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CHILE: UNIVERSITIES AND THE NATIONAL INNOVATION SYSTEM

AN INITIAL SCOPING STUDY

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An Initial Scoping Study

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Abstract

The present study offers a descriptive picture of the transition suffered by the Chilean university sector from a state-regulated regime to a market-driven one, complemented by demand-side subsidies facilitating market access to lower income segments of the local population. The process started three decades back and it was originally enforced under the expectation that markets and competition could bring about a socially optimal long term transformation of the university industry, without much government intervention being required.

Our enquiry shows the complex way in which economic and institutional forces have co-evolved in the transition from one policy regime to the next. The de-regulation of tertiary education markets induced a rapid process of entry of new service providers. The simultaneous introduction of demand-side subsidies extended market access to new segments of the population inducing a very rapid increase in the enrolment rate to universities, especially so in the lower two quintiles of the distribution. A major overhaul of the financial model and institutions supporting the provision of university services induced the university industry to move into a new environment in which fiscal block grants where gradually replaced by an alternative regime in which student fees, contractual income, competitive funds for R&D activities, performance-based contracts for infrastructure upgrading and philanthropic donations provide – alongside with block grants – the resources upon which the ´university industry´ presently operates. The transition resulted in a self-reinforcing virtuous circle of sectoral expansion and institutional transformation. Many observers believe (Pilar Aranet, 2007) that Chile is today in the midst of a ´growth crisis´ as it further proceeds into a more ´mature´ institutional and market structure scenario. Many problems of access, affordability, quality, accountability and production of public goods have remained unresolved from the past and require serious reconsideration in the years to come.

Some of the forces that motorized the process of expansion in the 1990´s seem to be wearing out, with the economy now expanding at a considerable slower pace than in the period 1984-1998 and with the university sector showing increasing signs of oversupply. The number of vacancies left unused seems to be increasing and the signs of a growing imbalance between supply and demand, as well as between academic disciplines, are getting increasingly evident. How much this is a structural issue – resulting from an economy which in recent years has slowed down its rate of expansion - or a cyclical issue, reflecting ´teething pains´ normally associated to growth and maturity, are questions of major importance in the near and medium term domestic policy debate. Briefly summarizing our more outstanding findings we notice that :

First, reflecting a pattern which can be seen in other countries – Australia, UK, US, for example – Chile exhibits a long term structural transformation of the financial model underlying the provision of university services. Fiscal block grants are gradually diminishing as a fraction of total university revenue and student fees, contractual services, competitive funds for R&D activities and for infrastructure building up efforts are gaining ground as sources of income. Fiscal block grants – AFD (´Aporte Fiscal Directo´) and AFI (´Aporte Fiscal Indirecto´) – only represent today between 1/3 and 50% of total university revenue (there is a significant variance in this respect among CRUCH universities), while revenue coming from the above mentioned alternative sources account for around 2/3 of total university revenue, again with a large variance among universities.

Second, a major achievement in terms of equity can be found in the fact that the proportion of youngsters between 18 and 24 accessing superior education increased from 15% in 1990 to 38% in 2006. The reason for celebration is even stronger when we notice that tertiary education access has increased well above average in the lower two quintiles of the income distribution. The proportion of low income families sending their first member ever to university has increased considerably during the 1990´s, suggesting that a significant process of upward mobility is on the making.

However, comparing with similar indicators for developed countries within the OECD, or for nations such as Korea, Ireland, or Estonia, where 2/3 of the youngsters between 18 and 24 years attain tertiary education, we notice that Chile has still a long way to go if the goal is to move from 38% to 60 or 70% of tertiary education attendance in the 18-24 years segment of the population.

Third, international comparisons indicate that Chile is behind world standards in terms of R&D expenditure, innovation activities and productivity growth. It is presently spending around 0.7% of GDP in R&D and although plans are that such expenditure is to be increased to around 1.2% of GDP in the course of a decade (CNI, 2008), it is presently lagging behind in terms of skilled man power creation needed to secure an adequate use of the fiscal resources in technology-generation activities. Local universities should be expected considerably to expand their rate of graduation of PhDs if doubling the R&D/GDP ratio is to be

attainable. As the University of Chile Commission argues in its recent report on ´Policies for the scientific and technological development of Chile´ ¨The country has to set itself the goal of graduating 100 doctors per million inhabitants in 2020, this meaning 1.700 new doctors annually¨

Furthermore, much remains to be done in terms of quality of educational services. The quality of education has a considerable impact upon the long term behaviour of the economy as well as upon the social, political and cultural functioning of society. Market processes have not done particularly well in relation to enhancing the quality of education. A frail accreditation mechanism and an over expansion of ´low end´ new universities entering the market during the early 1990´s have negatively affected quality of services. Although this seems to be in the process of improving, with small and low quality universities abandoning the market, or being taken-over by stronger ones which will re-structure them and upgrade their functioning, quality and consumer protection through a more solid accreditation system still remain as a promise for local university markets.

The ´Consejo Nacional de Innovacion para la Competitividad´ (CNIC) is at the centre of the current debate on innovation, both in terms of setting the agenda and monitoring the gradual building up of institutions and domestic technological capabilities, particularly with respect to the commercialization end of the R&D spectrum, strongly related to international competitiveness. It is easy to understand how recent confrontation with university scientists and professors could develop, as much of the academic community feels that innovation and knowledge generation activities should address a broader spectrum of issues than those specifically related to upgrading the international competitiveness of the local economy. Issues related to energy, environmental protection, desertification, health care, aging and stress, urban development and more should be set up as part of the Chilean future knowledge-generation agenda, beyond international competitiveness. Such tension can be creative and in many respects welcome. But it comes at a time in which university markets and public policy for the ´industry´ should be carefully examined if quality aspects and the balance between supply and demand for university services are adequately to be handled.

This seems to be a time for reflection, design and collaboration. Natural-resource based production and exports prospects remain good. Further economic diversification is needed, however, if the country is to increase its rate of economic growth. It seems likely that further government leadership, as has previously happened with the salmon industry, will be needed to attain the required pace of economic diversification. Such process needs to be closely accompanied by the development of the portfolio of innovation funding, incentive and support measures. Fiscal resources for stepping up both quantity and quality of R&D activities and tertiary education seem to be available. No doubt this is an enviable position, strengthened by the fact that the ´base line´ of departure is already very good. Quality improvements in universities have been pursued over the past decade through various different performance-based mechanisms (FDI and MECESUP) and lessons learned. The same is true as far as R&D activities is concerned,

where the Millennium Initiative, Financiamiento Basal and other competitive funds have significantly upgraded the institutional modus operandi of the local innovation system. It looks quite possible to have a significantly innovation-led agenda and the needed quantity and quality expansion of tertiary education and of R&D efforts. Institutional culture changes slowly, but it does change. Chile seems to be proceeding in the right direction as far as developing a strong National Innovation System in the years ahead.

This report argues for further policy development and action in some specific areas, so that access, affordability, quality, accountability of university services and the timely production of public goods could be successfully tackled by Chile in the years to come.

The very short term global and national economic outlook is flat and rocky. The sense of this Report is that this is a good moment to move ahead on the design of further restructuring and improvements to the national innovation system and to the tertiary education and research sector - and a particularly bad time for conflicts to impede getting on with it. Other important enquiries are underway by CRUCH, Government Agencies, World Bank/OECD (on tertiary education, in anticipation of Chile joining the OECD) and they are also likely to provide further advice in this respect.

Chile wants to proceed into a phase of ´technological deepening´, and of public goods creation which will simultaneously improve international competitiveness and equity in the access to ´merit´ goods in areas such as health, environmental protection, energy, desertification, and others. All of the above requires ´country-specific´ tertiary education and R&D activities as a sine qua non condition for the kind of long term development path Chile has adopted. Adequate macroeconomic management is important, but it is equally important to proceed with experimentation, learning and adaptation at the meso and micro level, creating markets, institutions and domestic capabilities. The international experience indicates that after periods of analysis and design, getting on with it becomes relatively more pressing relative to perfecting the design.

Keywords:

Education, Finance, Innovation.

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GLOSSARY

AFD	Aporte fiscal directo Direct Fiscal Allocation
AFI	Aporte Fiscal Indirecto Indirect Fiscal Allocation
BASAL	(Programa Financiamiento Basal) Programa para Centros Cientificos y Tecnologicos de excelencia Program for Science and Technology Centres of Excellence
C&T / S&T	Ciencia y Tecnologia Science and Technology
CEP	Centro de Estudios Publicos. Center of Public Studies
CNAP	Comision Nacional de Acreditacion, Ministerio de Educación Nacional Accreditation Commission, Ministry of Education
CNIC	Consejo Nacional de Innovación para la competitividad Nacional Council for Innovation for Competitiveness
CONICYT	Comision Nacional de Investigacion Cientifica y Tecnologica National Commission for Science and Technology Research
CORFO	La Corporación de Fomento de la Producción Chilean Economic Development Agency
CRUCH	Consejo de Rectores de Universidades Chilenas Council of Rectors of Chilean Universities
EMOL	Diario El Mercurio ´on line´ El Mercurial - periodical
FDI	Fondo de Desarrollo e Innovación Research and Innovation Fund
FONDAP	Fondo Nacional de Desarrollo de Areas Prioritarias National Fund for the Development of Priority Areas
FONDECYT	Fondo Nacional de Desarrollo Científico y Tecnológico National Fund for the Development of Science and Technology
FONDEF	Fondo De Fomento Al Desarrollo Científico y Tecnológico Science and Technology Development Research Fund
FONTEC	Fondo Nacional de Desarrollo Tecnologico y Productivo Nacional Production Technology Research Fund
FSCU	Fondo solidario de Credito Universitario University Credit Solidarity Fund
ICM	Iniciativa Cientifica Milenio Millennium Scientific Initiative
INNOVA	Programa de Innovación Tecnológica Technology Innovation Program
MIDEPLAN	Ministerio de Cooperacion y Planificacion Ministry of Cooperation and Planning
MECESUP	Proyecto de Mejoramiento de la calidad de la Educación Superior. Superior Education Quality Improvement Project
R & D / I+D	Investigacion y Desarrollo Research and Development
RICYT	Red Iberoamericana de Indicadores de Ciencia y tecnología. Ibero-American Network on Science and Technology Indicators
USAch	Universidad de Santiago de Chile University of Santiago de Chile

1. Introduction: University Sector, Institutions, Comparative and Conceptual Frameworks

Universities and other tertiary education institutions are service providing organizations. Said services can be grouped under three headings, each one covering a wide range of fields and activities:

- Tertiary education services;
- R&D services; basic and applied;[1]
- Production and dissemination of ´public goods´ and ´collective consumption´ services.

These are provided to private, non-profit and public sector individuals and organizations. All three types of university services are an increasingly important part of national innovation systems in many countries, in step with the growing relative importance of knowledge and knowledge services as factors of production. A 1997 OECD report on national innovation systems cites several definitions of these, including:

- " .. the network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies." (Freeman, 1987);
- " .. the elements and relationships which interact in the production, diffusion and use of new, and economically useful, knowledge ... and are either located within or rooted inside the borders of a nation state." (Lundvall, 1992);
- "... a set of institutions whose interactions determine the innovative performance ... of national firms." (Nelson, 1993);
- " .. the national institutions, their incentive structures and their competencies, that determine the rate and direction of technological learning (or the volume and composition of change generating activities) in a country." (Patel and Pavitt, 1994).

For reasons of history, economic structure and institutional development National Innovation Systems vary a great deal across countries.. The amount of R&D activities financed or performed by the private sector, by the higher education sector and by the public sector vary considerably across nations. Innovation Systems, of course, comprise much more than R&D expenditure and financing. Countries also differ considerably in institutions associated with the innovation process, tax measures and incentives, intellectual property laws, judiciary enforcement practices, degree of public-private cooperation in knowledge generation programs, and more.

[1] The line between applied research and innovation, where drawn, is usually determined by data available, and consequently the way each country organizes service delivery.

Almost all university services are to different degrees public goods, in that there is a significant element of collective consumption involved.

- Education services benefit students most, but there is a long history of regarding education as a part-public good (service) because 'your better education helps me as a colleague, spouse, parent, responsible citizen etc.'
- Basic and applied research end up to a large extent in one sector or other of the economy, but this isn't fully known in advance, and there is a lot of collective consumption and economies of agglomeration, particularly in ´generic´ (or platform) technologies such as it is the case with ICTs, biotechnologies and nanotechnologies.
- Commercial innovation services, with firms, may be almost entirely market or private goods, while community services and extension is predominantly public.

In Chile, and in most countries, the university sector contains a mixture of public and private institutions – a substantial majority public – and both public and private organizations are financed in different ways and to different degrees by public funding, private funding and revenue from contractual services.

Because of the public goods or collective consumption element of most of the services universities deliver, welfare economics and theories of the firm do not tell the whole story. Decisions on issues such as how much of the population should have tertiary education, what portion of the cost should they pay, how much and how best to finance basic research, or how much and how best to support community and 'bottom of the pyramid' innovation, typically remain as public choices. Valuable analytical frameworks to explore questions of this sort include:

- Welfare economics tools for evaluating efficiency and equity of public revenues and expenditures (public finance);
- Social choice, social justice and the capability approach;
- Growth and development thinking in its newest versions.

Universities are also a category of production organization delivering many services (particularly education) which are mostly private or individual-consumption in nature; the student pays the fee and gets the service. There is much to learn from looking at universities along the lines of industrial organization theory as drawn out briefly below. It should be kept in mind, though, that university markets do not fit well the description of a competitive market in two main ways (beyond services being part-public):

- they are typically oligopolies with a few dominant producers; and
- markets for education are full of uncertainties, coordination failures, prisoners dilemma, synergies and spillovers, signalling effects and non-appropriabilities.

Yet these are ´real life´ circumstances whose role needs to be examined if we are to understand how university markets operate and the complex set of forces that condition their inception and evolution in the economy.

This report starts by using an industrial organization model to examine observed behaviour and trends in the university sector in Chile, and finds this approach to be useful. To a considerable extent, this report is an industrial organization account of the functioning of university markets in Chile.

We start by recognizing that the word ´universities´ applies to a group of very diverse production organizations, at least as diverse and heterogeneous as the one we have to deal with when we talk about ´firms´. They come in all sizes and colours, private and public, non profit and profit oriented, involved in teaching exclusively, or engaged both in teaching, research and in the production of public goods, ´generic´ and discipline-specific, licensed, and subject to government control through explicit accreditation mechanisms, or un-licensed and scarcely monitored at all by public authorities, and so forth. Such variance in the ´nature´ of the firm suggests that we have a priori to expect a wide variance to prevail when examining university behavioural patterns.

Moreover, it is not only diversity of firms and the fact that forces other than markets and competition affect firm behaviour, but casual observation tells that large differences obtain between countries in relation to the way universities organize and develop, reflecting ´country-specific´ institutions and styles of social organization. N. Rosemberg has recently presented an interesting perspective on this topic examining the long term behaviour of US and European universities and their quite different patterns of inception in the economy.[2] In the case of Chile, it appears that the university sector is influenced by two major philosophical traditions, strongly embedded in Chilean social and political life. On the one hand, the secular tradition, associated to 19th century liberalism, represented by Andres Bello, the founder of the University of Chile. On the other, the Catholic Church tradition, incarnated in local ecclesiastic authorities. Both these philosophical traditions confront in matters related to the relative jurisdiction of family and State in educational matters as well as in relation to the extent to which religious matters should be part of the standard curricula imparted by public schools and universities. These two traditions were instrumental in the creation of the University of Chile in 1843, and of the Pontifical Catholic University of Chile, in 1888.

Chilean university life was also strongly affected by the University Reform Movement (in the 1960´s), which brought about new forms of governance to the sector as well as autonomy from central government. Shortly after – in the 1970´s – the university sector was strongly affected by military intervention and by the design of military authorities as Rectors and Deans of public universities. Public expenditure in education was drastically curtailed between 1974 and 1980 as part of a global macroeconomic stabilization program. Pari pasu with the above market mechanisms were introduced for the allocation of public resources in different areas of the economy, the university sector among them. University markets were de-regulated and private universities were admitted for entry. DFL Nº 4 passed by the Military Government in 1981, had a long lasting impact upon the structure and behaviour of university markets, as we shall show throughout this paper.

[2] 27. N. Rosemberg. Schumpeter and the endogeneity of technology. The Graz Schumpeter Lectures, Rutledge, NY 2000. Chap.3.

Section 2 of this report examines the behaviour of the university sector in the language of industrial organization theory. Universities are presented as an ´industry´ producing a complex mix of teaching (undergraduate and graduate) services, R&D activities, and public goods (in areas such as health, environmental protection, energy, urban development, culture and many others. In Chile, there are two leading players in the industry - Universidad de Chile and the Pontifical Catholic University of Chile - and a fringe of small and medium size universities competing in ´niche´ markets in a rapidly expanding national market for university services. New entry and the nature of competition in Chilean university markets are examined in this section.

Section 3 looks briefly at some of the early historical forces conditioning the evolving path of Chilean universities. Special attention is given to the sources of revenue financing university activities. Fiscal block grants and performance-related resources are provided by different agencies of the public sector but the opacity of the mechanisms that influence the amount of direct and indirect resources the industry receives influence access to the market, affordability, quality and accountability of university markets.

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In Sections 4 and 5 supply and demand side forces affecting market structure and performance are addressed. This is a highly heterogeneous industry in which firms differ in size, product mix, prestige, quality of services, and so forth. From the point of view of demand, it is an industry in which demand is expanding quite rapidly, with many new segments of the Chilean population entering the markets for tertiary education both as a result of a rapidly growing economy and of demand-side subsidies facilitating market access.

Having looked at the forces that condition the expansion of supply and demand, Section 6 examines various aspects related to the dynamics of market processes. Universities compete for students in many different ways, including product differentiation strategies, loans, advertising. Prestige and location appear as important determinants of firm behaviour. Significant imbalances between supply and demand for university services have developed in recent years. New institutions and an increasingly mature regulatory environment have gradually developed strongly influencing the long term functioning of Chilean university markets.

Besides providing undergraduate and graduate teaching services some universities also perform research and development activities. Markets for R&D activities present a different but related picture. Universities compete for R&D funds. Prestige and location are important. Some new entrants are pursuing niche strategies in upper-end research and innovation, and these involve attracting better students and faculty. Collaborative R&D activities with local firms are beginning to emerge, both between ´high-end´ new private universities and with old established ´historical´ universities, notably the University of Chile and the Catholic University. The recent lower-end expansion of tertiary education services does not appear to have an equivalent in research and innovation activities. The universities in this group are mainly profit-driven firms, not involved, or interested, in undertaking R&D activities.

Section 7 examines the role universities play within the national innovation system. Chile’s NIS has experimented significant changes and upgrading during the last decade. It has attained much new strength, but is under continuous pressure to expand and to stimulate the production of new scientific and social technologies for:

- local firms entering the market or expanding production and exports
- non-profit and public sectors agencies, initiating and expanding ´bottom-of-the- pyramid´ research in health, energy, environmental protection, urban development and many other fields.

In our assessment, some elements of the funding and incentive mechanisms for university services in Chile remain in need of attention in the ongoing process of building up individual, system and institutional capabilities. There are clear signs of improvement in the field, with new competitive funds and tax incentives directed at both private firms and private-public R&D activities. Based on strengths in basic sciences and/or applied R&D, many universities are striving in different ways to become more significant actors in the national innovation system. The lead universities are succeeding slowly in a broad range of services, and several strong CRUCH and private universities are becoming important actors in niche areas, related to the export sectors of the economy, notably in mining, forestry, fruit and wine, salmon. The recent creation of the National Council for Innovation (CNIC) constitutes clear evidence of the major interest Chile is presently placing in upgrading its long term performance in R&D activities and in innovation in general. There is a clear perception that productivity and international competitiveness strongly depend upon a much better performance of the local innovation system.

Much remains to be done in this direction, though, if Chilean Universities are to become a more vibrant actor within the local Innovation System. The report wraps up in Section 8 discussing several policy issues and possible research priorities. International comparisons are used in the report, as a tool for benchmarking the local situation, but the comparison should be done with a great deal of care given the major structural differences that prevail between a natural resource processing economy and another one specialized in high tech products and services. Where data availability proves insufficient, or unreliable, the need for further research is flagged out.

2. The Chilean University Sector as from an Industrial Organization Perspective

2.1 Neoclassical and other alternative roads for the study of university behaviour.

Many economists have approached the study of university behaviour using a conventional neoclassical production function equilibrium model.[3] E. James for example, conducts her research on the basis of a utility maximizing model in which universities are conceived as non profit organizations maximizing an objective utility function under the constraint that all the resources they generate are used in the production of teaching and research.

In her work prestige and faculty-workers satisfaction are related to students quality, teaching load and research budgets.

A. Geuna, in The Economics of knowledge Production (Geuna, 1999), criticizes the utility-maximizing model of university behaviour arguing that it is somewhat unrealistic to assume that universities operate in perfectly competitive markets and that they have a unique team-objective utility function to be maximized. Rather, conflicting objectives between academic disciplines as well as between more research-oriented and more commercially-oriented faculty should be addressed in order better to understand the incentive regime under which universities actually operate.

An alternative way of approaching the study of university behaviour is through what J.L.Santos calls the ´resource dependency theory´ . In this respect he writes: ¨Resource dependency theory lends itself to the study of universities as complex organizations with often diverse constituencies and competing goals by emphasizing the political dimension of these organizations and their relationship to the external resource environment¨ (Santos, 2007, pag. 127).

In numerous countries around the world – Chile among them – government investment in public universities has declined, resulting in institutions´ search for new sources of revenue. Student tuitions and fees have become a major mechanism of university financing in substitution for fiscal resources, but also contracts, grants, competitive funds for R&D activities and private gifts have now taken a significant role as sources of revenue for most universities in the world. As a result of the above the study of resource allocation processes among university departments and even among individual faculty, within departments, have now become important topics of

[3] E. James, 1990 Decision processes and priority in higher education. In (Ed. S. A. Hoenack and E. L. Collins The economics of American Universities .Management, Operations and fiscal environment. Albany, NY State. Also, form the same author: The private non profit provision of education: a theoretical model and application to Japan. Journal of Comparative economics, 10 255-76

research when examining issues of productivity and organizational behaviour (Ashar, 1987, Volk, Salughter & Thomas, 2001).

In this study we have chosen to look at university behaviour as from the perspective of industrial organization theory arguing that universities belong in an industry which produces teaching services, research and development, and other innovation-related public/community (sometimes called ´extension') services. The latter are provided free or at subsidized cost to organizations and communities in areas such as health, agriculture, energy, environmental protection, urban development, cultural goods and many others.

2.2 An industrial organization paradigm for the study of university behaviour

¨In the field of industrial organization we try to ascertain how market processes direct the activities of producers in meeting consumer demands, how these processes may break down and how they can be adjusted, through government intervention, to make actual performance conform more closely to the ideal,"[4]

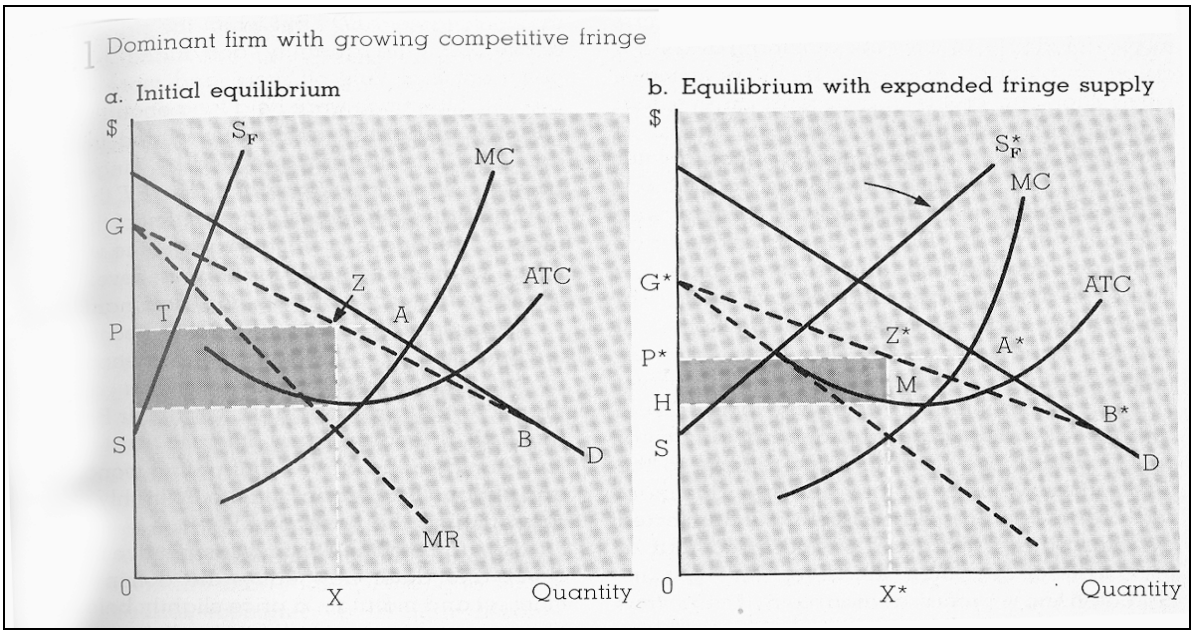
Market structure and performance are influenced by initial supply and demand conditions, by cost structures and economies of scale, by barriers to entry and product differentiation efforts, by the legal and regulatory environment in which firms operate, and so forth. The causation mechanism is circular and dynamic in the sense that it allows for ´feedback effects´ from market conduct back to market structure. Instead of making inferences about economic behaviour from an hypothetical market equilibrium approach, we try to examine the dynamics of market processes taking into account ´sector-specific´ initial conditions and the evolving nature of the incentive regime in which agents operate. Such a regime is influenced by economic and institutional forces that recurrently push the system out of equilibrium. The account of market functioning here to be presented has elements of what R. Nelson calls ´appreciative theorizing,´ and J.J. Brunner describes as ´landscape reconstruction,' i.e. it presents a historical and institutional account of the functioning of university markets in Chile.

Two large universities dominate the Chilean university scene. Their market position has been significantly challenged in recent years by the competitive entry of many small and medium size metropolitan and regional universities, both private and public, which are now trying to gain participation in teaching activities and, to a much lesser extent, in applied R&D activities. Given such circumstances we believe that the model of the ´dominant firm´ operating alongside with a fringe of small competitors could be a useful analytical framework in which to place the present study.

F. Scherer[5] discusses the case of the dominant firm and the fringe of alongside competitors in terms of a simple diagram, as follows:

[4] F. Scherer, 1980. Chapter 8: ´The dynamics of monopoly and oligopoly pricing.´ In Industrial Market Structure and Economic Performance, Chicago, 1971.
[5] F. Scherer Op. Cit. 1980 page 233

Figure 1: Scherer – Dominant Firm Oligopoly



In addition to the two dominant metropolitan universities we also find in Chile a number of regionally based ´old´ universities (such as Universidad de Concepcion, Universidad Catolica de Valparaiso, Universidad Austral, and a few others) that strictly speaking should not be considered among the fringe of new entrants. They are not ´large´ as the University of Chile and the Catholic University, but they are to some extent dominant in their own regions. For the moment they will be considered as part of the ´dominant group´.

The model of the dominant firm addresses the question of how a large enterprise selects a pricing strategy knowing that it has to face actual or potential competition from smaller rivals, which will take the price of the leader as given and expand their output to the point that they maximize profits.

When the dominant firm sets prices below the minimum marginal cost of the small firms - OS in Diagram a - none of them enters the market. If the price is set above such minimum some firms in the fringe find it profitable to develop production capacity of their own. By knowing the aggregate supply schedule of the group of small firms – SS - the dominant player knows how much of the market the small competitors will capture at each price and hence how much will be left for itself. With such information the dominant player sets up a price OP, equating marginal costs and marginal revenue maximizing profits and catering for the residual demand he calculates would be left over after the entry of small competitors.

Competitive entry will depend both upon the difference in production costs between the dominant player and the small competitors, and also on what the global demand for their join services actually is. It is both these variables that will determine market behaviour of the large firm and of the fringe, and condition the amount of profitable competitive entry from small firms.

Of course, the model is extremely simple, as it leaves out many interesting ´real life´ features which have to be taken into consideration, but even so it throws interesting light upon some of the issues we feel that need be understood. In proceeding, some of the underlying assumptions of the model will be relaxed, allowing for better understanding of the dynamics of market functioning.

a. Nature of the product

The model assumes both the dominant firm and the fringe to produce a single homogeneous product. In actual fact universities engage in the production of three quite different sets of ´products:´ teaching services (Undergraduate and graduate teaching), basic and applied research services, and different type of public goods and extension services. Within each set, there are many different ´products´ or services. The products differ widely in terms of production costs and expected returns. As a result, the product mix differs considerably among universities.

Expected returns are generally higher in the production of teaching services, and in the provision of contractual services to enterprises, and somewhat lower in the provision of extension services. Uncertainty, imperfectly appropriability and incomplete property rights negatively affect expected returns in the case of R&D and public/extension goods, so only a small number of universities – those whose ´mission´ is strongly defined in such direction, basically the University of Chile and the Catholic University – are willing to carry out R&D activities and to perform extension services.. Profit-oriented universities tend to stay close to the teaching end of the production spectrum where returns could be expected to be larger. A small group of the new private universities is involved in R&D activities, but in a much smaller scale.

It is also the case that significant differences in cost structure and in expected returns prevail when different academic disciplines are compared. Some disciplines demand complex and costly experimental equipment, both for teaching and for R&D activities; others can do with very little in this respect. As a result, new entrants could be expected a priori to be more willing to engage in competitive entry in the provision of teaching services in disciplines where production costs are lower and where economies of scale are less significant. It is not therefore surprising to see that competitive entry has occurred in Chile in the Social Sciences, in the field of Legal Studies and in Teacher Training, where low capital costs are involved, as compared with biotechnology, astronomy or nuclear physics where heavy and costly equipment is required.

For the same reason, private universities might not be much interested in performing R&D activities, unless financed by public grants, donors and philanthropic organizations. Some of the more prestigious new private universities are actively expanding in R&D and extension services supported either by private firms or by religious and philanthropic donors. Although this is clearly an interesting issue requiring further examination, it should be noted that data is lacking on many of these topics.

The model throws interesting new light into why private universities in Chile have in recent years opened up highly competitive programs in the Social Sciences but have not so much attempted to do so in the more basic sciences, where more complex and expensive experimental

equipment is needed. It could be assumed that the more costly – in terms of infrastructure and capital equipment – a discipline is, the less likely competitive entry will take place. Medicine is probably a different case demanding examination, as various private universities have in recent years opened up teaching facilities, associated with local hospitals and clinics.

We could also a priori expect universities to follow a dynamic entry path, starting by low cost disciplines and gradually moving up market to more costly ones when they manage to develop prestige and market share in low cost academic fields. A few small private universities show a product diversification pattern of this sort in Chile in recent years.

b. Teaching fees, public goods and new entry.

Total production costs are probably higher when universities engage in R&D activities and in the production of public goods. Doing research on cancer or on population aging or maintaining a philharmonic orchestra, are expensive activities where production costs are normally not recovered. In such circumstances it is not unlikely that cross subsidization might occur from resources coming from undergraduate teaching. In other words, when money for R&D activities and for the production of public goods is not explicitly allocated by the public sector (or sufficiently provided by private donors) – it is likely that the profit maximizing price set by the dominant firm in the market for teaching services will be somewhat higher than otherwise, so as to recover expenses made in association with these other non profitable activities.

It is important to realize that by setting a higher market price in the teaching side of their overall operation, the dominant player triggers off competitive entry from the fringe of small competitors. As such entry takes place the share of the market of the dominant player is bound to fall, making room for the new entrants. This cross-subsidization effect – from teaching activities to R&D and extension services – suggests that when the resources for R&D and extension services are not explicitly allocated in the system – or are insufficient - a tendency will prevail to cover the gap with income received from teaching activities, thus setting in motion an endogenous dynamics in favour of new entry. Diagram b. above describes this case, and indicates that when competitive entry takes place, profits for the dominant firm(s) tend to fall.

c. ´Low´ and ´high end´ entry, accreditation and quality of services.

Not all Chilean universities, education institutes and teaching programs have successfully gone through ´peer-review´ and accreditation processes. Accreditation involves six different sets of activities: Institutional management, Undergraduate Teaching, Research, Post Graduate Teaching, Relationship with the community and Infrastructure, and could be obtained for two to seven years depending upon the quality attained by each university in each area.. Only half a dozen universities – out of 60 – have received accreditation in four or more of the above categories for periods of four to seven years; further detail can be found in Table 10 below. Accreditation is associated with prestige and clearly constitutes an attractor for high quality students and well trained faculty. On the other hand, accreditation also means costs in tangible and intangible assets. Market entry strategies over recent years shows that some universities have opted for what we call here a ´low end´ strategy – expanding the number of teaching

campuses they operate across the country, without seriously concerning themselves for quality and accreditation - whereas other universities have opted for the opposite strategy, i.e. entering the market on the basis of high quality staff, ´state-of-the-art´ infrastructure and a ´world class´ teaching curricula. In a few number of cases universities have done both, in niche markets; a large low-cost teaching services provider with a world class medical biotechnology research facility in its midst, with student fees subsidizing R&D expenditure.

The nature of both models of market entry is clearly different and their relative incidence seems strongly to depend upon the regulatory environment in which universities operate. The ´low entry´ strategy reflects a short term maximizing behaviour probably associated with a less stringent regulatory environment and with frail accreditation rules. It is probably a strategy universities would tend to change when subject to stronger accreditation requirements and surveillance mechanisms, monitoring their performance. A frail accreditation system might allow for less than adequate behaviour on this front, extending the exploitation of monopolistic positions attained in ´low contestable´ markets.

In this respect, most countries have a variety of tertiary education institutions in addition to those accredited as universities and colleges (eg in Canada). These also provide a wide range of important teaching services financed by fees, differentiated amongst each other in the market mostly by the field and the job success rate of graduates, but not calling themselves universities. If demand for these institutions exists there seems no reason they should fold, but as in many other industries in which discriminatory practices prevail consumer protection legislation is strongly required.

At the other end of the spectrum, ´high entry´ market entry strategies are associated to academic prestige and credentials. A gradual expansion of R&D activities, and also a certain amount of product diversification can be expected to take place in this case, as part of a global expansion process.

Both strategies of market entry have occurred in Chilean university markets in recent years, with universities using different product differentiation efforts (advertising, loans, etc) to attract new students. The choice of a given university from the part of a student involves a considerable amount of irreversibility, given sunk costs and information asymmetries. There are major barriers to entry impeding the transfer of credits from one university to another, this being a significant source of inflexibility allowing for market imperfections.

´Low end´ market entry strategies should be more prevalent where frail accreditation mechanisms are present. Given information asymmetries and the large amount of irreversibility underlying the choice of university, absence of adequate accreditation mechanisms and imperfect information constitute a major source of market failure. MECESUP – a public agency from the Ministry of Education – and various private sector accreditation firms, are currently involved in expanding accreditation services in Chilean university markets. As a result of the above we can expect ´low end´ market entry strategies to become less prevalent in the medium term. Many non-accredited universities and professional institutes have in fact recently exited the market or have been subject to mergers and acquisitions from the part of larger and more prestigious universities. These issues are further examined in Chapter 6 below.

3. Chile: Historical Conditioning Factors

The Real Universidad de San Felipe de Santiago opened up in 1747 as an attempt to create a local educational option for the upper ranks of the Chilean society which only had the University of San Marcos, in Lima, Peru, as an alternative. The approval was requested to Felipe V in Spain in 1713 with a positive response being obtained only 25 years later. The disciplines originally imparted were Theology, Philosophy, Law, Medicine and Mathematics. It operated until 1813. After independence from Spain in 1818 it became part of the Instituto Nacional. The merger of both institutions provided the basis for the creation, in 1843, of the University of Chile. This emerged as the national university of a newly independent country. Secularism and 19th century liberal traditions were the basic imprint underlying the creation of the University of Chile. (J. L. Ossa, 2007)

It did not take long until the strongly articulated local catholic constituency, leaded by the Archbishop of Santiago, succeeded in creating the Catholic University of Chile. In 1872 Abdon Cifuentes, Ministry of Justice, Cult and Education opened the way in this direction, admitting private schools to adopt their own educational curricula. In 1888 the Catholic University of Chile was open and Monseñor Larrain appointed as its first Rector. It was in February of 1930 that it was declared Pontifical University by Pio XI, status which implies that the Dean of the university has to be jointly nominated by the Archbishop of Santiago and by Vatican authorities.

The third university was opened up by the Freemasonry movement in Concepcion in 1919. In the following three decades only six other universities opened up, making for a total of eight universities in Chile. In 1954 the Council of Rectors of Chilean Universities (CRUCH) was created bringing together the Rectors of these eight universities. Chile had at that point a total of around 20 thousand university students. The eight universities were entirely supported by fiscal resources and entrance was free.

An important process of structural transformation occurred in the post-war years. Like most other Latin American countries Chile was at that time involved in an ´inward-oriented´ development strategy with a dominant public sector involved in the production of a large number of goods and services, health, transport and telecommunication services, among them. University education was not an exception. The expansion of urban middle classes induced an equally rapid expansion in university enrolment. By 1967 the student population had reached 55 thousand people.. The University Reform Movement – involving ´co-governance´ of universities by professors, graduates and students - and autonomy from the central government – only became a major issue in Chile in the late 1960´s. The idea of universities becoming a public space where issues of social and political organization could be openly discussed became central to the new institutional ´atmosphere´ of the time. Concomitantly with the above the university sector continued to grow rapidly with the studentship reaching 150 thousand people by 1973.

The military intervention of 1973 introduced a dramatic change of regime. Both as a result of macroeconomic imbalances that accumulated in the economy in the years prior to the military take over and needed be redressed, and of the ideological inclination of the new government

which favoured market-led mechanisms in substitution for public sector intervention, a major change in public policy regime was implemented. Public resources for education contracted drastically after the military intervention, falling form 7% to just over 4% of GDP between 1973 and 1980. The reduction in block fiscal grants received from the public sector forced universities to search for alternative forms of finance, student fees becoming the obvious alternative. Together with this fundamental change in the financing for university services, the military authorities also proceeded to de-regulate the market allowing for the entry of private service providers. As a result of the above the structure and behaviour of university markets changed quite strongly in the 1980´s.

It is important to notice that large differences prevailed in the way the University of Chile and the Catholic University adapted to the new rules of the game. Whereas in 1973 the University of Chile had 65.000 students and the Catholic University 16.000, in 2006 the University of Chile had 27.000 students and the Catholic University close to 20.000. The DFL Nº 4, of January 1981, proceeded to break up the University of Chile in 17 different legally independent universities operating across the country. Together with the eight ´historical´ universities active in Chile from previous years, the new 17 universities created by the regional subdivision of the University of Chile formed the CRUCH, which thereafter was to be conformed by 25 different universities.

The de-regulation of university markets induced the creation of 22 new private universities and 23 professional institutes between 1981 and 1989. In the last three month of military rule, in 1990, 18 new private universities and 23 professional institutes were created. The Table below provides the information.

Table 1. The creation of universities, professional institutes and centres for professional training, Chile 1980-2006[6]

Number of	1980	1986	1990	1995	2000	2006
CRUCH universities	8	20	20	25	25	25
Private universities		3	40	45	39	36
Total universities	8	23	60	70	64	61
CRUCH Professional Institutes	--	4	2	--	--	--
Private Professional Institutes	--	19	76	73	60	43
Total Professional Institutes		23	78	73	60	43
Centres for Professional Training		132	161	127	116	102
Total tertiary education Establishments	**8**	**178**	**300**	**270**	**240**	**206**

It is important to notice the rapid process of market entry that obtained during the period 1980-1995. In the mid-1990´s the rate of new entry slowed down and between 1995 and 2005 the number of private universities actually goes down in the midst of a process of mergers and acquisitions. Many questions emerge – which we will examine in further sections of the paper –

[6] CNAP 1999-2007. El modelo chileno de acreditacion de la educacion superior. Consejo Nacional de Acreditacion, Santiago 2007 Page. 24.

concerning the quality and accreditation processes underlying the entry of these new private universities. Faithful to the idea that market forces could adequately monitor market entry without much government surveillance in terms of accreditation requirements, not much was done in terms of ex post monitoring new market entry. Many new problems related to quality of services and accountability emerged and have remained in place even to the present.

As mentioned before, it is also important to notice that a large number of service providers – Universities (private), Professional Institutes and Centres for Professional Training - left the market in more recent years, 1995-2006. This indicates that a complex winnowing process is taking place in the industry. Supply of university services has outpaced demand for such services in recent times with close to 30% of the vacancies offered by local universities remaining unclaimed in 2002 and 2003, and the number increasing still further in 2006. As many observers have noted there are long term imbalances between supply and demand for university services, but fees have not come down reflecting such state of affaires. Such major structural imbalance deserves further examination. Before going into the subject, however, the report explores the determining forces affecting the supply of, and the demand for, university services. This we do in the next two sections of the paper.

4. Chile: Factors Affecting the Supply of Services

4.1 The financial model

Universities finance their activities by a mixture of public resources, tuition fees, donations, research grants and revenue obtained from services they sell in different fields of economic activity. Large differences prevail between countries in the relative share of these various sources of revenue financing university activities. Also, changes in the relative participation of the above mentioned sources of revenue take place as a result of changes in public policies.

Clearly the more notorious long term transformation of the financial model underlying the provision of university services in Chile is the falling share of fiscal block grants within total university revenue and the concomitant expansion of the relative share of revenue resulting from student fees, competitive funds, contractual services and donations. Fiscal block grants – AFD (´Aporte Fiscal Directo´) and AFI (´Aporte Fiscal Indirecto´) – presently represent between 1/3 and 50% of total university revenue (there is a significant variance in this respect among CRUCH universities), while revenue coming from competitive funds, student fees (net of student financing out of public sector resources associated to FSCU (Fondo Solidario de Credito), contractual activities and donations account for around 2/3 of total university revenue.[7]

In the following pages we examine how each one of these alternative sources of revenue changed over time as a result of changes in public policies.

a. AFD and AFI; block grants for CRUCH universities

As explained before, the Council of Rectors of Chilean Universities (CRUCH) was originally created in 1954. Chile had at that time only eight universities, catering for a total student population of around 20 thousand students. Universities were financed through block grants from the public sector and enrolment was free.

The breaking up of the 17 regional campuses of the University of Chile, making them to become independent legal units, expanded CRUCH membership to 25 public universities. It is these 25 universities that currently receive Aporte Fiscal Directo (AFD), a block grant from the government, aiming at covering operational expenses (mostly wages and salaries of university personnel), but also an unspecified amount of R&D activities. AFD currently account for close to U$S 160 million annually. AFD represents nearly 1/3 (less in some cases, i.e. 20% at the University of Chile) of university revenue. CRUCH universities cover the gap between

[7] Although the numbers are different, the nature of the phenomena is similar, i.e. a substantial decline in the proportion of current revenue coming from block fiscal grants and a concomitant increase in the share of tuition fees, external contracts and performance-based fund as a proportion of total revenue. In a recent paper by J.L.Santos the author writes: ¨Over the 15 years from 1985 to 1999 (we notice) a decline in the proportion of funds provided from the state from 45% to 35%, an absolute decrease of 21%. During the same period, tuition and fees rose sharply from 14% in 1985 to 18% in 1999, an absolute increase of 27%, while private gifts, grants, and contracts rose from 3% in 1985 to 4.8% in 1999, an absolute increase of 55%.¨ J.Santos : Resource allocation in Public Research Universities. The Review of Higher Education , Winter 2007, Vol 30, Nº 2.

operational costs and revenue with student fees, contracted services, competitive research funds, AFI (Aporte Fiscal Indirecto), FDI-MECESUP funds and donations. Student fees have expanded strongly accounting for around 1/3 of total revenue, again with a large variance across CRUCH universities.

As for changes in time in the sources of funds the following table provides comparative data for 1990 and 2005.

Table 2 Fiscal Sources of Funds for Chilean Universities[8]
(At constant MM 2005 $)

Item	1990	%	1995	2000	2005	%
1.Fiscal Direct Support	61.934	51.1	87.486	102.575	109.483	38.3
2.Fiscal Indirect Support.	20.016	16.5	20.142	17.915	17.695	6.1
Block Grants		**67.6**				**44.4**
3.Fondo Solidario de Credito (FSCU)	28.328	23.3	19.449	42.819	55.251	19.3
4.Other forms of student support.	---		13.571	19.149	28.116	9.8
5.Institutional Development Fund	---		9.376	25.117	24.483	8.5
6.CONICYT	10.841	8.9	26.002	35.642	50.618	17.7
Competitive funds		**32.2**				**55.3**
Total fiscal resources.	121.120	100	176.028	243.220	285.650	100

The table indicates how the financial model underlying the provision of university services changed during the period 1990-2005. From a regime in which university revenue was largely based on block fiscal grants transferred by the central government Chile has now moved into an alternative financial regime in which block grants only account for around 1/3 of total revenue – and less in the case of many universities – while alternative sources of revenue expanded to account for the difference.

The logic underlying the distribution of AFD funds across CRUCH universities has always been somewhat opaque. It seems to derive from political decisions made in the early 1980´s which have not been subject to revision ever since. It is also unclear how much of AFD universities allocate for R&D activities or for the production of public goods. As with the reasons underlying the original distribution of AFD funds across different CRUCH universities the share of these resources that needed be allocated to research activities does not appear as having been discussed when the system was put in operation, and has remained obscure ever since.

Demand subsidies were introduced by the military authorities to facilitate market access. But it was only students applying to CRUCH universities that could get financial support from the Fondo Solidario de Credito Universitario (FSCU). There has been a great deal of argument around this issue recently, as this is regarded as a major barrier to entry discriminating against private universities. (Dean Montes, Universidad P. Hurtado, El Mercurio, Sunday, February 3, 2008)

[8] CNAP 1999-2007. El modelo chileno de acreditacion de la educacion superior. Consejo Nacional de Acreditacion, Santiago 2007. MM is million (10^6)

AFD funds are distributed among CRUCH universities according to a fixed rule which was established in 1981, by DFL Nº 4. Eight years after establishing such rule the government decided to change it, allowing 5% of the AFD funds to be allocated through competitive processes depending upon the number of papers being published, citations received, and number of research projects conducted by each university.

The available evidence shows that AFD resources have increased through time, but only very slowly. Between 1995 and 1997 they did so at 5% per annum but from 2003 to the present the rate of expansion was just 0.6% annually. They have been partially substituted by various market-based funds about which further analysis will be done later on in the monograph.

Table 3 Evolution of AFD Between 1995 and 2004[9]

Year	AFD (Mill.$ 2004)	% change vs. 1995	% change vs. prev. year
1995	86.744	-----	-----
1996	91.039	4.95	4.95
1997	95.687	10.06	5.11
1998	97.630	12.09	2.03
1999	100.008	14.53	2.44
2000	101.705	16.23	1.70
2001	102.987	17.49	1.26
2002	105.979	20.40	2.91
2003	106.426	20.82	0.42
2004	107.337	21.68	0.86

There is little information as to how AFD resources are being used by CRUCH universities. They are meant to cover operational costs, which basically involve wages and salaries of university personnel. But they are also used, to an unknown extent, to finance R&D activities. How much we do not know for certain. Perhaps relatively little, as a consequence of the expansion of universities in size and operational costs, and of the much slower rate of expansion of AFD in recent years.

Besides AFD the DFL Nº 4 of 1981 also created AFI - Aporte Fiscal Indirecto - which is related to the quality of the students each university incorporates each year. The best 27.500 students passing the university admission test are ranked according to their credits and divided into 5 subgroups of 5.500 students each. Then the subsidy for the lower quintile is determined and the subsequent groups get that amount per student multiplied by 3, 6, 9, and 12 as we move up along the scale. This means that CRUCH universities that manage to attract students in the better quintile get 12 times more per student than those that attract students from lower segments.

[9] Table 5.3. B. Santelises, C. Contreras and D. Morate. ´Inversion Nacional en Investigacion y Desarrollo. 1995-2004. In: (Eds.) J. Allende et. al. Analisis y Proyecciones de la Ciencia Chilena 2005. Chilean Academy of Sciencies, Santiago.

Range	As from PSU score	As from PSU score	Amount received per student. ($)
1	610.5	624.5	113.931
2	625,0	642,5	341.795
3	643.0	665.5	683.590
4	666.0	698.5	1.025.385
5	699.0	838.0	1.367.180

Source: El Mercurio, June 24th, 2008. Pag.C7.

This resource allocation mechanism introduces a selection bias which is now under close scrutiny by the Chilean parliament. Noting that some 220.000 applicants take the admission test each year it follows that it is only around 12% (27.500 out of 220.000) that are taken into consideration for the purpose of distributing the resources allocated by AFI.

Considering that a decade ago, in the early 1990´s, 27.500 students represented close to 25% of total annual enrolment, and that students from private schools get significantly higher credits in the university entry examination, AFI involves a selection bias against low income students, (and also against Institutos Profesionales and Centros de Capacitacion Tecnica) which are now crowded out by students applying to CRUCH universities. The Chilean Government is presently considering introducing changes into the AFI distribution system.

No other simple performance-based financing mechanism has yet been identified world-wide and there is a variety of alternatives to block grants that consider performance indicators - simple ones such as numbers of students, and more complex ones based on number of graduates, or exams passed, publications, patents for research and innovation services, and others – as the basis for performance-based allocations in this field. We will return to these topics in Section 6 below, when dealing with possible options for improving university financing in Chile.

b. Fees and demand subsidies; student financing

As explained before, about two thirds of total revenue of public universities comes from sources other than block grants. In other words, it is student fees, external contracting and competitive funds (provided by CONICYT and other public agencies) that presently provide the major part of university revenue.

When compared with average per-capita income fees for the principal CRUCH universities look rather high in an international comparison. GDP/person stands approximately at U$S 11,000 and fees at major CRUCH universities stands in the order of U$S 5000-6000/year. Chile appears as an outlier in this respect when judged by international standards.

Student fees are partly covered by different demand-side subsidies. Two of them stand out::

1. Fondo Solidario de Credito Universitario.(FSCU).

This is only extended to students applying to CRUCH universities. It involves a low interest rate – 2% - it can never comprise more than 5% of the salary of the recipient. It is basically directed

to the two lower quintiles of the income distribution pyramid. It is believed that nearly 80% of those applying for FSCU actually get it. (J. M. Benavente, 2008). More on this issue later on, when examining the determinants of the demand for university enrolment. .

2. State guaranteed loans. (Creditos con aval del Estado).
Public sector guaranteed loans are also available to cover tuition fees and other expenses associated to university enrolment. These are somewhat more expensive options than FSCU and target students from higher income group capable of affording a more expensive financing mechanism. The interest rate for these loans is 5%.

Although no hard information is available, local sources indicate that the percentage of non performing loans reaches 40%, a much higher rate than in other countries. This may serve the purpose of subsidizing tuition for students who can not or will not repay loans, but if so, it is argued below that there are better solutions to equity of access issues. Among other things, in not paying back loans, students get registered and may find it very difficult to get access to bank credits thereafter.

Further analysis is needed on student financing. At this point, from the perspective of university financing, gross student fees account for roughly 50% of total university revenues. The grant element of student financing – accounting for loan default component, would be the best measure of the extent to which total student fees ultimately divide into student-paid and government-paid university fees. With a high rate of loan default, the grant element obviously becomes larger. We suggest that 30-35% may be a reasonable estimate of the share of student fees in CRUCH universities revenue, but more information and analysis is needed.

Canadian student financing mechanisms have so far been easier to research; Annex B provides a listing, with web links for details, of the governmental programs, and there are also student oriented loans available from some Canadian banks. By international comparison, student financing in relation to university costs appears to be rather high in Chile.

c. Investment in infrastructure.- FDI and MECESUP

As also indicated in Figure 2 below another important source of university revenue is the DFI (Fondo de Desarrollo Institucional), which has recently been discontinued and merged with MECESUP (Programa de Mejoramiento de la Calidad de la Educacion superior). Close to 10% of CRUCH universities fiscal resources presently come from this source.

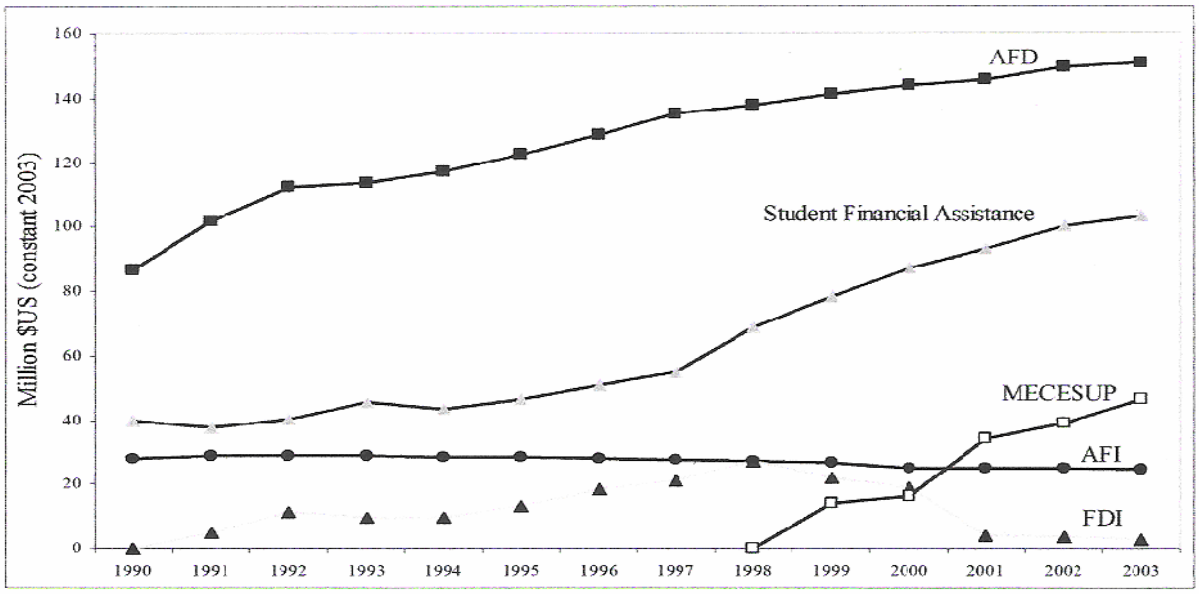
In 1998 the government decided - and agreed with the World Bank which was to contribute nearly half of the resources - to implement a quality improvement program in the area of Higher Education. This program was called ´Programa de Mejoramiento de la Calidad de la Educacion Superior´ (MECESUP). It involved a 5 year implementation period, with a total investment of U$S 250 million, that is U$S 50 million per annum. The Program had as its central objective that of improving the academic infrastructure of the 25 CRUCH universities, including the upgrading of libraries, buildings, and experimental equipment. It also accepts projects involved in the upgrading of ´intangibles´ such as teaching curricula and administrative processes required for accreditation of institutions and of specific programs.

MECESUP has recently started to experiment with performance-based agreements with CRUCH universities. It has signed four of them with The University of Tarapaca (Arica), University of Chile (Santiago), University of Bio-Bio (Concepcion) and University of La Frontera (Temuco), for a three year period, covering a broad spectrum of quality enhancement activities for a total investment of U$S 16 million. In Section 6 below we look at some comparative international experience with performance agreements.

The information so far presented concerning different sources of revenue at CRUCH universities, and their changes through time, can be seen below in Figure 2. We notice that although AFD continues to be the major source of revenue it has reached a ´plateau´ in recent years. Contrariwise, student fees and resources deriving from MECESUP have expanded much faster since 1997-98 covering for the relative slow down in AFD.

Figure 2 Public subsidies for Tertiary Education in Chile, 1990-2003[10]

[10] In Kristian Thorn, Lauritz Holm-Nielsen, and Jette Samuel Jeppesen, Approaches To Results-Based Funding In Tertiary Education: Identifying Finance Reform Options for Chile, op. cit



Source: MINEDUC (2004)

d. CONICYT and the financing of R&D

Another major source of funds supporting the functioning of Chilean universities is CONICYT – the National Commission for Science and Technology – under the Ministry of Education. This agency is an autonomous public corporation created in 1967 to promote scientific and technological research and the training of human resources. It has become increasingly important in recent years, managing a large number of competitive funds.

In 1982-83 the Chilean economy entered into a deep recession triggered of by the Mexican Moratoria and the drying out of most external sources of finance. GDP fell by 14% in 1982 and a major banking crisis unfolded in 1983. Fiscal resources diminished drastically and public expenditure was cut down across the board. Concomitantly with the above the government announced the implementation of a new policy regime which involved the transition to market-based allocation processes in the field of R&D expenditure. This change in policy regime led to the creation of FONDECYT in 1982 – the National Fund for the Development of Science and Technology. FONDECYT is the largest of the various competitive funds managed by CONICYT.

From a recent public presentation of its Director, Dr. V. Heyl, we notice that CONICYT´s total budget has increased from 48.518 $MM Chilean pesos in 2004, (around U$S 80 million) to nearly 90.000 $MM Chilean pesos in 2007, around U$S 180 million. This rapid rate of expansion in the short period of just four years has given CONICYT a most prominent role within Chile´s National Innovation System.

Six different competitive funds absorb nearly 90% of CONICYT resources. The Table below indicates the relative participation of these funds

Table 4 CONICYT Resource Allocation Structure 2007[11]

Programa Bicentenario	18.8 MM$	20.8%
FONDEF	12.2 MM$	13.5%
FONDECYT	25.9 MM$	28.7%
Programa financiamiento Basal	9.0 MM$	10.0%
Becas de Post graduacion	8.3 MM$	9.2%
FONDAP	4.8 MM$	5.3%
Total	86.0 MM$	87.5%

FONDECYT National Fund for the Development of Science and Technology
FONDEF Science and Technology Development Research Fund
FONDAP: National Fund for the Development of Priority Areas

CONICYT finances basic and applied research projects, technological development activities in joint venture with private firms, and various other institutional building up efforts in the field of science and technology. Each is considered briefly below.

d1. Funds supporting basic and applied R&D

Various different competitive funds were created by CONICYT during the 1990´s covering a variety of different purposes.. Some funds addressed the development and upgrading of human capital. Others were more specifically directed towards supporting basic research. Some of the funds had a neutral character while others were ´sector-specific´ targeting agricultural activities, the fishing industry, the forestry sector and so forth.

As an example of the above, consider the case of FONDECYT and the Millennium Science Initiative which support Basic and Applied research. The Table below provides information as to the evolution of expenditure on both these programs between 1995 and 2004.

Table 5 R&D Financed by FONDECYT & Millennium Projects; 1995-2004[12]

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
FONDECYT	16.176	18.313	19.329	19.472	20.272	19.714	21.693	21.460	21.082	21.263
Millennium						3.268	4.404	4.158	4.085	3.610
Total	16.176	18.313	19.329	19.472	20.272	22.983	26.098	25.619	25.168	24.874
(i)	---	13.3%	19.6%	20.4%	25.4%	42.2%	61.4%	58.5%	55.7%	53.9%
(ii)	27.1%	13.3%	5.6%	0.7%	4.1%	13.4%	13.6%	- 5.6%	- 1.8%	-11.6%

(i) cumulative percentage change with respect to 1995
(ii) percentage change with respect to previous year.

The table shows that both funds involve a total allocation of resources in the order of U$S 50 million for the financing of basic and applied research. The two funds target different constituencies, however. The Millennium Science Initiative – created by the Chilean government

[11] Source: CONICYT, 2007; MM is million (10^6)
[12] B. Santelises et. al. Op. Cit. Chilean Academy of Sciences, 2005, page. 119.

in 1999 with the advice of a group of foreign scientists and of World Bank experts – basically aims at individual researchers, involves much bigger research projects and is more oriented towards basic research programs. (93% of its resources go to basic research as against 7% going to applied research). It is administered in Chile by the Ministry of Development Planning.

The Millennium Initiative has introduced many interesting new practices such as, for example, involving external peer review or inducing local researchers to link with private capital.

In contrast to The Millennium Science Initiative FONDECYT caters for the flow of R&D projects systematically emerging from Chilean university labs. Whereas the Millennium Institutes are just a few and are chaired by scientists of high domestic and international prestige, FONDECYT R&D projects come in the order of 350 to 400 per annum and represent the core of the ongoing flow of research efforts carried out by Chilean scientists and researchers.

d2. Funds supporting innovation and private sector partnership ventures

Besides FONDECYT and Iniciativa Milenio, CONICYT finances more applied R&D activities. An important one, about half the size of FONDECYT, is FONDEF - Science and Technology Development Research Fund - in which the public sector operates in joint venture with private firms. Throughout the period 1996-2007, FONDEF financed close to 600 R&D projects for a total amount of around U$S 300 million dollars, i.e. close to U$S 20 million annually.

Table 6 Applied R&D Projects Financed by FONDEF 1996-2007[13]

	Projects Annually Fnanced	Total Expenditure (MMU$S)	Agribusiness	Forestry	Manufact.	Fisheries	Other
1996	32	22.5	8	6	3	9	3
1997	50	29.4	11	15	3	9	12
1998	33	16.7	4	9	0	9	11
1999	44	17.9	7	5	3	13	14
2001	50	21.8	4	4	4	13	25
2001	61	24.5	6	8	4	16	27
2003	62	25.5	10	6	1	17	28
2004	60	24.4	13	4	8	15	20
2005	61	24.8	6	4	9	20	22
2006	44	19.1	4	1	2	16	20
2007	38	19.6	2	1	4	13	18

This report returns in Section 7 to a broader description of Chile´s National Innovation System but for purposes of closing down the present section dealing with the financing of CRUCH

[13] Source: FONDEF, January 2008.

universities we should add that universities can also obtain funding for R&D and innovation projects from several other sources, including:

MINEDUC – Ministry of Education (as above)
- CONICYT – National Commission for Science and Technology Research – including:
  - FONDECYT National Fund for the Development of Science and Technology
  - FONDEF Science and Technology Development Research Fund
  - FONDAP National Fund for the Development of Priority Areas
  - BASAL Financiamiento Basal Program

MINAG - Ministry of Agriculture
- FIA Agricultural Innovation Fund (also FIP – fisheries, FIM - minerals)

MINECON – Ministry of Economy
- CORFO – Chilean Economic Development Agency/Corporation
  - FONTEC National Fund for Technology and Productive Development
  - FDI Development and Innovation Fund
  - INNOVA - FDI and FONTEC were merged in 2005 into INNOVA Chile, which also has participation of CONICYT and FIA
    - FIC - National Innovation Fund (est. $200 m. 2008)
  - FAT Technical Assistance Fund
  - PDP Suppliers Development Program

MIDEPLAN – Ministry of Planning
- MSI Millennium Science Initiative

CORFO comprises the principal funding mechanism for private sector innovation, and INNOVA has rapidly expanded in recent years providing resources for public-private collaboration research projects. While FONTEC and FDI could be regarded as ´second generation´ policy instruments, reflecting the 1990´s thinking in relation to policy interventions to induce innovation, INNOVA appears as a ´third generation´ policy instrument of quite recent vintage. In a recent PPTs presentation made in Dublin, Claudio Maggi stresses the institutional learning´ component underlying the transition from ´2nd generation´ to ´3er generation´ policy instruments, and assigns a great deal of importance to the use of competitive matching funds as part of the new public policy strategy on this front. (C.Maggi, Innovation for Competitiveness in Chile, Dublin, March 2007).

The Financiamiento Basal Program – also a major competitive fund managed by CONICYT - was introduced in 2007, at a time in which the Consejo Nacional de Innovacion (CNIC) was created on the basis of a tax on cooper revenues. We shall look at the relationship between universities and the National Innovation System in Section 7 of this report.

Having so far examined the functioning of the financial model underlying the provision of university services in Chile we now turn to aspects of structure and behaviour of university markets and to the ´industrial organization´ account of the functioning of university markets..

4.2 Structure and behaviour of university markets in Chile.

a. Size, AFI students, students/faculty ratio, and other structural features of Chilean university markets.

Nearly 50 universities are actively offering teaching services in Chile. Table 7 provides a useful overview of the size distribution of the participating institutions.

Table 7 Size and AFI Students : 45 Universities, 2005[14]

Institution	Total Enrolmt.	New Stud.2005	Students AFI	Faculty equiv.	Stud./ faculty.
U. de Las Americas	22.500	5.183	86	712	32
Academia Humanismo Cristiano	3.200	589	29	152	22
Universidad Adolfo Ibáñez	6.570	1.330	832	222	30
Adventist University of Chile	1.482	444	1	45	33
University Alberto Hurtado.	2.528	469	87	107	24
Universidad Andres Bello	22.700	5.873	878	750	30
Universidad de Antofagasta	6.390	1.114	240	307	19
Universidad Arturo Pratt	18.000	1.558	96	369	23
Universidad de Atacama	3.300	494	30	154	18
Universidad Austral de Chile	11.000	1.970	711	347	28
U. Autonoma de Chile	9.000	2.890	48	263	34
Universidad Bolivariana	3.300	950	1	151	22
Universidad Catolica de Chile	21.400	3.451	3.236	1.642	13
U. Catolica de Valparaiso	13.149	2.844	1.690	497	27
U. Catolica de Temuco	5.000	1.450	138	287	16
U. Cat.Santisimia Concepcion.	5.300	1.471	205	323	19
U. Catolica del Maule	4.500	969	306	272	18
U.Catolica del Norte	7.500	1.575	545	403	22
U. Catolica Silva Henriquez	4.100	992	16	141	30
U.Central de Chile	6.100	1.785	98	248	25
Universidad de Chile	27.000	4.075	3.870	1.088	16
Universidad de Concepción	19.000	4.556	2.337	1.169	17
Universidad de la Frontera	8.300	1.462	561	461	16
Universidad de la Serena	8.200	1.596	324	315	26
U. de la Republica	5.500	1.545	34	190	29
Universidad de Los Lagos	20.000	3.500	80	253	18
Universidad de Magallanes	2.500	883	72	162	15
U. de Playa Ancha	7.800	1.740	232	381	21
Universidad de Santiago	17.800	3.024	2.084	806	22
Universidad de Talca	5.500	1.054	584	236	23
Universidad de Tarapaca	6.311	1.310	146	273	23
Universidad de Valparaíso	13.800	3.464	1.256	517	27
U. de Viña del Mar	5.700	1.109	34	324	18
Universidad del Bio Bio	8.300	1.859	338	496	17
Universidad del Desarrollo	8.100	1.547	389	299	27
Universidad del Mar	19.030	6.479	36	645	29
Universidad del Pacifico	3.200	809	63	91	35
Universidad Diego Portales	9.800	1.845	840	302	33
U. Ibero-Americana UNICIT	1.500	363	6	82	18
U. Los Andes	4.000	911	536	353	11
Universidad Mayor	15.900	2.762	627	660	24
U. Metropolitana de Ciencias de la Educacion.	5.100	923	469	358	14
Universidad San Sebastián	10.200	1.252	216	11	14
Universidad Santo Tomas.	14.900	4.795	120	442	34
U. Tecnica Federico S. Maria	10.800	2.660	1.481	394	28
U. Tecnologica Metropolitana	14.200	1.648	718	365	24
Universidad UNIAC	2.800	492	33	189	15

[14] Fuente: El Mercurio, Ranking de Universidades: www.emol.com/especiales/infografias/

The university ´industry´ exhibits a high degree of business concentration. Five universities – Universidad de Chile, The Catholic University, Universidad Andres Bello, Universidad de Las Americas and Universidad Los Lagos – show an enrolment of more than 20.000 students each. Relative to a total university population of around 500,000 students, we notice that the five larger firms in the industry absorb nearly ¼ of the total. Further down this section evidence is presented indicating that only two of the above five universities have received proper accreditation for a period of seven years. Lack of accreditation of some of the largest universities in the country clearly points out to a major structural frailty of the market for university services which will have to be seriously examined in the near future by Chilean policy makers.

A second group of relatively ´large´ universities follows the previous one. It is integrated by 12 universities with a studentship of between 10 and 20 thousand students each. Jointly these universities cater for around 40% of the market, and among them we count highly ´selective´ universities (with a high ratio of AFI students in their annual enrolment) – U. of Santiago, The Catholic University of Valparaiso and the University of Concepcion – and also ´large´ universities but with a very poor record of selectivity, i.e. a very low AFI ratio, as in the case of Universidad de Las Americas or Universidad del Mar.

b. Accreditation.

Not all Chilean universities have successfully passed through a process of formal accreditation Furthermore, among those that have done so not all of them have been accredited for seven years – which is the maximum the present accreditation mechanism allows – nor have been accredited in each one of the six different categories the accreditation process takes into consideration. Such six categories are: 1.Institutional management, 2.Undergraduate Teaching, 3.Research, 4.Post Graduate Teaching, 5.Relationship with the community and, finally, 6.Infrastructure.. Only a few universities have received accreditation in all six of the above mentioned categories, and for 7 years, which is the maximum possible. The following Table presents evidence concerning the accreditation status of the universities presently operating in Chile. We notice that a large number of them has received accreditation only for two years, and only in some of the six areas being evaluated, suggesting that a serious ´quality´ issue is hereby involved and will have to be tackled by local authorities in the not so distant future. Conscious of the above both public and private accreditation agencies - MECESUP and various independent private accreditation firms - are currently working on accreditation standards. (See: CNAP 1999-1007; also El Mercurio, A, 29. Domingo 3 de febrero 2008).

Table 8. Accreditation Status of Chilean Universities (2007)[15]

Institution Universities	Effectively accredited areas Fields of accreditation	Period of accreditation (Expiring year)
Universidad Academia de Humanismo Cristiano	1.Institutional management 2.Undergraduate teaching	November 2008
Universidad Adolfo Ibañez	1.Institutional management 2.Undergraduate teaching 3.Post graduate teaching	August 2009
Adventist University of Chile		NOT ACCREDITED
University Alberto Hurtado.	1.Institutional management 2.Undergraduate teaching 3.Relations with the community	November 2009
Universidad Andres Bello	1.Institutional management 2.Undergraduate teaching 3.Infrastructure & equipment	August 2008
Universidad de Antofagasta	1.Institutional management 2.Undergraduate teaching	January 2009
Universidad Arturo Pratt		NOT ACCREDITED
Universidad de Atacama	1.Institutional management 2.Undergraduate teaching	January 2008
Universidad Austral de Chile	1.Institutional management 2.Undergraduate teaching 3.Research and development 4.Postgraduate teaching.	August 2009
Universidad Autonoma de Chile	1.Institutional management 2.Undergraduate teaching	December 2008
Universidad Bolivariana		NOT ACCREDITED
Universidad Catolica de Chile	1.Insitutional management 2.Undergraduate teaching 3.Research and development 4.Post graduate teaching 5.Relations with the community 6.Infrastructure & equipment.	August 2011
Universidad Catolica de Valparaiso	1.Institutional management 2.Undergraduate teaching 3.Research & development 4.Post graduate teaching	August 2009
Universidad de Tecmuco	1.Institutional management 2.Undergraduate teaching	November 2009
Universidad Catolica de la Santisimia Concepcion.	1.Institutional management 2.Undergraduate teaching 3.Infrastructure & equipment	January 2008
Universidad Catolica del Maule	1.Institutional management 2.Undergraduate teaching 3.Relations with the community 4.Infrastructure & equipment	January 2009
Universidad Catolica del Norte	1.Institutional management 2.Undergraduate teaching	December 2010

[15] CNAP 1999-2007; op. cit.

	3.Research & development. 4.Infrastructure & equipment	
Universidad Catolica silva Henriquez	1.Institutional management 2.Undergraduate teaching	October 2008
Universidad Central de Chile	1.Institutional management 2.Undergraduate teaching	December 2008
Universidad de Chile	1.Institutional management 2.Undergraduate teaching 3.Research & development 4.Post graduate teaching 5.Relations with the community 6.Infrastructure & equipment.	August 2011
Concepcion	1.Institutional management 2.Undergraduate teaching 3.Research & development 4.Post graduate teaching 5.Relations with the community Universidad de 6.Infrastructure and equipment	August 2010
Universidad de la Frontera	1.Institutional management 2.Endergraduate teaching 3.Research & development	November 2008
Universidad de la Serena	1.Institutional management. 2.Undergraduate teaching	January 2008
Universidad de la Republica		NOT ACCREDITED
Universidad de Los Lagos		NOT ACCREDITED
Universidad de Magallanes	1.Institutional management 2.Undergraduate teaching	Re-accredited until November 2008
Universidad de Playa Ancha	1.Institutional management 2.Undergraduate teaching	December 2008
Universidad de Santiago de Chile	1.Institutional management 2.Undergraduate teaching 3.Research & development 4.Relations with the community 5.Post graduate teaching 6.Infrastructure & equipment	April 2008
Universidad de Talca	1.Institutional management 2.Undergraduate teaching 3.Research & development 4.Infrastructure and equipment	August 2009
Universidad de Tarapaca	1.Institutional management 2.Undergraduate teaching 3.Infrastructure & equipment	August 2007
Universidad de Valparaiso		January 2009
Universidad de Viña del Mar	1.Institutuional management 2. Undergraduate teaching	October 2008
Universidad del Bio Bio	1.Institutional management 2.Undergraduat teaching 3.Relations with the community 4.Infrastructure & equipment	January 2009
Universidad del Desarrollo	1.Institutional management 2.Undergraduate teaching 3.Continuous education 4.Relations with the community	November 2011

Universidad del Mar		NOT ACCREDITED
Universidad del Pacifico	1.Institutional management 2.Undergraduate teaching	August 2007
Universidad Diego Portales	1.Institutional management 2.Undergraduate teaching 3.Infrastructure & equipment	August 2008
Universidad Ibero-Americana UNICIT	1.Institutional management 2.Undergraduate teaching	December 2007
Universidad Mariano Egaña		NOT ACCREDITED
Universidad Mayor	1.Institutional management 2.Undergraduate teaching	December 2009
Universidad metropolitana de Ciencias De la Educación.	1.Institutional management 2.Undergraduate teaching	January 2008
Universidad San Sebastián	1.Institutional management 2.Undergraduate teaching	June 2008
Universidad Santo Tomas.	1.Institutional management 2.Undergraduate teaching	December 2007
Universidad Tecnica Federico S. Maria	1.Institutional management 2.Undergraduate teaching 3.Research & development	December 2011
Universidad Tecnologica Metropolitana		NOT ACCREDITED
Universidad UNIAC	1.Institutional management 2.Undergraduate teaching	December 2007

The university industry shows a complex and variegated scenario as far as accreditation is concerned. Only a small number of Chilean universities have received accredited in all six areas of evaluation and for seven years, which is the maximum possible. The group includes the University of Chile, the Catholic University, and the University of Concepcion. Close behind we find a small group of universities accredited on four or five areas (out of six being examined) or for shorter periods of time, say four years. This group includes Universidad Austral, Universidad Catolica de Valparaiso, Universidad del Bio-Bio, Universidad de Talca. Contrary to the above, a large number of universities have not yet been accredited, or the accreditation has elapsed (or is going to do so shortly). This third group includes both public and private universities. Among private universities only a small group has done well as far as accreditation is concerned. This group includes Universidad del Desarrollo, Adolfo Ibañez, Diego Portales, Los Andes, Andres Bello and Universidad Mayor. These private universities are currently gaining prestige and market share in teaching services for undergraduate students.

It is reasonable to assume that a positive relationship prevails between depth and length of the accreditation status and quality of services, keeping in mind that this is an industry in which a great deal of asymmetric information prevails, making it difficult to know exactly how much the information on accreditation actually reaches the public and, when it does, how much of it is actually taken into consideration at the time a new student applies for admission.

c. AFI students, prestige and selectivity.

In an important recent book, J. J. Brunner argues that universities compete for students. He calls ´selection capacity´ the ratio of AFI students to total new enrolment for each university. A priori

we expect such indicator to be positively correlated both with prestige and quality of services. Seven universities – out of 45 included in Table 7 – which jointly account for 20% of the total enrolment of 2005, managed to capture 55% of AFI students. The selectivity ratio of these universities is – the University of Chile 0.94, (3.870 AFI students), The Catholic University, 0.93 (3.236 AFI students), the University of Santiago, 0.68 (2084 AFI students), Adolfo Ibañes 0.62 (832 AFI students), the Catholic University of Valparaiso, 0.59 (1.690 AFI students), U. de Los Andes, 0.58 (536 AFI students) and University of Concepcion 0.51 (2337 AFI students). These 7 universities jointly captured close to 15.000 AFI students in 2005, well above half of the total 27.500 slots available. Their enrolment rates indicate that they only account for 20% of the total for that year, meaning a rather high ´selection capacity´. No doubt this is correlated with prestige and also with quality of services. If we take the ratio of students to faculty as a ´proxy´ for quality, we get a rpiori confirmation of the above. In the case of U. of Chile, The Catholic University, the University of Concepcion and U. Los Andes, such ratio is around 13, compared to an average of 23 students per faculty for the group of 45 universities here under examination.

d. fees

Large differences prevail among universities as far as student fees for similar disciplines are concerned. Of course, having the same denomination does not say much about quality and we have to assume that large quality differentials prevail between universities if we are to explain that studying, say, Architecture, costs twice as much at the Catholic University or at Diego Portales than in Arturo Pratt or at Universidad de la Republica. More research on quality of services and its relationship with fees seems to be urgently needed if we are further to understand the nature of the competitive process in Chilean university markets.

Table 9 Comparative Fees for similar disciplines at Chilean universities.

(in 2008 dolars)

	Architecture	Marine Biology	Law.	Civil Engineering	Comercial Engineering	Medicine	Sociology
U.Valparaiso	2.260.	1,560.	1.850.	2.100.	1.850.	2.900	1.650
U.de Chile	2.298.	2.150	2.633	2.500	3.080	3.389	1.930
U.Catolica	3.600	3.280	3.280	4.020	3.740	4.200	2.970
A. Ibañez *					3.330		
Republica	1.500		1.550		1.350		1.400
Los Andes			3.335	3.335	3.335	4.709	3.400
D. Portales	3.029		3.058	2.994	3.026		2.820
Los Lagos	1.580	1.580		1.580	1.580		1.400
A. Pratt	1.614	1.390	1.640	1.460	1.393		1.423
USAch	2.272				2.521	2.679	1.929
A. Bello	3.019	2.740	3.019	3.019	3.019	4.900	2.520

e. Mergers and acquisitions

As in many other industries, the university industry and university markets show frequent processes of mergers and acquisitions, as well as foreign direct investment from major international investors active in teaching activities. The recent arrival to Chile of international players such as Laureate Inc. or the Apollo Group, which entered the market buying smaller local universities constitute examples of the above. Further details of mergers and acquisitions are provided in Section 6.1, when discussing the dynamics of market processes.

Further Chilean and Comparative University Data

Table 10 provides further information on Chilean universities, and the Section is rounded out by presenting some comparative data on the Canadian university system. The Canadian system contains 90 universities and colleges and, as with the European universities, fees cover a smaller proportion of total costs – typically 15-20%. It also appears clear that international and private funding are more important than in Chile,, and that the structures of government funding mechanisms (regional, national, provincial) is different, and more differentiated and targeted in terms of services (education, basic research, applied research, commercialization, extension) – though this is a matter requiring further examination..

Table 10 Indicators for Five Research Oriented Universities in Chile 2004[16]

Table Nº 1: Indicators for five research-oriented universities in Chile, year 2004

		Enrollments			Faculty (2003)				Research		
	Estab. Year	Total	% High scores	% Graduate	Total	% FT	% PhD	%of FT w. PhD	Projects 3 yrs.	Publications 3 yrs.	Nº Ph.D.s conferred 2003
		(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Universidad de Chile	1842	26,470	94	11.7	3,392	35.9	20.7	34,3	569	2,322	50
P. Universidad Católica de Chile	1888	19,829	94	10.0	2,349	43.4	48.9 (*)	71,6(*)	393	1,432	37
Universidad de Concepción	1919	18,411	51	5.1	1,430	57.1	25.5	40,8	222	928	34
Universidad de Santiago	1947	17,555	75	3.2	2,425	25.0	13.9	38,8	157	546	8
Universidad Austral	1954	9,295	41	3.9	784	67.2	22.6	31,7	95	376	5
	Average	18,312	71	6.8	2,076	45,7	26.3	43.4	287	1,121	27

Sources: (a) and (c): Consejo Superior de Educación *Indices* database, year 2004. (b) DEMRE, AFI distribution 2005, for the class of 2004. (d), (e), (f), (g) and (j) is data for 2003 from Consejo de Rectores (2003). (h) and (i): El Mercurio (2004).

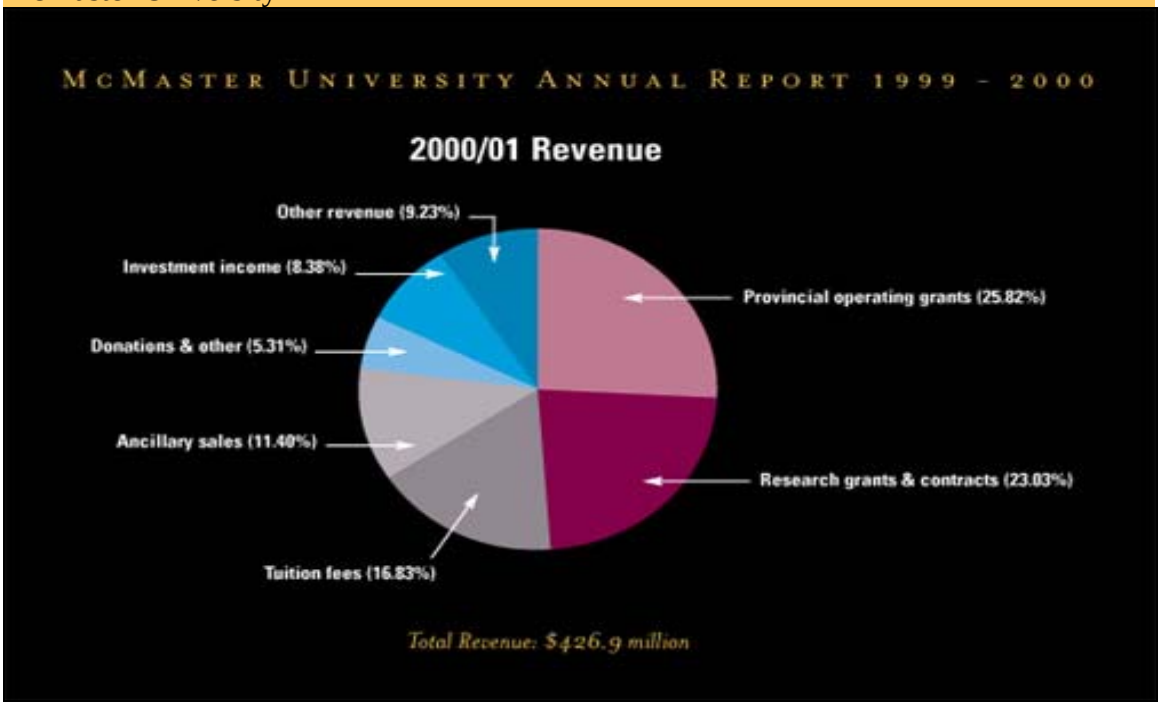
Notes: (b) "High scores" is the % of freshmen among the 27.500 best scoring students in the national standardized admissions test. (c) "% Graduate" is the proportion of graduate students in total enrollments. Indicators for "Faculty" consider: (d) total headcount, (e) the proportion of faculty who are full-time, (f) the proportion of faculty with a PhD degree, and (g) the proportion of full-time faculty who are PhD holders. Under "Research": (h) "number projects" considers all externally funded, and competitively assigned, research grants, and (i) "publications" is the sum of all ISI-indexed articles published in the previous three years. (j) is the number of Ph.D. degrees conferred in 2003.

(*) Includes faculty with a medical specialization degree. If those are excluded, the proportion of PUC faculty with doctorates reported by *Qué Pasa* (2004) is 29.7%, and FT faculty with Ph.D.s is 47%.

[16] The table is from Andres Bernasconi, Are there research universities in Chile?, 2005 – link on the website of J. J. Brunner at http://mt.educarchile.cl/mt/jjbrunner/archives/2005/10/chile_higher_ed.html

Table 11 Finances of a Canadian University

McMaster University



ACADEMIC FIGURES

STAFF	2000	2000
ACADEMIC FIGURES	1,189	37%
Support	2,339	73%
Total	3189	100%

DEGREES GRANTED	2000	2000
Bachelor's	3,030	80%
Master's	512	14%
Doctoral	120	3%
Doctor of Medicine	103	3%
Total	3,765	100%

STUDENT ENROLMENT	2000-01	2000-01
Undergraduate	11,932	53%
Full-time	2,514	11%
Part-time	3,459	15%
Graduate	1,597	7%
Full-time	751	3%
Part-time	2,266	10%
Total	22,519	100%

FULL-TIME UNDERGRADUATE	2000-01
Male/Female ratio	43.4/56.6%

EXPENDITURES (000's)	2000-01	2000-01
Instruction	$129,265	34%
Student & Academic Services	25,403	7%
Library	10,677	3%
Scholarships and Bursaries	17.31	0%
Physical Plant, Admin. & Fundraising	36,856	10%
Research	107,628	28%
Ancillary Operations	47,859	12%
Capital	4,465	1%
Works of Art	141	0%
Trust and Endowment	23,490	6%
Total	$385,801	100%

Table 12 Queens University Data Charts and Tables[17]

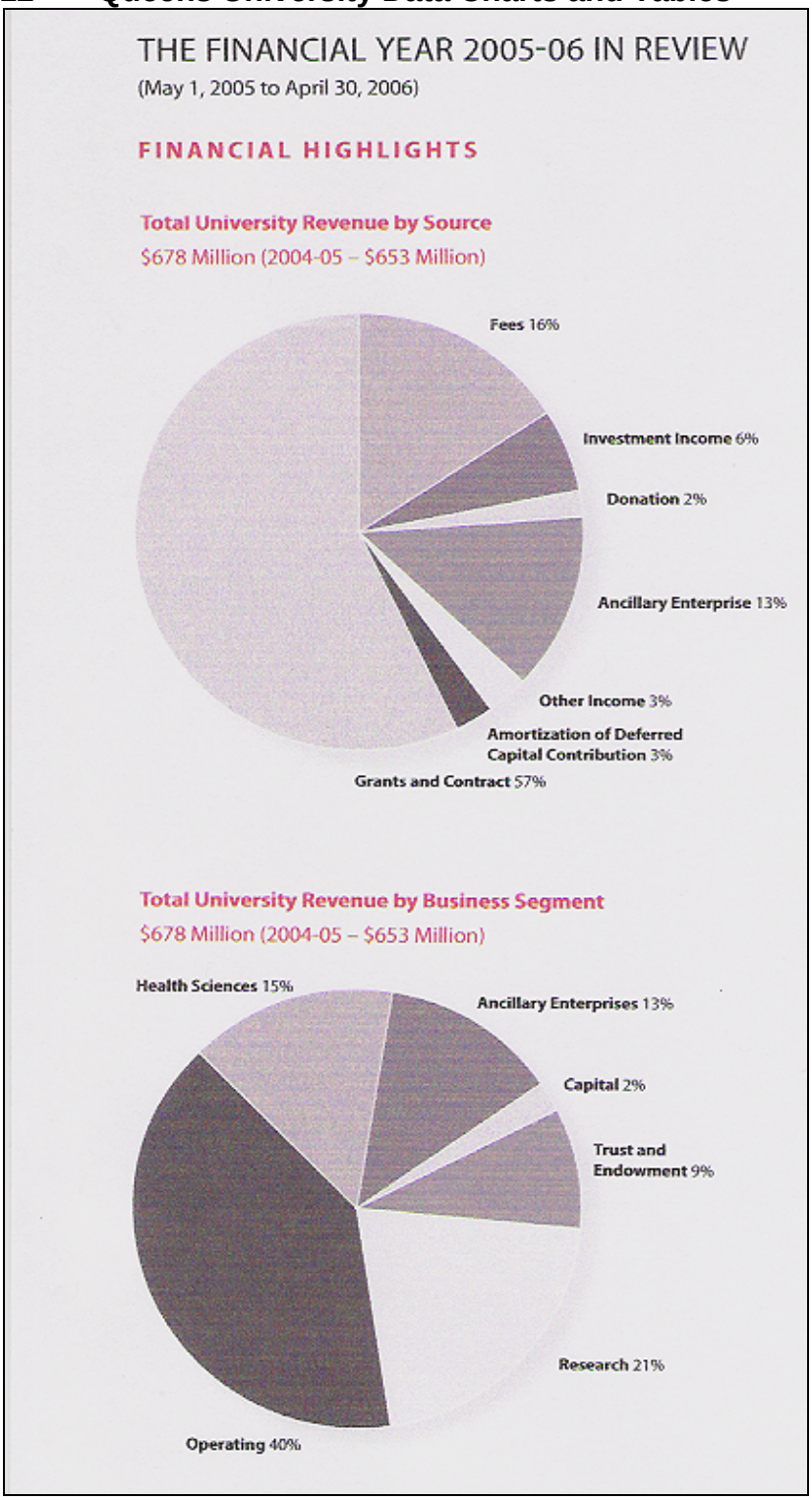


Table (cont.)

[17] Queen's University Annual Report, 2005: http://www.queensu.ca/fins/info/pdf/AnnualReport2006.pdf

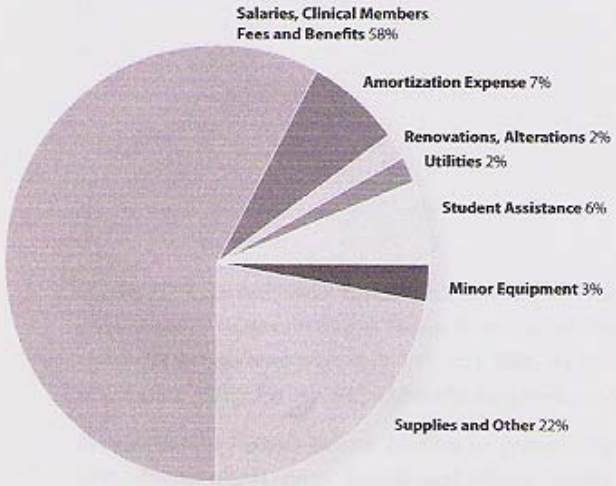
PROVINCIAL GOVERNMENT OPERATING FUNDING

($000's omitted)

	Budget 2005-06	Actual 2005-06	Actual 2004-05
Base Operating Grant	$ 111,246	$111,290	$ 111,443
Quality Assurance Fund	4,352	4,352	4,352
Quality Improvement Fund	5,760	4,500	0
Tuition Freeze Compensation	5,660	6,259	2,644
Enrolment Based Grants	25,097	23,742	17,500
Performance Fund	2,071	1,946	2,227
Research Performance Fund	1,500	1,527	1,655
Renovation Fund	1,826	1,825	1,826
Municipal Tax Grant	1,239	1,256	1,239
Deferred Maintenance	0	0	9,113
Other	914	884	891
Total Provincial Funding	159,665	157,581	152,890
Less: Allocation to Capital	(1,826)	(1,825)	(10,939)
Less: Allocation of Faculty of Health Sciences	(22,678)	(22,678)	(21,243)
Total Provincial Funding per Appendix 2	$ 135,161	$133,078	$ 120,708

Total University Expense by Type

$637 Million (2004-05 – $614 Million)



Total expenses increased $22 million (3.7%) to $637 million as compared to the previous year. Over half (58%) of the University's resources are spent on salaries and benefits which totaled $371 million during 2005-06, an increase of 4.3% over the previous year. Benefits increased as a result of additional pension plan contributions and the increasing accrual for employee future benefits.

(For a comprehensive breakdown, see Appendix 1.)

5. Factors Affecting the Demand for Services; Growth, Education and Social Mobility

5.1 Demand for education services

Various different forces have fuelled the rapid expansion of demand for tertiary education in Chile over the past three decades. On the one hand, the high rate of growth attained by the economy, in particular during the period 1984-1998. On the other, the increasing availability of scholarships, grants and credits, both from public and private sources, facilitating entry to universities and other tertiary education institutions. The table below indicates that the enrolment in tertiary education organizations multiplied by a factor of 4 between the early 1980´s and 2006. It is important to notice that such expansion was much stronger in the lower quintiles of the distribution, making the access rate to university in the 18-24 age bracket in the lowest quintile of the distribution to increase from 4% to 15%, from 1990 to 2003 and from 8% to 21% in the next lower quintile.

Table 13 Enrolment in Chilean Tertiary Education Organizations 1983-2006

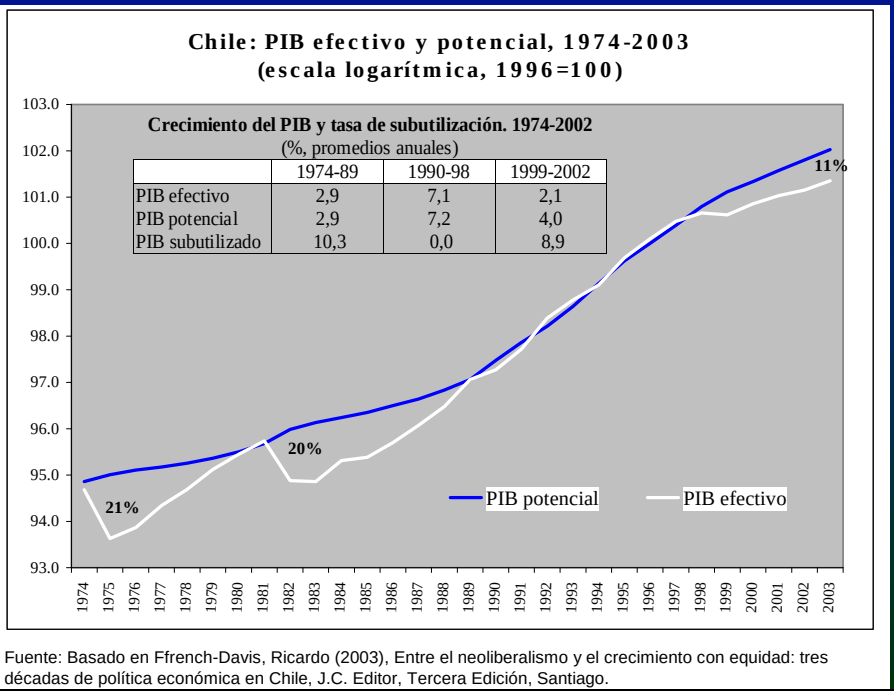
	1983	1985	1990	1995	2000	2006
CRUCH universities.	105.341	108.674	108.119	154.885	201.186	256.750
Private universities	2.708	4.953	19.509	69.004	101.386	180.346
Total Universities	108.049	113.625	127.628	223.889	302.562	473.096
Prof. Institutes	25.244	32.233	40.006	40.980	79.904	119.251
Prof.Training Centers	39.702	50.425	77.774	72.735	53.354	63.387
Total	172.995	196.283	245.408	337.604	435.830	619.734
Average % change			1985-95	**3.2%**	1995-06	**5.7%**

The period 1984-1998 is frequently regarded as the ´golden age´ of the Chilean long term growth process. After the Debt Crisis of 1982, the economy entered into a rapid period of expansion which lasted until 1998. An average rate of growth of 7% was attained, with many new firms opening up in the economy. The following diagram describes the process.[18]

Figure 3 Actual and potential GDP, Chile 1974-2003.

[18] R. French Davis. Entre el neoliberalismo y el crecimiento con equidad. J. C. Saez, Editor, Santiago, tercera Edicion, 2003.

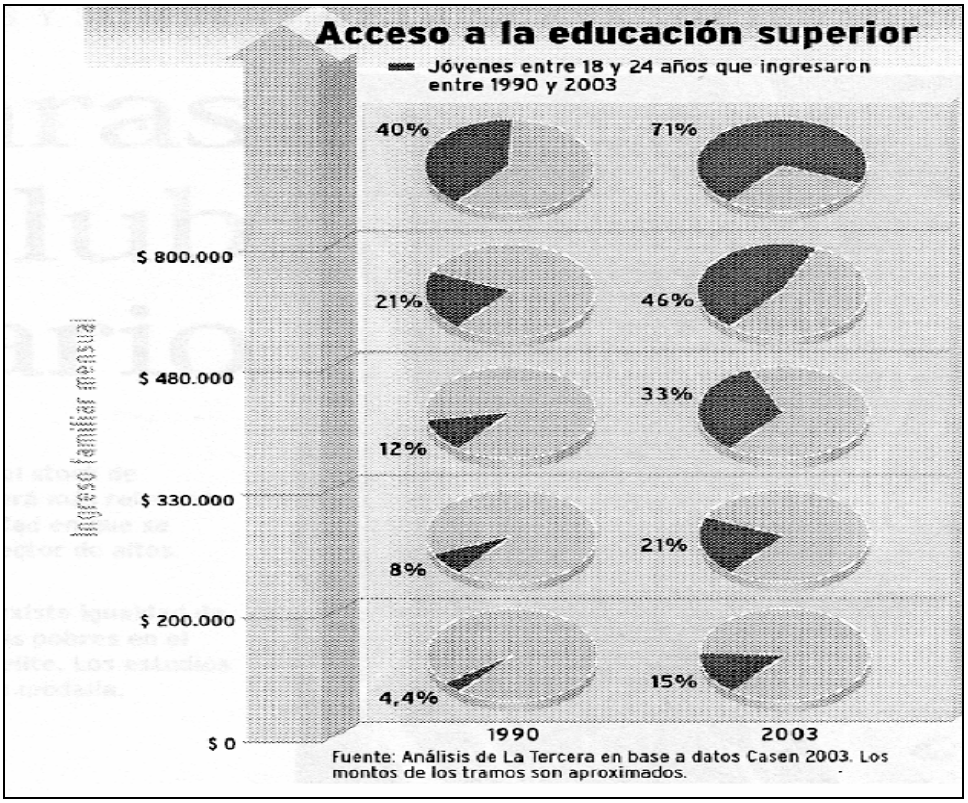
BETWEEN 1985 AND 1998 GDP GREW AT AN AVERAGE ANNUAL RATE OF 7% . AFTER 1998 THE ECONOMY ENTERED INTO A ´PLATEAU´ WITH ANNUAL GROWTH RATES IN THE REGION OF 4.2%.



Fuente: Basado en Ffrench-Davis, Ricardo (2003), Entre el neoliberalismo y el crecimiento con equidad: tres décadas de política económica en Chile, J.C. Editor, Tercera Edición, Santiago.

During the 1990´s the production structure underwent a rapid process of technological modernization in sectors such as cooper mining, salmon farming, fruit and wine production, the forestry industry. The new firms erected ´world class´ computer-based manufacturing facilities, rapidly gaining share in international markets. The new production facilities demanded new, more professional management as well as a more skilled labour force. The strong signal coming from the production structure favoured a rapid expansion of demand for tertiary education. Markets responded well to such expansion with an increase in the number of institutions providing teaching services. 10 new universities opened up between July 1990 and December 2005 (CNAP 1999-2007). The total number of university students increased from 245.000 in 1990 to 435.000 in 2000. As already mentioned, the rate of new student enrolment was well above average in the lower quintiles of the distribution, as shown in Figure 4.

Figure 4. Access to Tertiary Education in Chile



.

One national newspaper (La Tercera, Sunday, October 15th, 2006) puts the issue in the following terms ¨Per capita income increased by 30% between 1992 and 2003 broadening the segment of those that could dream sending their children to university.¨ A wide and heterogeneous middle class emerged. Pari pasu with the above the rapid expansion of the university infrastructure created new opportunities for accessing university education and more demand-side subsidies facilitated market entrance for low income groups. We find here a virtuous circle of faster economic growth leading to quality upgrade of the labour force which, in turn, brought about faster productivity growth.

Figure 3 indicates that after 1998 the Chilean economy experimented a significant slow down in its long term rate of expansion. The above has triggered of an interesting debate on issues of inter-generational social mobility. Although available studies indicate that intergeneration mobility has increased in Chile in the past two decades it is important to notice that the elasticity of income received by the younger generations - 18-24 years old - vis a vis the elasticity of income received by their parents, seems to be coming down in recent times. This suggests that the slowing down of the rate of economic growth might be inducing a concomitant slowing down in the process of intergenerational mobility in recent years. (Javier Nuñez, *Diario Financiero*, December 27, 2005).

How does the above finding affect the functioning of university markets?. Whereas in the past decade supply of university services has been running behind demand for said services, – particularly in the lower quintiles of the distribution – the more recent evidence indicates that

this is might no longer be the case as there are signs of oversupply of university vacancies. A specialist in tertiary education questions - Pilar Aranet – writes as a result of the above:: ¨this (that supply is outpacing demand) provides some space for reflection and to put more focus on quality aspects related to what the future needs of the country and of the young population are likely to be.¨[19]

5.2 Demand for research and innovation services.

Having so far examined the demand for educational services we now turn to the demand for R&D and innovation activities, also a major ´product´ of local universities. Good information on demand for research and innovation activities is not easy to obtain, but interviews with entrepreneurs in different fields of economic activity suggest that the demand for R&D and knowledge-generation activities is likely to expand in the years ahead. This trend seems likely to continue, given factors like:

- competitive pressures of a relatively open and efficient economy;
- opportunities and challenges of expanding natural resource based exports in today's multi-polarizing global economy;
- growing demand for better public goods and services.
- Increasing fiscal incentives.
- new competitive funds demanding stronger interaction between firms and university labs

If demand for innovation services – commercial and public – will grow faster than GDP, supply and funding become important issues to be address in a timely way. Some countries deliberately overbuild by a (small) margin. The alternative is likely to have undersupply and relatively higher prices of science, technology and skills, just the opposite of what seems ideal for an innovation oriented development strategy. It would be straightforward if markets could be left to meet demands, but given the various forms of market failure in knowledge markets already discussed in this report founding decisions have to go hand in hand with evolving R&D demands.

Which universities will specialize in which R&D and innovation services? The major CRUCH universities might be expected to be active in most or all service areas, and on a wide range of disciplines and fronts. Consistent with our industrial organization perspective, several small CRUCH and private universities can also be expected to developed niche R&D and innovation activities. In the larger and ´old´ universities R&D capabilities have been accumulating over the past decades, but in some of the new private universities we notice a recent trend of recruiting top scientists and technicians to form high-end science and commercialization labs.

Both short-term economic outlook and longer-term national/global economic trends will be important to the restructuring and anticipated expansion of R&D capabilities as one key component of economic diversification and innovation for competitiveness. In the short term, Chile appears to be going through a period of very strong currency appreciation, with mixed consequences in the economy. For some firms this means very high profits, for most, the

[19] Pilar Aranet, CNAP 1999-2007, Op. Cit. pag.90

attractiveness of exports has strongly diminished. These may be short term circumstances, but they obviously affect entrepreneurs' expectations. Some universities are reporting new firms approaching them with the idea of jointly developing R&D activities. This likely reflects recently introduced tax incentives, but may also signal some new areas of interest in fields such as energy, environmental protection, health or biotechnologies.

The longer-term economic outlook is challenging but probably not dire. Global demand for resources will be fuelled by China, India and the fast-growth manufacturing export economies. Being a decade into an innovation agenda is an asset for domestic and export sectors and does deliver, in the experience of many countries. This looks to be a good time to push ahead with the innovation agenda recently brought to the fore by CNIC and to proceed with the development of a broader set of R&D capabilities..

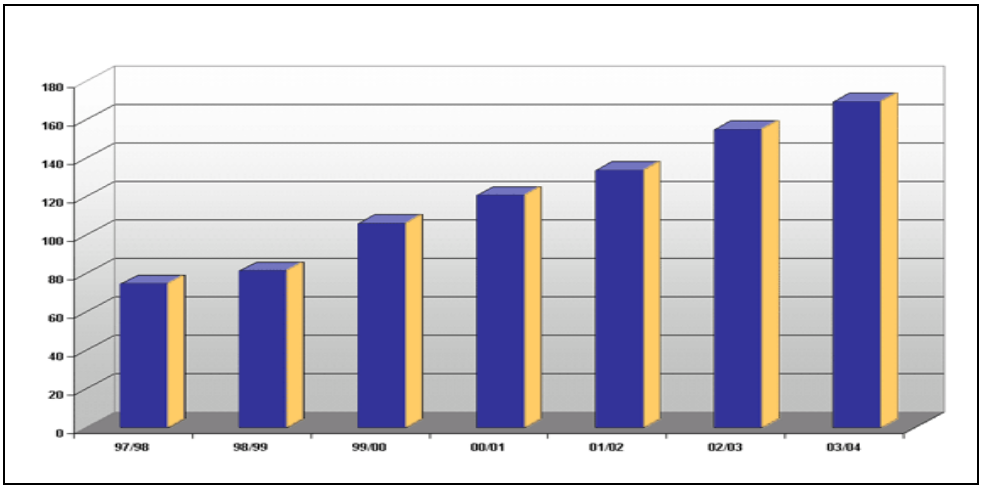
This chapter concludes with information on the research demand and funding for one principal research-oriented Canadian university – McMaster. A near-term priority is to get further information on the funding of R&D and innovation activities of several Chilean universities. This would enable filling out the picture of research funding - CONICYT funding (Section 4), funding from other government funds in the national innovation system, private sector funds and international funding. It would also enable a much fuller understanding of R&D expenditure and organization; how funding is obtained and managed by university departments, what decisions and issues are faced daily at the micro management of R&D activities.

The following table provides quantitative information on research funding for McMaster University and a little bit of comparative data for Canadian Universities. This subject is picked up again in section 7, in looking at the role of universities in the national innovation system.

We notice the diversity of funding sources underlying the Canadian case. Federal government funding dominates, but provincial, not-for-profit, industry and foreign sources are all important.. Diversity probably contributes to stability of overall funding in the case of shifts in national government policies and funding levels. Another observation is that the federal funding is predominantly managed by 3 research councils in health, natural sciences and engineering and social sciences and humanities . A third is that comparisons among universities can be made on many indicators of research capacity, performance and intensity. Such data are relatively easily available in Canada, being generated and used by public funding institutions, by universities in advertising their advantages and by the Association of Universities and Colleges of Canada (AUCC) in documenting and promoting benefits of the university system. Not such information seems to be presently available in the case of Chile.

Table 14 Research Demand and Funding Information for Canadian Universities

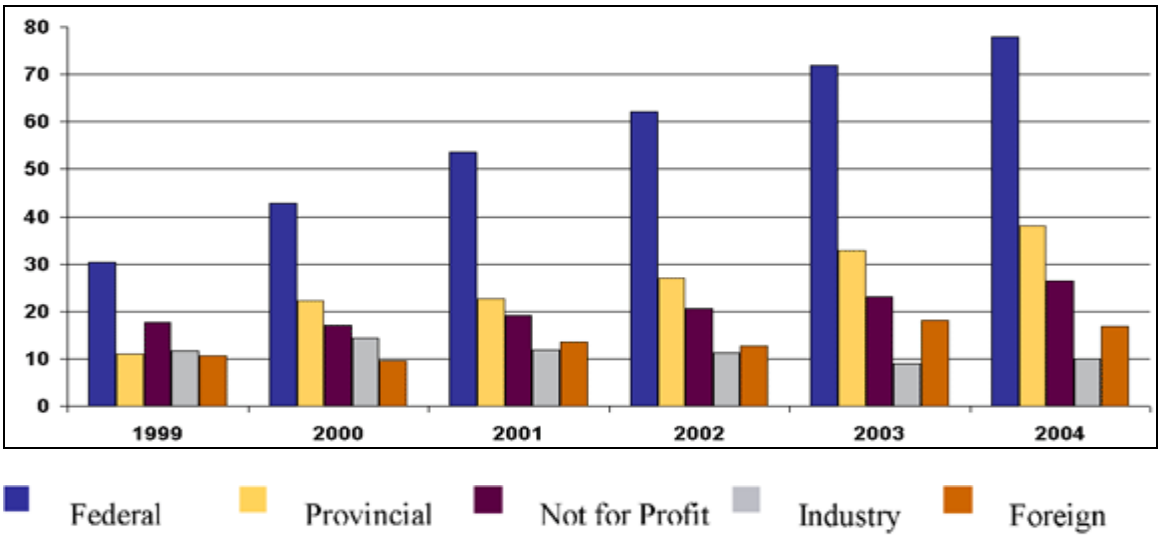
a. Growth in McMaster Research Funding 97/98 to 03/04 ($ millions)



Source: McMaster University Research Funding Database (MURFI)
1998 - 2004 (Time periods are fiscal year ending)

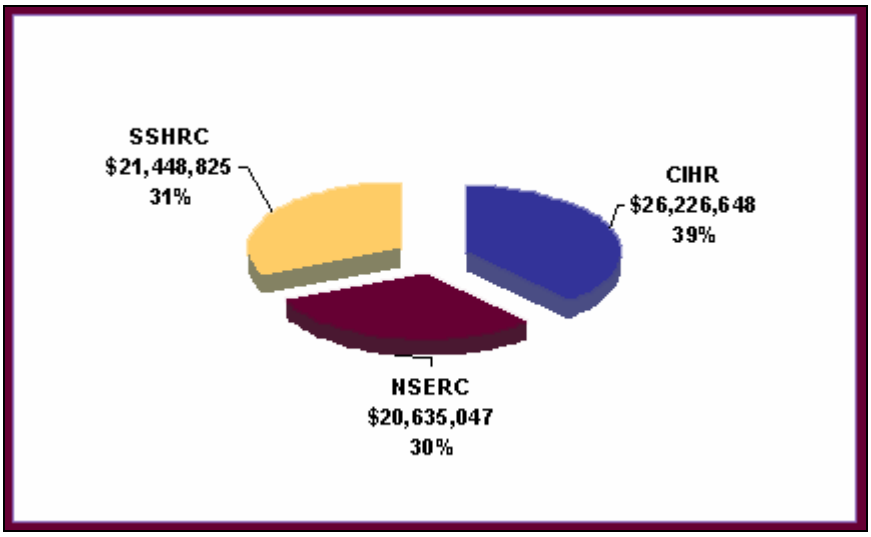
b. External Research Funding Sources 1999 – 2004

$ millions



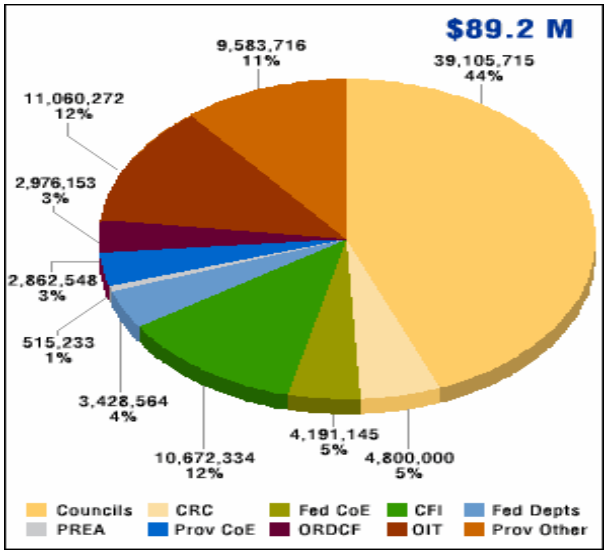
Source: McMaster University Research Funding Database (MURFI) 1999 – 2004:
http://www.mcmaster.ca/research/facts/facts3.htm

c. McMaster University: Funds from Federal Research Councils



CIHR: Canadian Institutes of Health Research
NSERC: Natural Sciences and Engineering Research Council
SSHRC: Social Sciences and Humanities Research Council

d. McMaster University: Federal & Provincial Research Funding



Councils: CIHR, NSERC, SSHRC
CRC: Canada Research Chairs
Fed CoE: Federal Networks of Centres of Excellence
CFI: Canada Foundation for Innovation
PREA: Premier's Research Excellence Awards
Prov CoE: Provincial Centres of Excellence
ORDCF: Ontario Research and Development Challenge Fund
OIT: Ontario Innovation Trust

e. Top 10 Canadian Research Universities

05	2004	University	Sponsored Research Income			Number of Full-time Faculty	Research Intensity
			FY 2004 $000	FY 2004 $000	%Change 2004-2005		$ per Full-time Faculty $000
1	1	University of Toronto*	$708,642	$623,995	13.6	2,376	$298.3
2	3	Université de Montréal*	$492,286	$446,247	-3.8	1,851	$231.9
3	2	McGill University *	$423,051	$523,497	-22.2	1,476	$286.6
4	5	University of Alberta*	$396,867	$360,009	10.2	1,524	$260.4
5	4	University of British Columbia*	$359,544	$363,337	-1.0	1,875	$191.8
6	**7**	**McMaster University***	**$344,979**	**$246,173**	**40.1**	**1,119**	**$308.3**
7	7	University of Calgary*	$271,513	$251,379	8.0	1.521	$178.5
8	10	University of Ottawa*	$238,270	$190,343	25.2	1,002	$237.9
9	6	Université Laval*	$231,097	$279,866	-17.4	1,380	$167.5
10	9	University of Western Ontario*	$179,883	$191,231	-5.9	1,260	$142.8

* Has a medical school

Notes:

1. **Sponsored research income**: includes funds to support research paid either in the form of a grant or by means of a contract from a source external to the institution.
2. Financial data were obtained from Statistics Canada.
3. Faculty data were obtained from Statistics Canada, Conférence des recteurs et des principaux des universités du Québec (CREPUQ) and the RE$EARCH Infosource Canadian University R&D Database. For confidentiality reasons, Statistics Canada randomly rounds the figures either up or down by a multiple of "3"
4. Data are provided for the main university/college including its affiliated institutions, where applicable.
5. All institutions are members of the Canadian Association of University Business Officers (CAUBO)

Information prepared by Research Infosource Inc., November 3, 2006

f. Top 10 Canadian Universities Ranked by Research Intensity

2005 Rank	University	Research Intensity ** ($ per Full-time Faculty) $000
1	**McMaster University***	**$308.3**
2	University of Toronto*	$298.3
3	McGill University	$286.6
4	University of Alberta*	$260.4
5	University of Ottawa*	$237.9
6	Université de Montréal*	$231.9
7	Queen's University *	$197.9
8	University of British Columbia*	$191.8
9	University of Calgary*	$178.5
10	Université Laval	$167.5

Information prepared by Research Infosource Inc., November 3, 2006

* Has a medical school

** Top 10 research intensity list includes full service institutions only

Apparent ties due to rounding

6. Dynamics of University markets.

6.1 An overall view of market functioning.

Having in Sections 4 and 5 examined the incidence of supply and demand forces underlying the functioning of Chilean university markets we now proceed with the study of the dynamics of market processes. Chilean university markets underwent a major structural transformation in the course of the past three decades. Issues of access, affordability, quality and accountability have been affected and major questions also remain unanswered concerning how university R&D activities and the production of public goods are to be financed in the current market-led sectoral organization regime.

To re-cap, various co-evolving forces underlie the expansion and re-structuring of Chilean university markets over the past three decades. First,, the rapid pace of economic growth, particularly between 1984 and 1998. Many new firms entered the economy demanding qualified human capital in a wide range of disciplines. Second,, the de-regulation of university markets, induced a rapid process of market entry. New private universities joined the market and gained participation in specific academic disciplines. Third,, demand-side subsidies permitted an extended process of market access, affecting in a particularly strong way low income groups in society. Fourth, pari pasu with the above, many public institutions started competitive funding of R&D activities and of infrastructure upgrading. The above changes took place in simultaneous, without following any a priori design or master plan. Their co-evolution reinforced a successful process of economic and institutional transformation.

The contemporary scenario can be described as follows:

Some 200.000 secondary students – of very heterogeneous cultural and family backgrounds – compete annually for admission at local universities.

The best 27.500 of these students – 12% approximately – receive AFI subsidy. Some 50 universities compete for the best prepared of these youngsters, offering them grants, scholarships, loans. Also a great deal of advertising is involved.

Two highly prestigious universities – the University of Chile and the Catholic University jointly absorb close to 8.000 of these students. 95% of the students they enrol bring with them AFI subsidy.

So, these two universities establish the ´threshold line´ i.e. the required credits to be obtained for admission – setting up the number of vacancies they are prepared to offer annually in each discipline. Said threshold line is somewhere around 680 points, with differences across disciplines, with medicine and civil engineering being more difficult to access than the social sciences, given the number of vacancies being offered and the demand for them. Student fees are somewhat higher at the Catholic University than at the University of Chile. They come in the range of 4 to 6 thousand U$S dollars.

A second group of reputable universities picks up the next group of close to 8 thousand students. These students also carry AFI subsidies (but less on a per capita basis that in the first group). In this group we find CRUCH universities – USAch, the Catholic University of Valparaiso, the University of Concepcion - and also some private universities, Los Andes, Adolfo Ibañez.. In these universities the percentage of students carrying AFI subsidy is in the range of 50-60%. Student fees in the CRUCH universities of this group do not differ much from the previous ones. They are higher in the case of the private universities.

So, this still leaves some 10.000 students that carry with them AFI subsidy to be accepted in the remaining 40 universities. Diego Portales, Universidad Austral and Universidad Catolica del Norte – all three of them in the middle of the distribution of students with AFI - manage to get around 35% of their students in such category.

At the ´low end´ of university markets, many small and poorly accredited universities provide lower priced (and lower quality), university services. It is in this area of the market that M&A have occurred in recent years, with small universities being acquired both by local as well as by foreign investors. This suggests that university markets are far from equilibrium, and that a process of restructuring and rationalization is still going on. Instituto Los Leones has recently taken over Universidad de La Republica, Uniac – the University of Arts, Science and Communications – has been purchased for U$S 40 million by the US Apollo Group, in alliance with the Carlyle Group, also a large international investor in the education field. Universidad A. Bello – one of the ´large´ universities in Chile (more than 20 thousand students) – has been acquired by the Miami-based Laureate Inc. and there are indications that other cases will follow. Diseconomies of scale and low reputation, a large clientele securing a steady flow of income from fees, and many other reasons account for the recent trend of M&A in local university markets..

At the ´high end´ of the market a slow process of consolidation and market diversification seems to be taking place involving a small number of private universities, such a Adolfo Ibañez, Los Andes, Diego Portales. These universities are gradually opening up new careers, trying to capitalize on their already high prestige. Their fees are higher than those charged by the University of Chile and by the Catholic University, but their enrolment keeps on growing at a rapid pace. They are in the process of incorporating high quality faculty, mostly PhDs recently returning from graduate studies in the US or in European universities. It is interesting to observe that they ´buy´ out faculty from the University of Chile or from the Catholic University, pushing their salaries upwards.

Tuition fees for the CRUCH universities are covered – mostly, but not entirely, by FSCU (Fondo Solidario de Credito Universitario) or by bank loans with the public sector acting as guarantor. FSCU and other forms of financing are attained, roughly, by 60% of CRUCH students. The rate of non performing loans is rather high, 40% being the figure sometimes mentioned.

Student fees represent between 1/3 and 50% of CRUCH universities revenue, with a large variance among them. This makes the Chilean case an outlier in terms of family financed university education expenses.

AFD plus AFI represent 1/3 of university revenue and the remaining 2/3 is covered by contracts as well as by resources derived from competitive funds and donations. Private universities are supposed to be non-profit organizations so they tend to operate under the coverage of real estate companies which normally own the land and the physical infrastructure which they then rent back to their controlled university. As from this perspective private universities – low and high end universities – constitute highly profitable investments.

Research and innovation activities link closely with education services. Basic and applied academic research may in small part be funded by block grants, but it is mostly CONICYT through various competitive funds which provides financing for R&D activities, to an amount close to U$S 180 million annually. One third of these resources go to FONDECYT which finances some 350-400 R&D projects. Overheads coming from these projects also generate university revenue. CONICYT also administers FONDEF, the Millennium Initiative, the Programa Basal and other competitive funds financing R&D activities.

CONICYT funds are not meant to finance equipment for R&D activities.. Said expenses partially come from other competitive funds, such as MECESUP (ex FDI) and others. MECESUP runs a U$S 50 million program annually from which it pays for the above mentioned expenses in equipment and infrastructure, but also for performance-based agreements and accreditation activities carried out by CRUCH universities. Four of these programs are currently under operation to an amount of U$S 16 million for a period of three years.

Higher-end metropolitan and a few regional and private universities are competing successfully for public funding under the Ministry of Economy – CORFO/INNOVA. The lion's share of research funding goes to the large CRUCH R&D oriented universities. Smaller and newer universities are accessing to CONICYT funding, but so far in very small numbers. FONDECYT resources also go to a large extent to CRUCH universities.

FONDECYT R&D projects in execution:

Universidad de Chile	348
Catholic University	280
Universidad de Concepcion	134
Universidad de Santiago	108
Universidad A. Bello	22
Los Lagos	13
Diego Portales	12
Los Andes	11
Adolfo Ibañez	5

The recent Basal program, managed by CONICYT, has an annual budget of close to U$S 12 million and has a 5 years duration. Eight different R&D programs were recently approved: astrophysics, climatology, mathematical modelling, aquaculture, plant-insect interactions, aging and regeneration, mining technology, stress depression and addiction are the major fields in which projects have been selected.. The original proposal was for these projects to be located outside of the universities, and for the R&D groups to have their own legal status, so the resources would go to them without going throw the ordinary financial channels of CRUCH universities. This was the source of some tension between CRUCH universities and CONICYT. Eventually such tension settled down and it was agreed that the approved projects needed to have their own legal status quite separately of whether or not they happened to be located in any given university. Three of the eight approved project came from private sector research groups.[20]

To conclude, the study shows a successful institutional building up process and a proactive government as far as R&D activities and innovation are concerned. But it also indicates the existence of major problems and unresolved issues concerning the financing of R&D activities and the provision of public goods to the economy. Prior to addressing these issues in further detail, the remainder of this section provides further comparative information on the functioning of tertiary education markets – and particularly the types of financing mechanisms used – in Chile, Canada and other countries.

6.2 Comparative education and research funding mechanisms

This section focus mainly on ***educational*** services funding, with ***research*** funding in 6.3 below, but there is a fair amount of overlap so that national systems tend to look at these sets of services as interrelated in important ways. Country systems can be compared in terms of the use of different sets of service delivery and performance indicators by which they allocate public funds. On the educational services side, indicators range from simple to complex multiple indicator sets. Indicators can measure inputs, process or outputs.

[20] One of these - the ´Ciencia para la Vida´ center chaired by P. Valenzuela, the well established Chilean biologist that developed salmon vaccines and holds international patents on his vaccines.

Table 15 Comparison of Country Funding Systems for Education Services[21]

Country	Education funding basis and indicators	
Argentina	AR-model (Asignación de Recursos) based on the 'objective' budget whose calculation draws on the following criteria:	
	• Number of effective students • Adequate teacher per student ratios	• Teachers' salary scales
France	Number of students enrolled, adjusted to different costs of different careers – funding per student (lump sum) based on:	
	• Teaching staff (not funded by govt.) • Compensation for non-academic staff	• Technical requirements and equipment • Teaching facilities
U. K.	• number of students • length of courses • size of the institution	• location • level of specialization • number disadvantaged students
Denmark	Number of exams passed - 'Taximeter' tariff / exam-passed based on:	
	• Costs of education and equipment • Joint costs (e.g. admin. Buildings)	• Expenses - experimental sciences, pract. training (e.g. medicine, physics)
USA - States	• Admin./academic costs/staff (input) • Tuition and fees (input) • R&D sponsored by ext. sources (input) • Financial aid (input) • Job placement (outcome)	• Technology/ distance learning (process) • Student transfers (output) • Time-to-degree (output) • Graduation/ retention rate (output)
South Africa	Amounts published annually for:	
	• Teaching inputs: enrolled students, weighted by course material, course level, instruction-delivery mode • Research outputs: - totals of doctoral & post-doc. graduates - research publications compared to national benchmarks	• Teaching outputs: enrolled students multiplied by graduation benchmarks (Min. of Ed. rolling 3-year basis) • Institutional factors: - large prop. of disadvantaged students - size of institution based on number of enrolled students

Performance contracts:

Several countries use performance contracts as a basis for funding university education and research services. France for example targets long-term investments in buildings, equipment and facilities through funding of priority projects including new technology and libraries. In Finland, objectives and indicators are clear; contracts are tailored to each institution and made up of three parts: core, performance and funding for specific initiatives, with deliverables for all three types. Core funding remains stable during the tree-year contract period, whereas performance funding is tied to number of agreed indicators, for example:

[21] This table, and text below it, is based directly on Kristian Thorn, Lauritz Holm-Nielsen, and Jette Samuel Jeppesen, Approaches To Results-Based Funding In Tertiary Education: Identifying Finance Reform Options for Chile, World Bank Policy Research Working Paper 3436, October 2004, which sets out many country systems.

- Funding for research from external sources
- Provision of adult education
- Participation in international cooperation
- Assessed learning achievement
- Graduation time

Chile's recent experimental use of performance-based agreements between MECESUP and some CRUCH universities has been mentioned. They comprise: The University of Tarapaca (Arica), University of Chile (Santiago), University of Bio-Bio (Concepcion) and University of La Frontera (Temuco), for a three year period, covering a broad spectrum of quality enhancement activities for a total investment of U$S 16 million. These agreements appear as an adequate mechanism for quality upgrading.

There are different approaches to system management, for example: legislation mandates the system and specifies evaluation criteria; legislation mandates the system and establishes the framework for decision-makers and institutional management to agree on indicators and reward mechanisms; and supervisory authorities in collaboration with institutional management voluntarily agree on and adopt a new results-based funding system. The political-economy dimensions of changing educational (and research) funding systems are almost always a prominent part of the challenge; resistance coming from potential losers in terms of funding, and others – and support from potential winners and others. Gradual introduction is possible through initially applying it to additional funds, or small scale pilots.

Starting with a simpler set of indicators may be a good strategy. If not already being done, given needs for improvement in Chile, design and analysis of a few main options would appear very useful. Analysis would include both benefit-cost assessment, and a look at impacts on different universities. Building information systems is always crucial to the transparency and success of delivery and performance based funding mechanisms.

6.3 University research evaluation and funding

Many countries have in recent years introduced different methods of evaluation of R&D activities and performance-based funding in comparison with other approaches to funding.

"Although some have attempted to distinguish between 'evaluation' and 'assessment', both terms are used in measuring the qualitative and quantitative outputs of any given academic unit. In practice, 'evaluation' can be divided into ex ante and ex post forms. Ex ante evaluation is conducted prior to research – to assess its potential significance and likelihood of success. Ex post evaluation comes once research has been completed, and assesses output and impact. Summative evaluation involves making judgements about the performance of a unit by comparison with similar units. Evaluation results are increasingly used as a tool for research management. 'Evaluation for strategy' is conducted at both national and institutional levels – in 'quality assessment systems', for example. Evaluation is also used to decide funding, following performance assessments of researchers, projects, programmes, departments, and institutions. The assumption is that funds that are allocated after performance is evaluated, will yield greater returns. In formative evaluation, the aim is to assist a unit in achieving those returns."[22]

[22] Aldo Geuna and Ben R. Martin, University Research Evaluation and Funding: An International Comparison, Kluwer Academic Publishers, Netherlands 2003. See also Aldo Geuna and Edward Elgar, The Economics of

Councils typically play a very important role, whether constituted by government or national associations of universities, allocating funds through evaluation of (mainly) "four typical output measures: volume, quality, impact, and utility. Peer review and bibliometric measures are their main methods. In 'peer review', the unit of assessment is normally the 'project' or the 'individual'. However, because bibliometric analyses cannot be usefully applied across the board, to all departments in a large number of universities, peer review has become the principal method of university assessment as well. When supplemented with publication and citation data and other information, this method is called 'informed peer review'."

The U. K. provides an interesting example of many approaches in its research assessment exercise (RAE), one of the most advanced research evaluation systems in Europe. Evaluation now takes place not only at the level of the individual researcher and project, but also at institutional and national levels. The first RAE was carried out in 1986, has been repeated every 3-5 years. It has not so far separately assessed basic and applied research. "To refute the criticism that it is biased against applied research, panels have been instructed to give equal weighting to all research, whether basic or applied; and to focus upon quality. In response to criticisms that interdisciplinary research has not been fairly assessed, universities have been encouraged to submit interdisciplinary work to the most appropriate panel, and to suggest second panels to consider submissions in parallel."

The RAE is 'ex post evaluation' based on 'informed peer review'. All research activities are categorized in 'units of assessment' (UoA – 68 in 2001) For each UoA, a panel 10-15 experts is chosen from nominations by some 1,300 professional associations and learned societies. "Chairs are nominated by panellists from earlier exercises, and appointed by the Higher Education Funding Councils (HEFCs). Chairs in turn chose members from nominees proposed by outside bodies, taking into account experience, standing, and representation of user communities."

The panels look at information provided by each university on:

- staff - academic and support, 'research active' and not;
- details on research-active staff whose work is to be evaluated;
- ***publications*** and other public outputs – up to 4 per research-active staff;
- an overview of research students and research studentships;
- details of external research income, including amounts and sources;
- a description of the research environment, its structure, policies and strategies; and
- general observations and additional information (including indicators of excellence).

Ratings are assigned (e.g. 1 to 5) and "used by the HEFCs to determine funding for each unit, with the total block grant calculated by summing across all units. In 2001, as earlier, publications constituted the core of university assessment."

Many other countries use a more 'dual' approach where Councils give grants based on (informed) peer review and governments give funds to institutions. Denmark may be a good comparator for Chile in that "until 1995, research funds were allocated on an incremental basis;

Knowledge Production: Funding and the Structure of University Research, Edward Elgar Publishing Limited, Cheltenham UK, 1999. The information for this section is also mostly from this source. As are all direct quotes..

since then, amounts awarded have .. five elements: a basic grant, a performance-related grant for teaching, a research grant, a grant for other activities, and a capital grant. No other performance measures are used, although PhD student numbers help determine the performance-based grant for teaching." Some countries use very simple or no performance based funding. "In Norway, universities receive block grants, and no distinction is made between teaching and research. Until recently, there has been no attempt to adopt performance measures, apart from giving a fixed sum per doctoral graduate. Similarly, in Sweden there is no mechanism for performance based research funding. "

Assessments of experience do not yield many generalizations, as country systems and objectives differ so greatly. Many different designs work well, and the following assessment by Guena and Martin is based on a lot of cross-country experience:

"Given the substantial (and perhaps increasing) costs of a fully performance-based system, it is worth pointing to the advantages of a 'hybrid' system, based partly on performance (incentive-creating) and partly on educational size (cost-minimizing). The Netherlands, Finland, and Denmark have such systems. In addition, there is a danger with assessments like the British RAE that focus upon a one-dimensional concept of quality, and which link the results directly to funding. In The Netherlands, by contrast, peer review is used to assess performance in four dimensions – scientific quality, scientific productivity, scientific relevance, and long-term viability – and rankings are not directly linked to funding. The greater breadth of this quality measurement encourages greater diversity, which is undoubtedly an advantage in helping to ensure the 'health' of a nation's academic research. For countries contemplating a performance-based system, such a hybrid approach may offer better prospects for the future, than the more expensive methods used in the UK."

Table 16 Strengths and Drawbacks of performance-based Funding Mechanisms

	Advantages	Drawbacks
Performance-based	– 'meritocratic' in that it links resources to performance, rewarding good research – strong incentive to improve individual as well as institutional performance – competition may lead to increased efficiency – ineffective research identified and cut – encourages research to be properly completed and written up for wider dissemination – provides public accountability for government funds invested in research – encourages more explicit/coherent research strategy on part of department or institution – provides mechanism for linking university research to government policy (e.g., to shift priorities) – concentration of resources may enable best departments to compete with world leaders (e.g., in US)	– high cost and labour intensity (whether peer review or indicator-based) for universities and evaluating agencies – may ⇒ 'homogenization' of research and universities – i.e., decrease in diversity and experimentation – may discourage more innovative and risky research – encourages 'publication inflation' (e.g., 'salami publishing') and other 'game playing' (e.g., with indicators) – i.e., 'looking good' rather than necessarily doing better – may encourage traditional 'academic' research at expense of research linked to society's needs – tends to separate research from teaching ⇒ lower priority for teaching – rewards past performance not current or future potential ⇒ reinforces research elite/status quo – may ⇒ over-concentration – may lead to excessive government influence/'interference' in university research

Educational size	– low cost to administer – provides departments with 'seed corn' funds to invest in new people/research areas – provides 'space' for long-term research and scholarship – encourages diversity in research – enables academics at any university (not just an elite few) to get involved in research – encourages integration of teaching and research so can exploit synergy between them – protects autonomy of institutions and individuals	– little direct incentive to improve research performance (whether individual or institutional) – may ⇒ stagnation – may give excessive power to officials who distribute core funding within institution – little public accountability for funds (notionally) provided for research – may ⇒ 'ivory tower' research with no social or other relevance – may reinforce public stereotype that some academics are 'lazy' – may be little or no correlation between student numbers and level of research effort by department – distribution of resources/effort may bear little relationship to stated government policy – spreading resources evenly but thinly may ⇒ unable to compete with world-leading institutions

International experience suggests that there may be ways to build the performance of tertiary institutions and services through further development of a set of funding mechanisms which provide relatively simple, flexible but dependable, transparent and, to a degree, performance-oriented block and research funding mechanisms. With respect to block grants, it may be possible to accomplish this aim by changes in AFD and AFI, but given drawbacks in each, it may be worth considering evolution into a clearer system based on delivery and performance indicators and on appropriate process for dealing with (the many) unique circumstances.

In tandem, as is further explored in the next chapter, this appears to be a good time to examine the structure and functioning of CONICYT funding, particularly FONDECYT, and perhaps consider developing a management framework for university R&D funding that uses competitive proposals and performance indicators (institutional assessments) most effectively for more basic and more applied research. A main objective, it is suggested, is to provide a clear and fair framework for individual (public) universities to develop quickly and competitively. Some detailed design and benefit-cost analysis of different block and R&D funding mechanisms is certainly a suggestion of this Report.

7. Universities and the Functioning of the National Innovation System

In this next-to-final chapter, our study proceeds with the examination of Chile´s national innovation system and of the role local universities play within said system.

7.1 Overview of the Chilean NIS

Chile spends little in R&D activities, both in absolute as well as in relative terms. Current estimates indicate such expenditure to be in the order of 0.7% of GDP, that is around U$S 600 million per annum. Both in comparison with what more mature – or even emerging - nations spend in knowledge generation activities, which is in the region of 3 to 3.5% of GDP, or considering how much it is needed to come up with a new chemical entity and its eventual development into a new FDA approved drug, or in the design, prototype-testing and eventual marketing of a new ´world class´ piece of sophisticated equipment, or a genetically modified new seed, Chilean figures appear as certainly small. Any large MNC spending in the order of U$S 2 billion annually in R&D triples the amount of expenditure in knowledge generation activities.

Moreover, around 60% of the money spent by Chile comes from public sources, the private sector still not having developed a strong commitment to explore the international knowledge frontier in search for new products and production processes. This does not really mean that Chilean firms do not involve themselves in domestic knowledge generation activities. They do, but mostly in ´adaptive´ engineering efforts whose main objective is that of improving process engineering know how and product designs they normally obtain from abroad. This is clearly different from undertaking more complex research exploring the international technological frontier.

A recent study by J. M. Benavente indicates - based on the 2004 National Innovation Survey – that from a total universe of around 6.500 manufacturing firms only 450 (7%) report having introduced innovations and carried out product differentiation efforts. R&D in the business sector of the economy is highly concentrated among large companies, to the extent that 26 of them account for around 60% of total private sector expenditure. It is these firms that have R&D departments and experimental facilities. 4/5 of the Chilean firms that report innovative activities indicate that they innovate importing capital goods and taking foreign product licenses instead of having ´in house´ technological facilities, or establishing stronger links with national universities, public R&D labs or local engineering firms.

Furthermore, most of them stay close to the commodity end of the production spectrum, exporting low domestic value added goods which afterwards receive further technological transformation in the recipient countries. It is only recently that the national debate on these issues has began to receive some attention and that both government officials and entrepreneurial associations have begun seriously to entertain the idea that Chile could do much better in terms of innovation and R&D activities. CRUCH universities report clear indications coming from

local firms in the sense that that they intend further to advance in collaborative R&D ventures with university labs in the near future.

Why is the local picture so different from the one we find in South East Asian countries, and also in some of the ex-socialist nations now rapidly joining the league of strong spenders in R&D activities? It is interesting to observe that Chile is not all that different from the rest of Latin America, in spite of the fact that it is now proposing to double R&D expenditure over the next decade and to develop new policies and institutions for so doing. From that point of view Chile seems to have an important lead in developing the needed ´institutional architecture´ to attain progress in this direction.

In part also, the present state of affairs may be the result of a much too long adherence to Washington Consensus policy prescriptions advising macroeconomic stability, the enforcement of property rights and minimal public sector intervention in the economy as necessary and sufficient conditions for a successful long term development of the economy. . While this might be right for a successful development strategy based on market principles we know that he upgrading of domestic technological capabilities, the production of public goods and the process of creating diversity and ´technological deepening´ in the economy normally demand a fair amount of active policy intervention from the part of government, due to ubiquitous market failures.

The way in which Chile initiated its economic transition to a market regime in the early 1970´s appears to explain the low priority S&T issues had in the domestic policy agenda of the time. It was believed that market forces by themselves were capable of putting the economy on the right long term growth track, and that demand-side subsidies could be used – as in the case of education, for example – when markets did not guarantee adequate access to goods and services to the lower income segments of society.

It seem likely that in such a policy environment the multiple 'market failure' problems posed by technology markets and by R&D and innovation remained under analyzed and not explicitly taken into consideration by policy makers. In any case, very little discussion on public goods, asymmetries of information, externalities and knowledge markets is to be found in the local policy agenda of the 1970´s and 1980´s.

In the late 1990´s, however, these topics came to the fore in the Chilean political debate. The change of mood occurred as local policy makers became more aware of the experience of countries such as Finland, New Zealand, Ireland and Israel which have already been experimenting with C&T policies for two decades, or even longer. The National Council for Innovation and Competitiveness was then created and it acquired major political visibility designing and putting under Parliament consideration a policy document defining Chile´s national strategy in the field of S&T and innovation. The agenda brought forth by the National Council of Innovation discusses many issues related to the restructuring in the university sector, both in its role of provider of teaching services as well as of R&D and innovation activities.

One might anticipate both the continuation of institution building up efforts and a relatively rapid growth in innovation funding and support in the years to come. It appears likely that fiscal resources available for these activities will expand significantly in the medium term, and that

quality improvements through stronger accreditation mechanisms and performance-based funding will be attained as well.

7.2 Private spending on R&D and innovation: Chile and international comparisons

Available statistics do not indicate how much R&D and ´knowledge-generation´ activities Chilean business firms perform ´in house´ or help to finance, providing resources to public R&D labs or to local universities. There are reasons to believe that the National Survey on Innovation (Encuesta Nacional de Innovacion) presently carried out by INE underestimates ´in house´ ´adaptive´ R&D efforts undertaken by enterprises pari pasu with their production activities. Individual plant visits carried out by the authors of this report in salmon farming firms, vineries, fruit production farms and pulp and paper mills suggest that experimental and ´trouble-shooting´ activities are regularly carried out by many firms, but are not adequately measured by national innovation surveys. Such activities often involve the production of incremental know how which is novel to the firm, (and sometimes even to the industry), and should therefore be measured as domestic R&D expenditure. Unfortunately, it is not.

On the other hand, when we compare with other countries in the world, it becomes apparent that Chilean firms spend much too little in R&D activities, and do not act as a significant source of funding for R&D efforts performed by universities or public sector labs. The lion share of university funds for R&D comes from fiscal sources. The information concerning the above is fragmentary and should be used with a great deal of care. It is reported in Table 17.

Table 17 : Gross domestic expenditure in RD. By Sector Of Performance And source of funds. (OECD). [23]

CHILE (unit: million national currency)						
	2002		2003		2004	
BUSINESS ENTERPRISE SECTOR						
SOURCE OF FUNDS						
BUSINESS ENTERPRISE	103060.4	91.2%	140486.6	93.4%	171548.6	94.8%
DIRECT GOVERNMENT	9914.2	8.8%	9425.8	6.3%	8707.1	4.8%
HIGHER EDUCATION						0.0%
PRIVATE NON-PROFIT						0.0%
FUNDS FROM ABROAD			488.7	0.3%	750.0	0.4%
TOTAL BERD	112974.7	100.0%	150401.1	100.0%	181005.8	100.0%
GOVERNMENT SECTOR						
SOURCE OF FUNDS						
BUSINESS ENTERPRISE						
DIRECT GOVERNMENT	34754.2	100.0%	38415.6	100.0%	40233.9	100.0%
HIGHER EDUCATION						
PRIVATE NON-PROFIT						
FUNDS FROM ABROAD						
TOTAL GOVERD	34754.2	100.0%	38415.6	100.0%	40233.9	100.0%
HIGHER EDUCATION SECTOR						
SOURCE OF FUNDS						
BUSINESS ENTERPRISE	1884.3	1.5%	4085.8	4.1%	3458.5	2.7%
DIRECT GOVERNMENT	51246.1	41.8%	42666.9	42.4%	44068.3	35.0%
GENERAL UNIVERSITY FUNDS	68113.8	55.5%	51049.3	50.8%	75095.5	59.7%
GOVERNMENT SUB-TOTAL	119359.9	97.3%	93716.1	93.2%	119163.8	94.7%
HIGHER EDUCATION	1380.2	1.1%	2762.5	2.7%	3161.0	2.5%
PRIVATE NON-PROFIT						
FUNDS FROM ABROAD						
TOTAL HERD	122624.4	100.0%	100564.5	100.0%	125783.3	100.0%
PRIVATE NON-PROFIT SECTOR						
SOURCE OF FUNDS						
BUSINESS ENTERPRISE			3901.9	7.5%	4394.2	9.6%
DIRECT GOVERNMENT	8437.9	18.6%	6071.0	11.7%	6850.5	14.9%
HIGHER EDUCATION						
PRIVATE NON-PROFIT	1037.8	2.3%	1404.5	2.7%	1292.2	2.8%
FUNDS FROM ABROAD	35809.4	79.1%	40417.7	78.0%	33306.8	72.7%
TOTAL PNP	45285.1	100.0%	51795.2	100.0%	45843.7	100.0%

[23] Te data base from OECD -this has been made available by the OECD with the precaution that earlier years than 2002 may have unreliable part. Please see Annex B for details..

GERD						
SOURCE OF FUNDS						
BUSINESS ENTERPRISE	104944.7	33.2%	148474.3	43.5%	179401.4	45.7%
DIRECT GOVERNMENT	104352.3	33.1%	96579.3	28.3%	99859.8	25.4%
GENERAL UNIVERSITY FUNDS	68113.8	21.6%	51049.3	15.0%	75095.5	19.1%
GOVERNMENT SUB-TOTAL	172466.2	54.6%	147628.6	43.3%	174955.3	44.5%
HIGHER EDUCATION	1380.2	0.4%	2762.5	0.8%	3161.0	0.8%
PRIVATE NON-PROFIT	1037.8	0.3%	1404.5	0.4%	1292.2	0.3%
FUNDS FROM ABROAD	35809.4	11.3%	40906.4	12.0%	34056.9	8.7%
TOTAL GERD	315638.4	100.0%	341176.4	100.0%	392866.7	100.0%

Table 18 shows that just 1.5% of R&D expenditure carried out by local universities is funded by local firms, as against 9% in Canada. Clearly, Chilean firms have not so far developed an interest for the exploration of the technological frontier of their field of activity, neither do they see universities, and public sector R&D labs, as potential partners for joint technological activities..

Table 18 HERD – R&D Performed by the Higher Education in Chile and Canada by Financing Sector – 2002

	Chile		Canada	
	2002		2002	
Source Of Funds	Million CLP	%	Million CAD	%
Business Enterprise	1884	1.5%	644	8.6
Direct Government	51246	41.8%	2645	35.6
General University Funds	68114	55.5%	2015	27.1
Sub-Total Government	119360	97.3%	4660	62.6
Higher Education	1380	1.1%	1420	19.1
Private Non-Profit	0	0.0%	604	8.1
Funds From Abroad	0	0.0%	101	1.3
Total Herd	122624	100.0%	7429	100.0

The frailty of the local technological environment is further confirmed by the low number of scientists and engineers annually graduating from domestic universities. (Tokman & Zahler, 2004).

Table 19 Scientific and Technological Capabilities

	PhD Graduates in Science (per million inhab.1996-99)	Scientists and engineers in R&D activities (per million inhab. 1990-2000)
US.	91	4.099
Finland	177	5.059
Ireland	82	2.184
Israel	88	1.563
Sweden	197	4.511
N. Zealand	n/d	2.197
Korea	49	2.319
Singapore	n/d	1.653
Chile	3	370

Fuente: Tokman y Zahler (2004

Table 20 provides a preliminary set of international indicators which might serve as benchmark to the Chilean situation. The comparison, however, has to be carried out with a great deal of care given the large differences in production structure that prevail between Chile and some of the manufacturing exporting countries referred to in Table 20. It seems clear, for example, that the rate of patenting of a country specialized in salmon farming, wine and fruits should not be straightforwardly compared with the rate of patenting of an economy exporting high tech manufacturing goods and services. The propensity to patent varies quite sharply across sectors of economic activity making it more than doubtful the meaning to be attributed to a comparison of this sort.

Table 20 GERD Country Data Summary[24]

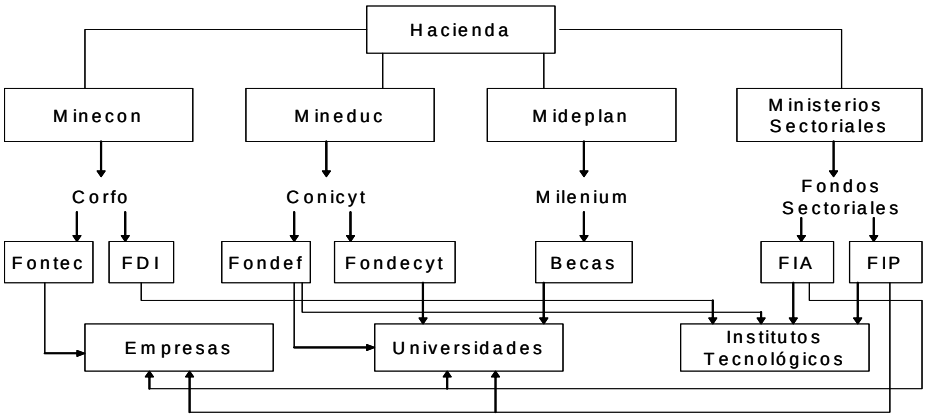
Country		Chile	Canada	Brazil	Arg.	USA	Gt. Br.	Neth.	Russia	China	Korea	Thailand
Year		2000	2000 (1999)	2000 (1996)	2000	2000 (1997)	2000 (1998)	1999	2000	2000	2000	2000 (1997)
Total patents (USPTO)	Number	15	3,419	98	54	85,070	3,667	1,247	183	119	3314	15
Total patents (EPO)	Number	1	276	13	1	7434	1372	1078	22	11	164	0
Royalties & lic. / GDP	%	0.05%	0.47%	0.18%	0.16%	0.18%	0.50%	0.73%	0.02%	0.1%	0.5%	0.50%
R&D expend / GDP	**%**	**0.54%**	**1.69%**	**0.83%**	**0.44%**	**2.70%**	**1.87%**	**2.00%**	**1.09%**	**1.0%**	**2.7%**	**0.12%**
R&D expend./ L. Force	c.USD/P	45	557	58	55	1308	621	885	39	12.06	487.1	5
R&D personnel / Pop.	%	0.04%	0.30%	0.02%	0.08%	0.41%	0.27%	0.26%	0.35%	0.1%	0.2%	0.01%
R&D personnel / L. Force	%	0.06%	0.44%	0.03%	0.12%	0.63%	0.41%	0.38%	0.50%	0.1%	0.3%	0.02%
R&D financed by												
Abroad	%	4.7%	13.9%		1.8%		16.2%	11.2%	12.0%		0.1%	3.1%
Productive sector	%	24.9%	42.6%	40.1	23.4%	66.5%	49.8%	49.6%	32.9%		72.4%	12.2%
R & D performed by												
Productive sector	%	14.9%	56.8%	45.5	25.4%	75.3%	65.6%	56.4%	70.8%	60.0%	74.0%	7.3%
Higher educ. Sector	%	43.8%	31.0%	43.5	34.7%	13.6%	20.7%	26.2%	4.5%	8.6%	11.3%	36.0%
Public sector	%	40.4%	12.2%	11.0	39.9%	11.1%	13.7%	17.4%	24.7%	31.4%	14.7%	56.7%
GDP / Pop	c.USD/P	5,354	22,525	4,633	7,934	31,924	22,037	30,136	2,470	824	13,198	22,037
Stock of patents (US, EU)	Number	13	3,908	157	43	122,157	27,763	15,360	122	2635	778	9
Population	Million	15.21	30.77	170.10	37.03	282.20	58.72	15.81	145.60	1262	47.01	58.72
Labour Force	Million	9.79	21.00	112.57	23.18	185.78	39.00	10.78	101.24	862.2	34.08	39.00

[24] The sources of this data are 1) the Lederman Innovation Dataset: selected data are mostly from the year 2000; data market are for the year indicated in brackets at top of column – and 2) Chilean data on R&D finance and performance are from OECD GERD data, 2000. Please see Annex A and Annex B for details of these datasets.

7.3. Universities within the Chilean Innovation System.

The National Innovation System of any given country brings together a complex network of public and private sector organizations, including business firms, universities, regulatory agencies, financial institutions, engineering consultants, etc. which in one way or other affect the creation, importation, adaptation and diffusion of new technologies in the economy. As far as Chile is concerned the National Council for Innovation has recently described the local innovation system as follows:

Figure 5 Chile´s National Innovation System



We notice universities being basically related to Mineduc, on the one hand, and to Mideplan, on the other. That is to say, to the Ministry of Education and to the Ministry for the Economy. . This is clearly related to the fact that universities ´produce´ human capital, technology and public goods for different sectors in the economy. The arrows in the Diagram indicate flow of funds suggesting that the above mentioned Ministries provide much of the fiscal resources upon which universities base their operation. . In both cases the gradual transition to competitive funding and matching grants describes the institutional atmosphere in which universities find themselves currently operating pari pasu with the growing maturity of the Chilean innovation system.,

8. Suggested priority Issues for attention and further examination.

The present study offers a descriptive picture of the transition the Chilean University industry has suffered from a state regulated regime to a market-driven regime, complemented by demand-side subsidies to facilitate market access. The process started three decades ago and it was originally enforced under the expectation that market processes could bring about a socially optimal long term transformation of the university industry.

Many aspects of market functioning have changed as a result of the transition to a market-based regime, but major questions of market access, affordability, quality and accountability, yet have remained unresolved and demand further consideration. Consider some of them:

1. higher education access

It may be useful to begin by stressing some of the more outstanding indications of success. It is remarkable that the proportion of youngsters between 18 and 24 accessing superior education increased from 15% in 1990 to 38% in 2006. There is even more reason to celebrate, as accessibility has increased well above average in the lower quintiles of the income distribution. The proportion of low income families sending their first member ever to university has increased considerably during the last decade, suggesting that a process of upward mobility is taking place.

Notwithstanding this, there appears to be still a lot that needs to be done in relation to market access. Comparing similar indicators for developed countries within the OECD, or for nations such as Korea, Ireland, or Estonia, where 2/3 of the youngsters between 18 and 24 years attain tertiary education, it is clear that even having done outstandingly Chile still faces a long road ahead if it is to proceed from 38% to 60 or 70% of its youngsters attending university education.

2. underpinning expansion of innovation - education

A second issue which demands further thinking, turning to the research and innovation spheres of university activity, is that of how to finance expanding production both of PhDs and graduates, and of the public goods elements of R&D efforts. In a system which is increasingly depending on university revenue coming from student fees there is a clear limitation as to what can be achieved in this respect. International comparisons indicate that Chile is well behind world standards in R&D spending relatively to GDP.. It is presently spending around 0.7% of GDP in knowledge-generation activities, and plans are to expand this ratio to around 1.2% of GDP in the course of a decade.(CNI, 2008). In such a context, universities should be expected to considerably expand their rate of graduation of PhDs if such an expansion in R&D is to be attainable. As the University of Chile Commission argues in its recent report on ´Policies for the scientific and technological development of Chile´ ¨The country has to set itself the goal of graduating 100 doctors per million inhabitants in 2020, this meaning 1.700 new doctors annually¨ (Mimeo, January 2008, pag.5).

An observation of this report is that the block grant mechanisms AFD and AFI could probably be improved upon with aspects of results or performance based funding based on student numbers, levels, disciplines, graduation etc. Several country examples are sketched in Section 6.2. As accreditation and restructuring proceed, universities expansion will likely benefit from relatively explicit block funding dependent fairly, predictably and regularly on the services being delivered. AFI is an interesting and unusual incentive and reward for quality based on student national examination results, but this report has pointed out unfavourable equity effects. Before generalizing AFI eligibility, further consideration of AFI is suggested. Some other aspects of quality are addressed below.

3. underpinning expansion of innovation – R&D and innovation services

Expanding R&D expenditure in the way CNIC advises also looks to be a complex process, with many inter-related policies, mechanisms and funds affecting university services. At one end of the market, growth of high-end commercialization and particularly export-oriented innovation activity, supported by public incentives and funding, will call on university-private partnerships and on basic and applied research done in universities to expand quite rapidly if not always smoothly. Other innovation engagement and services should expand roughly in sync. Innovation funding and support available to universities has been expanding rapidly through CONICYT, and on public-interest private partnerships, CORFO. Many private companies have recently been actively seeking university partnerships, probably reflecting both recent tax incentives and ongoing demand growth in export and niche markets.

Growth of FONDECYT – basic and applied university research – has stalled. This may reflect a combination of slowing and restructuring in the sector, and shift of attention and funding from R&D to commercialization. It will need to keep up again in future, and the funding and management mechanisms to evolve. FONDECYT is allocated competitively by peer review within disciplines, but the allocation to disciplines has been on an historical basis. Other country experiences (Section 6.3) provide various mechanisms for improving university R&D strength and performance over time, based on both competition and institutional assessment. These suggest that relatively simple and flexible mechanisms can increase performance, fairness and transparency in how resources are allocated, and predictability for expansion and building institutional capacities.

A suggestion of this report is to look in greater detail into the benefits and costs, levels and distribution, of alternative R&D funding and assessment systems. Because education and R&D services interact so closely, it would seem useful to do some this along side design and analysis of block funding. Micro research *and data development*, particularly for individual universities and groups will be essential to ongoing sector development.

4. quality of education services

A fourth area demanding and currently receiving attention is that related to quality of educational services. Self-regulated market processes have given way to the frail accreditation picture previously described. It appears that an over expansion of ´low end´ market entry has occurred under a weak regulatory regime, strong information asymmetries and other forms of market failure. Although this seems to be in the process of improving, with small and low quality universities abandoning the market or being acquired by stronger ones which will no doubt re-structure them and make them more competitive, quality and consumer protection considerations argue for a solid and widely understood system of accreditation. The system exists, and private sector accreditation firms are expanding rapidly – a needed part of the regular accreditation assessments needed in a large system. Performance-based agreements are being signed by MECESUP and various CRUCH universities. All of this will bring about a gradual upgrading in university performance.

But it may not be enough. More institutional development funding at this stage would appear potentially high-return. Performance agreements may work for many purposes, and have the appeal of being to some degree competitive. However, as accreditation becomes firm, there is

both the ongoing upgrading of good institutions – with which Chile is well endowed – and the consideration of institutions that have quickly expanded, are responsible for some of the jump in enrolment to 38%, but are not universities under any of the 6 accreditation criteria. Institutional capacity building is asymmetric – built with difficulty and lost with speed and ease. Market forces will sort this out, but consideration of institutional development funding for both university and technical & professional education would seem very prudent.

For one thing, the time dimension involved in market processes bringing about improvements may be socially unjustifiable as with respect to education, an important ´merit´ good affecting growth and development. In part, this goes back to the block and R&D funding mechanisms, but explicit and effective institutional development support is a feature of both university and other tertiary education services in many countries, aimed at both quality and enrolment objectives.

The quality of education constitutes a matter with major incidence on the long term behaviour of the economy as well as the social, political and cultural development of the society. The 'public-goods' benefits of good-quality tertiary education are argued to be high throughout economic sectors and daily life, and to stem from market externalities, spillovers and collective consumption. Much of the university sector is composed of public institutions, major assets to develop as private universities and services also expand. And it is oligopolistic – not unlike other countries such as Canada – but with unique issues raised by the structure of services and concentration of institutions.

Professional and technical education regulation, accreditation and funding issues are related, are not addressed in any depth in this report, and may be a priority for some detailed examination in the near future, as there appears to be a lot of restructuring going on in those services and institutions. Further micro economic research and synthesis of existing research is also suggested as a high priority for private firms, how much they spend and do in ´adaptive´ engineering, what is the real cost structure of research activities in different sectors and how much unmeasured external resources are received. While this Report is mostly based on available secondary information, it recognizes and recommends further micro research and field work, and further development of research capability on this sector within Chile and linked to regional and international tertiary sector and innovation system research and policy capabilities.

5. Strategy, coordination, compromise, culture building, learning and adapting

Our enquiry shows the complex way in which economic and institutional forces have co-evolved in this transition from a state-regulated regime to a market-driven model of tertiary sector organization. At no point did a ´master plan´ exist indicating how the transition was to take place. Various forces came together fuelling the global transformation of the industry. First, the de-regulation of the market, facilitating entry of new competitors. Second, the simultaneous introduction of demand-side subsidies supporting market access to new segments of the population. Third, a major overhaul of government institutions adapting them to handle a wide set of competitive funds in which ´peer review´ mechanisms and new forms of accountability were involved. All of the above resulted in a self-reinforcing and mostly virtuous circle of sector expansion and institutional transformation. Many observers believe (Pilar Aranet, 2007) that Chile is today in the midst of a ´growth crisis´ as it further proceeds into a more ´mature´ institutional and market structure. Many problems of access, affordability, quality, accountability

and production of public goods have remained from the past phase of transition and demand serious reconsideration in the forthcoming stages.

Some of the forces that motorized the process of expansion in the 1990´s seem to be wearing out, with the economy now expanding at a considerable slower pace and with the university sector showing increasing signs of oversupply. The number of vacancies left unused seems to be increasing giving signs of a growing imbalance between supply and demand at current prices. How much this is cyclical and what longer-term growth path is likely and desirable are matters of both economic and market growth and of public policy.

In addition to market projections, under discussion are the long term ´desirable´ growth path of the university sector and the long term 'desirable' growth path of the economy, from which the demand for qualified human resources is derived. It appears widely accepted that the structure and performance of the sector need to be improved with the right kind of sector-specific funding and incentives, but if nothing happens in terms of a more vibrant process of global economic expansion that might prove a frustrating effort, as the demand for the new graduates simply will fail to appear. Catch 22, but the innovation agenda is being advanced in a determined way, and some downward pressure on the price of skilled and highly skilled workers has been a feature of successful economic diversification and technology-deepening success of many countries. In the public part of tertiary education, 'over-build by just the right amount,' is good advice, but much easier said than done in changing market economy conditions.

The innovation agenda of the past decade, since 1998/99, is in one way interventionist; it is very proactive on spurring commercialization in the private sector, and in the funding and stimulation of applied research in universities. New institutions and funds, new cooperative forms of interaction between the public and the private sector, different forms of approaching issues of human capital development, of research financing and of technology diffusion in the economy have been introduced. These may be oriented to commercialization in specific markets and sectors, but also have to draw on expanding capacities in tertiary education, R&D and public services.

The example of CONICYT expansion also shows that the process has been very proactive as well as experimental. The most recent Basal program, for example, has selected priorities which go well beyond the eight clusters chosen by CNIC and deal with issues beyond international economic competitiveness, as major objectives for S&T and innovation policy. Further initiative appears needed beyond the borders of the world market place in dealing with mounting challenges in energy, desertification, environmental protection, quality of health services, aging and stress, urban development, and others. These may be under consideration, but seem to appear very little in the public discussion about science, technology and innovation policy.

CNIC is at the centre of the innovation agenda, generally in terms of thinking and advice, and particularly with respect to the commercialization end of the spectrum. It is easy to understand how recent confrontation with university scientists and professors could develop, these lasts ones claiming for a S&T agenda broader than that imposed by the needs of stronger international competitiveness. Such tension can be creative and instrumental for the country to develop an innovation agenda closer to its global social and economic needs.

This seems to be a time for reflection, design and collaboration. Natural-resource based production and exports prospects remain good. Further economic diversification is needed, however, if the country is to increase its rate of economic growth. It seems likely that further government leadership, as has previously happened with the salmon industry, will be needed to attain the required pace of economic diversification. Said pace can be accelerated by ongoing development of the portfolio of innovation funding, incentive and support measures. Fiscal resources for stepping up commercialization, R&D and tertiary education seem to be accessible. This is an enviable position, and the base of tertiary institutions is already very good. Quality improvements in universities have been pursued over the past decade through FDI and MECESUP and lessons learned. It looks quite possible to have a significantly innovation-led agenda *and* the needed expansion in tertiary education and R&D. Institutional culture changes slowly, but it does change, and steps forward are being given.

This report argues for further policy development and action in some specific areas – 1 to 4 just above – and further analysis in others. This seems a time for good communication in particular among universities, the Ministry of Education, Ministry of Economy and CNIC – and with the private sector. Chilean firms appear to be responding to both structural adjustment pressures in the global/national economy and innovation measures of government, but slowly. Ways need to be found to accelerate the pace on this front.

The very short term global and national economic outlook is flat and rocky. The sense of this Report is that this is a good moment to move ahead on the design of further restructuring and improvements to the national innovation system and to the tertiary education and research sector - and a particularly bad time for conflicts to impede getting on with it. Other important enquiries are underway by CRUCH, Government Agencies, World Bank/OECD (on tertiary education, in anticipation of Chile joining the OECD) and they are also likely to provide further advice and suggestions for future action.

Chile wants to proceed into a phase of ´technological deepening´, and of public goods production and dissemination in areas such as health, environmental protection, energy, desertification, urban development and more. Region technological and institutional capabilities should be a matter of concern and strong upgrading. All of the above demands ´country-specific´ tertiary education and R&D activities as a *sine qua non* condition for the long term development path Chile has adopted. Adequate macroeconomic management is important, but it is equally important to proceed with experimentation, learning and adaptation at the meso and micro level, creating markets and institutions, developing domestic capabilities. Experience of many countries suggests that after periods of analysis and design, getting on with it becomes relatively more pressing relative to perfecting the design.

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BASAL	(Programa Financiamiento Basal) Programa para Centros Cientificos y Tecnologicos de excelencia Program for Science and Technology Centres of Excellence http://www.conicyt.cl/573/propertyvalue-2440.html
CEP	Centro de Estudios Publicos. Center of Public Studies http://www.cepchile.cl/dms/lang_2/home.html
CNAP	Comision Nacional de Acreditacion, Ministerio de Educación Nacional Accreditation Commission, Ministry of Education http://www.cnachile.cl/portada/miembros_cna_frontpage.html
CNIC	Consejo Nacional de Innovación para la competitividad Nacional Council for Innovation for Competitiveness http://www.consejodeinnovacion.cl/cnic/cnic/web/portada.php
CURA	Community-University Research Alliances (CURA) Canada http://www.sshrc.ca/web/apply/program_descriptions/cura_e.asp
CONICYT	Comision Nacional de Investigacion Cientifica y Tecnologica National Commission for Science and Technology Research http://www.conicyt.cl/573/article-27477.html
CORFO	La Corporación de Fomento de la Producción Chilean Economic Development Agency http://www.corfo.cl/index.asp?seccion=1&id=2572 http://www.corfo.cl/biotechnology/
CRUCH	Consejo de Rectores de Universidades Chilenas Council of Rectors of Chilean Universities http://www.cruch.cl/
EMOL	Diario El Mercurio ´on line´ El Mercurial – periodical www.elmercurio.com
FONDAP	Fondo Nacional de Desarrollo de Areas Prioritarias National Fund for the Development of Priority Areas http://www.conicyt.cl/573/propertyvalue-1753.html
FONDECYT	Fondo Nacional de Desarrollo Científico y Tecnológico National Fund for the Development of Science and Technology http://www.conicyt.cl/fondecyt/acerca.html http://www.fondecyt.cl/acerca.htm
FONDEF	Fondo De Fomento Al Desarrollo Científico y Tecnológico Science and Technology Development Research Fund http://www.fondef.cl/
FSCU	Fondo Solidario de Credito Universitario University Credit Solidarity Fund http://www.tramitefacil.gov.cl/1481/article-46918.html
ICM	Iniciativa Cientifica Milenio

	Millennium Scientific Initiative http://www.mideplan.cl/milenio/
INNOVA	Programa de Innovación Tecnológica Technology Innovation Program http://www.innovacion.cl/
McMaster	McMaster University Canada - research@McMaster http://www.mcmaster.ca/research/facts/facts3.htm
MECESUP	Proyecto de Mejoramiento de la calidad de la Educación Superior Superior Education Quality Improvement Project http://www.mecesup.cl/
MIDEPLAN	Ministerio de Cooperacion y Planificacion Ministry of Cooperation and Planning http://www.mideplan.cl/final/index.php
MINEDUC	Ministerio de Educación Ministry of Education, Chile http://www.mineduc.cl/index0.php?id_portal=1
OECD	Reviews of Innovation Policy: Chile http://www.oecd.org/document/2/0,3343,en_2649_34269_39588354_1_1_1_1,00.html
QUEENS	Queens University Canada – annual reports http://www.queensu.ca/fins/info/financials.html
RICYT	Red Iberoamericana de Indicadores de Ciencia y tecnología. Ibero-American Network on Science and Technology Indicators
J. J. Brunner	Chile - Higher Education: information and analysis http://mt.educarchile.cl/mt/jjbrunner/archives/2005/10/chile_higher_ed.html

-- Research papers and official pronouncements
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Annex A. Chilean Universities in a comparative perspective.

Table

LAS UNIVERSIDADES EN CIFRAS

	Matrícula total 2006	Matrícula total doctorado y/o esp. médicas	Matrícula pregrado nueva 2005	Alumnos con AFI 2006 (1)	Monto AFI (M$) 2006 (2)	Monto ($) AFI por alumno pregrado 2005	Docentes jornadas completa equivalente (3)	Docentes doctores j. completa equivalente	Alumnos por docentes JCE	Publicaciones ISI últimos 3 años (4)	Índice de impacto ISI (5)	Publicaciones SCIELO últimos 3 años (6)	Publicaciones por JCE	Proyectos Fondecyt en ejecución (7)	Total montos ($) proyectos
Academia de H. Cristiano	3.280	20	589	29	13.859	23.530	152	38	22	1	0,00	6	0,03	6	85.215
Adolfo Ibáñez	6.579	0	1.333	832	512.449	384.433	222	87	30	13	0,00	3	0,07	6	46.059
Adventista de Chile *	1.482	0	444	1	106	239	45	8	33	0	0,00	1	0,01	0	0
Alberto Hurtado	2.528	0	469	87	34.488	73.535	107	51	24	1	0,00	5	0,03	2	17.082
Andrés Bello	22.732	69	5.873	878	410.572	69.908	750	100	30	97	0,00	11	0,14	22	371.358
Arturo Prat	8.354	0	1.558	96	39.248	25.191	369	27	23	27	0,00	15	0,09	5	56.322
Austral de Chile *	9.614	145	1.979	711	405.495	204.899	347	207	28	491	0,83	109	1,57	55	1.051.895
Autónoma de Chile	9.029	0	2.865	48	13.753	4.800	263	21	34	0	0,00	0	0,00	0	0
Bernardo O'Higgins	2.290	0	419	Renunció	Renunció	Renunció	57	3	40	0	0,00	0	0,00	0	0
Bolivariana	3.302	0	952	1	106	111	151	21	22	0	0,00	0	0,00	0	0
Católica C. Raúl Silva H.	4.171	0	992	16	4.549	4.586	141	9	30	0	0,00	23	0,08	1	7.061
Católica de la S. Concepción	6.192	0	1.471	205	109.599	74.506	323	44	19	51	0,00	7	0,17	3	80.394
Católica de Temuco	4.629	0	1.459	138	50.885	34.877	287	30	16	33	0,00	12	0,14	4	47.317
Católica del Maule	4.949	0	969	306	176.987	182.649	272	81	18	9	0,00	6	0,04	0	0
Católica del Norte	9.018	18	1.574	545	313.140	198.945	403	137	22	222	0,82	41	0,60	32	495.562
Central de Chile	6.116	0	1.785	98	33.430	18.728	248	23	25	3	0,00	8	0,03	0	0
De Antofagasta	5.749	17	1.114	240	150.222	134.849	307	81	19	111	0,85	22	0,40	13	206.937
De Artes y Cs. Sociales, Arcis	5.160	0	701	39	18.090	25.806	264	45	20	2	0,00	2	0,01	2	11.521
De Artes, Cs. y Com., Uniacc	2.819	0	492	33	15.340	31.179	189	6	15	0	0,00	0	0,00	0	0
De Atacama	2.830	0	494	30	8.886	17.988	154	19	18	3	0,00	1	0,02	1	9.811
De Chile	26.659	1.254	4.076	3.870	3.721.706	913.078	1.688	491	16	2.732	0,90	512	1,77	348	6.557.971
De Concepción *	19.462	1.413	4.556	2.337	1.486.884	326.357	1.169	431	17	1.165	0,87	185	1,08	134	1.940.956
De Cs de la Informática, Ucinf	6.800	0	2.642	7	1.481	561	155	10	44	0	0,00	47	0,15	0	0
De La Frontera	7.372	155	1.462	581	367.939	251.668	461	92	16	195	0,86	0	0,42	28	391.077
De La Serena	8.234	27	1.596	324	146.202	91.605	315	67	26	70	0,00	6	0,23	6	128.072
De Las Américas	22.561	0	6.181	86	31.314	5.066	712	19	32	3	0,00	6	0,01	0	0
De Los Andes	4.000	81	911	536	377.989	414.917	353	74	11	54	0,00	26	0,19	11	164.130

* Datos solicitados directamente a las universidades

** Datos 2005.

1) Es el Aporte Fiscal Indirecto que recibieron las universidades este año por cada alumno matriculado en 2005 que estuvo entre los mejores 25.000 puntajes de la PSU 2004.

2) Corresponde al aporte total obtenido por las universidades por los alumnos matriculados en 2005.

3) Corresponde a la suma del total de horas de todos los docentes dividida por 44 (número de horas de una jornada completa)

4) Se refiere al total de artículos publicados en revistas científicas internacionales y que registra el Institute for Scientific Information.

5) Se refiere al impacto de las publicaciones de académicos chilenos, que se mide por la cantidad de citaciones en artículos de reconocimiento internacional.

6) Se refiere al total de artículos publicados en el reg

7) S

LAS UNIVERSIDADES EN CIFRAS

	Matrícula total 2006	Matrícula total doctorado y/o esp. médicas	Matrícula pregrado nueva 2005	Alumnos con AFI 2006 (1)	Monto AFI (M$) 2006 (2)	Monto ($) AFI por alumno pregrado 2005	Docentes jornadas completa equivalente (3)	Docentes doctores j. completa equivalente	Alumnos por docentes JCE	Publicaciones ISI últimos 3 años (4)	Índice de impacto ISI (5)	Publicaciones SCIELO últimos 3 años (6)	Publicaciones por JCE	Proyectos Fondecyt en ejecución (7)	Total montos ($) proyectos	Proyectos por JCE
De Los Lagos **	4.598	0	3.506	80	33.007	9.414	253	37	18	51	0,00	9	0,22	13	161.247	636
De Magallanes *	2.490	0	883	72	29.939	33.906	162	23	15	46	0,00	18	0,34	7	131.723	812
De Playa Ancha	7.839	12	1.740	232	86.113	49.490	381	45	21	10	0,00	2	0,03	2	27.774	73
De Santiago	17.895	158	3.024	2.084	1.174.167	388.283	806	246	22	585	0,91	40	0,75	108	1.236.919	1.534
De Talca	5.454	0	1.054	584	309.437	293.583	236	109	23	125	0,86	68	0,67	24	293.677	1.245
De Tarapacá	6.311	0	1.310	146	57.867	44.173	273	63	23	83	0,00	57	0,41	13	132.506	485
De Valparaíso	13.847	0	3.464	1.256	714.297	206.206	517	68	27	135	0,88	31	0,29	16	173.381	335
De Viña del Mar	5.759	0	1.109	34	12.166	10.970	324	27	18	1	0,00	1	0,00	1	13.515	42
Del Bío-Bío *	8.368	0	1.859	338	131.074	70.508	496	79	17	67	0,00	16	0,15	8	85.994	173
Del Desarrollo	8.069	104	1.647	389	244.270	148.312	299	33	27	17	0,00	7	0,07	4	108.860	364
Del Mar	19.030	0	6.479	56	27.188	4.196	645	30	29	7	0,00	0	0,01	0	0	0
Del Pacífico	3.236	0	809	63	26.765	33.084	91	10	35	0	0,00	0	0,00	0	0	0
Diego Portales	9.897	0	1.845	840	408.245	221.271	302	44	33	28	0,00	12	0,11	6	77.218	256
Finis Terrae	3.185	0	862	226	99.549	115.486	412	10	8	0	0,00	3	0,00	0	0	0
Gabriela Mistral	2.665	0	589	Renunció	Renunció	Renunció	100	18	27	0	0,00	1	0,00	0	0	0
Iberoamericana de C. y T., Unicit	1.490	0	363	6	2.962	8.160	82	5	18	4	0,00	0	0,05	0	0	0
Internacional SEK	737	0	173	5	1.693	9.786	46	9	16	0	0,00	7	0,08	0	0	0
La República	5.594	0	1.545	34	11.214	7.258	190	38	29	0	0,00	0	0,00	0	0	0
Marítima de Chile *	782	0	198	4	846	4.273	46	3	17	0	0,00	0	0,00	0	0	0
Mayor	15.956	57	2.762	627	343.713	124.444	660	63	24	14	0,00	8	0,03	0	0	0
Metropolitana de Cs. de la Educ.	5.138	0	923	469	228.190	247.226	358	46	14	16	0,00	7	0,05	7	52.761	147
Pontificia U. Católica de Chile	20.750	956	3.415	3.236	3.185.983	932.938	1.642	624	13	1.802	0,93	431	1,23	280	4.280.980	2.607
Pontificia U. Católica de Valpo. *	13.245	118	2.844	1.690	963.539	338.797	497	174	27	239	0,90	71	0,55	47	585.480	1.178
San Sebastián	10.205	0	2.552	216	112.878	44.231	714	11	14	9	0,00	10	0,02	0	0	0
Santo Tomás	14.951	0	4.795	120	42.210	8.803	442	42	34	14	0,00	1	0,03	0	0	0
Técnica Federico Santa María	10.887	57	2.660	1.481	1.089.535	409.600	394	110	28	309	0,96	18	0,81	52	450.604	1.143
Tecnológica de Chile (ex VIPRO)	10.214	0	515	40	19.254	37.386	561	3	18	2	0,00	0	0,00	0	0	0
Tecnológica Metropolitana	14.275	30	1.648	718	267.332	162.216	365	51	39	24	0,00	2	0,07	2	15.125	41

* Datos solicitados directamente a las universidades

** Datos 2005.

1) Es el Aporte Fiscal Indirecto que recibieron las universidades este año por cada alumno matriculado en 2005 que estuvo entre los mejores 25.000 puntajes de la PSU 2004.

2) Corresponde al aporte total obtenido por las universidades por los alumnos matriculados en 2005.

3) Corresponde a la suma del total de horas de todos los docentes dividida por 44 (número de horas de una jornada completa)

4) Se refiere al total de artículos publicados en revistas científicas internacionales y que registra el Institute for Scientific Information.

5) Se refiere al impacto de las publicaciones de académicos chilenos, que se mide por la cantidad de citaciones en artículos de reconocimiento internacional.

6) Se refiere al total de artículos publicados en el registro Scientific Ele Online.

7) Según Conicyt: In

Annex B. Lederman-Saenz Database: R & D Statistics by Country and Year

This database was provided via IDRC with the paper by Daniel Lederman and Laura Saenz, Office of the Chief Economist, Latin America and the Caribbean, The World Bank; Innovation and Development around the World, 1960-2000; World Bank Policy Research Working Paper 3774, November 2005.

Abstract This paper presents a database of indicators of innovative activity around the world since the early 1960s. The data include measures of innovation outcomes as well as variables related to innovation effort. The main indicator of innovation outputs is patents. The main variables related to innovation inputs are investment in research and development (R&D) and technical personnel (engineers, scientists) working in R&D activities. The sources of these data are publicly available (OECD, UNESCO, etc.), yet there have been few attempts at double checking the consistency of these data and digitizing observations dating back to the 1960s. After discussing the sources and definitions of the data, the paper examines trends and patterns

of innovation outputs and inputs by looking at the over-time behavior of the relevant series and comparing the performance of developing and high-income countries. The authors also provide cross-regional comparisons and a detailed examination of trends in selected countries. In turn, the authors provide estimates of the impact of innovation on long-run development by following an emerging empirical literature on the determinants of levels of GDP per capita. The econometric results suggest that innovation might indeed have strong positive effects on long-run development, which might be stronger than the direct effects of institutions. The analysis pays close attention to issues related to the potential endogeneity of innovation (and institutions) with respect to the level of development.

Data are for the indicators in the tables that follow, and for a large number of countries, from 1960-2000/2001 or later, depending on country. A group of main comparator countries has been selected in the Tables below. The Working Paper explains the data in much more detail, makes international country and regional comparisons, and looks at factors explaining performance.

Country R & D Statistics

Country (Selected)		Chile	Canada	Brazil	Arg.	USA	Gt. Br.	Neth.	Russia	C
Year		2000	2000	2000	2000	2000	2000	1999	2000	
			(1999)	(1996)		(1997)	(1998)			
Total patents (USPTO)	number	15	3,419	98	54	85,070	3,667	1,247	183	
Total patents (EPO)	number	1	276	13	1	7434	1372	1078	22	
Royalties & lic. / GDP	%	0.05%	0.47%	0.18%	0.16%	0.18%	0.50%	0.73%	0.02%	
R&D expend / GDP	%	0.54%	1.69%	0.83%	0.44%	2.70%	1.87%	2.00%	1.09%	
R&D expend./ Labour Force	c. USD/P	45	557	58	55	1308	621	885	39	12
R&D personnel / Pop.	%	0.04%	0.30%	0.02%	0.08%	0.41%	0.27%	0.26%	0.35%	
R&D personnel / L. Force	%	0.06%	0.44%	0.03%	0.12%	0.63%	0.41%	0.38%	0.50%	
R&D financed by										
Abroad	%	4.9%	13.9%		1.8%		16.2%	11.2%	12.0%	
Productive sector	%	18.0%	42.6%	40.1	23.4%	66.5%	49.8%	49.6%	32.9%	
R&D performed by										
Productive sector	%	10.1%	56.8%	45.5	25.4%	75.3%	65.6%	56.4%	70.8%	
Higher educ. sector	%	48.5%	31.0%	43.5	34.7%	13.6%	20.7%	26.2%	4.5%	
Public sector	%	41.3%	12.2%	11.0	39.9%	11.1%	13.7%	17.4%	24.7%	
GDP / Pop	c. USD/P	5,354	22,525	4,633	7,934	31,924	22,037	30,136	2,470	
Stock of patents (US, E)	number	13	3,908	157	43	122,157	27,763	15,360	122	
Population	million	15.21	30.77	170.10	37.03	282.20	58.72	15.81	145.60	
Labour Force	million	9.79	21.00	112.57	23.18	185.78	39.00	10.78	101.24	

Country (LAC Region)		Chile	Canada	Mexico	Brazil	Arg.	Uruguay	Columbia
Year		2000	2000	1999	2000	2000	1999	2000
			(1999)		(1996)			
Total patents (USPTO)	number	15	3,419	76	98	54	2	8
Total patents (EPO)	number	1	276	8	13	1		1
Royalties & lic. / GDP	%	0.05%	0.47%	0.16%	0.18%	0.16%	0.04%	0.07%
R&D expend / GDP	%	0.54%	1.69%	0.43%	0.83%	0.44%	0.26%	0.24%
R&D expend./ Labour Force	c. USD/P	45	557	25	58	55	27	9
R&D personnel / Pop.	%	0.04%	0.30%	0.02%	0.02%	0.08%	0.10%	0.01%

R&D personnel / L. Force	%	0.06%	0.44%	0.04%	0.03%	0.12%	0.16%	0.01%
R&D financed by								
Abroad	%	4.9%	13.9%	23.6%		1.8%	7.9%	
Productive sector	%	18.0%	42.6%	27.2%	40.1	23.4%	35.6%	34.9%
R&D performed by								
Productive sector	%	10.1%	56.8%	34.2%	45.5	25.4%	36.7%	18.0%
Higher educ. sector	%	48.5%	31.0%		43.5	34.7%	47.1%	57.0%
Public sector	%	41.3%	12.2%		11.0	39.9%	16.3%	25.0%
GDP / Pop	c. USD/P	5,354	22,525	3,622	4,633	7,934	6,562	2,285
Stock of patents (US, E)	number	13	3,908	3,908	157	43	7	11
Population	million	15.21	30.77	96.56	170.10	37.03	3.31	42.30
Labour Force	million	9.79	21.00	59.62	112.57	23.18	2.07	26.43
Stock of patents granted	number	180	57291	1832	1263	904	46	180
Stock of plant patents	number		84	1	2	3		
Stock of design patents	number	4	5556	131	86	45	76	8
Plant patents	number		10	1	2			
Design patents	number		484	17	13	9	2	

Country (US, Austral, EU)		**Chile**	**Canada**	**USA**	**Australia**	**Gt. Br.**	**Germany**	**Spain**
Year		2000	2000	2000	2000	2000	2000	2000
			(1999)	(1997)	(1998)	(1998)		
Total patents (USPTO)	number	15	3,419	85,070	704	3,667	10,234	270
Total patents (EPO)	number	1	276	7434	125	1372	5396	125
Royalties & lic. / GDP	%	0.05%	0.47%	0.18%	0.22%	0.50%	0.20%	0.24%
R&D expend / GDP	%	0.54%	1.69%	2.70%	1.51%	1.87%	2.46%	0.87%
R&D expend./ Labour Force	c. USD/P	45	557	1308	517	621	1180	228
R&D personnel / Pop.	%	0.04%	0.30%	0.41%	0.33%	0.27%	0.32%	0.19%
R&D personnel / L. Force	%	0.06%	0.44%	0.63%	0.50%	0.41%	0.46%	0.28%
R&D financed by								
Abroad	%	4.9%	13.9%		2.6%	16.2%	2.1%	4.9%
Productive sector	%	18.0%	42.6%	66.5%	45.0%	49.8%	66.1%	49.7%
R&D performed by								
Productive sector	%	10.1%	56.8%	75.3%	44.8%	65.6%	70.8%	53.7%
Higher educ. sector	%	48.5%	31.0%	13.6%	29.2%	20.7%	16.0%	29.6%
Public sector	%	41.3%	12.2%	11.1%	26.0%	13.7%	13.2%	16.7%
GDP / Pop	c. USD/P	5,354	22,525	31,924	23,840	22,037	32,599	17,343
Stock of patents (US, E)	number	13	3,908	122,157	2,107	27,763	116,643	1,296

Population	million	15.21	30.77	282.20	19.18	58.72	82.21	40.50
Labour Force	million	9.79	21.00	185.78	12.90	39.00	55.92	26.97
Stock of patents granted	number	180	57291	1870058	12090	101679	231329	3871
Stock of plant patents	number		84	4471	101	295	834	11
Stock of design patents	number	4	5556	130797	1753	4099	4728	424
Plant patents	number		10	232	15	35	70	1
Design patents	number		484	11285	139	372	505	46

Country (Other Europe)		**Chile**	**Canada**	**Neth.**	**Norway**	**Finland**	**Denmark**	**Poland**	**Ru**
Year		2000	2000	1999	1999	2000	1999	2000	2
			(1999)						
Total patents (USPTO)	number	15	3,419	1,247	224	618	487	13	
Total patents (EPO)	number	1	276	1078	125	263	244	7	
Royalties & lic. / GDP	%	0.05%	0.47%	0.73%	0.18%	0.35%	0.00%	0.34%	
R&D expend / GDP	%	0.54%	1.69%	2.00%	1.70%	3.38%	1.96%	0.70%	
R&D expend./ Labour Force	c. USD/P	45	557	885	978	1617	1100	43	
R&D personnel / Pop.	%	0.04%	0.30%	0.26%	0.41%	0.51%	0.347%	0.14%	
R&D personnel / L. Force	%	0.06%	0.44%	0.38%	0.63%	0.75%	0.52%	0.21%	
R&D financed by									
Abroad	%	4.9%	13.9%	11.2%	6.3%	2.7%	5.4%	1.8%	
Productive sector	%	18.0%	42.6%	49.6%	49.5%	68.1%	59.7%	32.6%	
R&D performed by									
Productive sector	%	10.1%	56.8%	56.4%	56.0%	70.9%	63.4%	36.1%	
Higher educ. sector	%	48.5%	31.0%	26.2%	28.6%	17.8%	20.3%	31.5%	
Public sector	%	41.3%	12.2%	17.4%	15.4%	11.3%	16.3%	32.4%	
GDP / Pop	c. USD/P	5,354	22,525	30,136	37,377	32,057	37,545	4,223	
Stock of patents (US, E)	number	13	3,908	15,360	1,284	2,944	2,635	128	
Population	million	15.21	30.77	15.81	4.46	5.17	5.32	38.65	
Labour Force	million	9.79	21.00	10.78	2.89	3.47	3.55	26.56	
Stock of patents granted	number	180	57291	26687	3593	7602	6479	699	
Stock of plant patents	number		84	686	1		158		
Stock of design patents	number	4	5556	1021	269	427	1026	6	
Plant patents	number		10	65			11		
Design patents	number		484	80	21	30	86		

Country (Asia)		**Chile**	**Canada**	**China**	**India**	**Japan**	**Korea**	**Singapore**
Year		2000	2000	2000	2000	2000	2000	2000
			(1999)					

Total patents (USPTO)	number	15	3,419	119	131	31296	3314	218
Total patents (EPO)	number	1	276	11	7	5497	164	6
Royalties & lic. / GDP	%	0.05%	0.47%	0.001232	0.000655	0.001936	0.005192	
R&D expend / GDP	%	0.54%	1.69%	0.01	0.006099	0.029887	0.026757	0.01878
R&D expend./ Labour Force	c. USD/P	45	557	12.06203		1967.069	487.0749	747.578
R&D personnel / Pop.	%	0.04%	0.30%	0.000551		0.005103	0.002305	0.0041
R&D personnel / L. Force	%	0.06%	0.44%	0.000806		0.007493	0.00318	0.00583
R&D financed by								
Abroad	%	4.9%	13.9%			0.004	0.001	0.03794
Productive sector	%	18.0%	42.6%			0.813629	0.724	0.5
R&D performed by								
Productive sector	%	10.1%	56.8%	0.6		0.71	0.74	0.6
Higher educ. sector	%	48.5%	31.0%	0.086		0.145	0.113	0.23
Public sector	%	41.3%	12.2%	0.314		0.145	0.147	0.14
GDP / Pop	c. USD/P	5,354	22,525	824.0887	459.3504	44822.7	13197.75	2822
Stock of patents (US, E)	number	13	3,908	2635	71	96893	778	6
Population	million	15.21	30.77	1262	1016	126.9	47.008	4.01
Labour Force	million	9.79	21.00	862.21	625.22	86.423	34.081	2.849
Stock of patents granted	number	180	57291	930	902	452737	18169	96
Stock of plant patents	number		84		3	136	3	
Stock of design patents	number	4	5556	86	14	18836	961	11
Plant patents	number		10			16	1	
Design patents	number		484	44		1497	150	2