.1 
Economic Welfare = SMTTH1(.5*Attractiveness to develop business + .3*Marginal contribution to GDP* (1 + Exogenous GDP Growth) + .2*100*100/Marginal Contribution to unemployment), Delay in the Perception 
Facility for social interaction = .1*Capacity + .2*Service Quality + .7*100*100/Prices 
Marginal contribution to GDP = Comp Revenues*Comp Market Share + (1-Comp Market Share)*Inc Revenues 
Marginal Contribution to unemployment = (0.8*Effect of Inv in Umemp + .2*100*100/Inc Op Cost Trend Factor) 
Political Welfare = 0.8*Availability of Media Services + 0.2*Institutional Support 
Social Welfare = SMTTH1(0.1*100*100/Marginal Contribution to unemployment + 0.9*Facility for social interaction, Delay in the Perception) 
Welfare = (Economic Welfare^2)*Political Welfare*(Social Welfare^2)/100000000 
Effect of Inv in Umemp = GRAPH(Investments)
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