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11 de Septiembre 2139
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Comparative analysis of productivity in public and private Chilean hospitals

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Santiago, agosto de 1985

* Our acknowledgement to Paul Meo, Willy De Geyndt, Shujiro Urata and Andras Uthoff for their suggestions and valuable comments, and to the Wordl Bank for sponsoring this research.

** Con el patrocinio del Banco Interamericano de Desarrollo.

I. INTRODUCTION

Almost 90 percent of the Chilean hospitals' capacity belongs to government services. This means that for a great majority of the population healthcare depends mostly on the work of the public sector. On the other hand, it is a fact that the health public sector has been stagnated in terms of investment (hospitals and equipment) for more than a decade. Investment in health has been 50 percent lower in the period 1974-1982 than it was during 1969-70 (1) what is also confirmed by the decreasing indicator 'beds per capita' (3.7 in 1960 to 2.9 in 1983).

Consequently, effectiveness and productivity in this sector, being normally a matter of concern, becomes much more important if the diminishing resources per capita are considered.

Following some indicators such as infant mortality -which has sistematically decreased since the 60's and significantly diminished in the last ten years- as well as other health indicators that show that tuberculosis and infant diarrhea, abortion and infections have reduced their importance as main cause of death, the health sector seems to have a greater effectiveness which can probably be derived from a more preventive emphasis given by the health policy, rather than a curative one. However the Chilean health situation is not free from backward indicators in some areas or deteriorations as is the case with the situations of the hospital system. Among the backward indicators are the increase of enteric infectious diseases such as Typhoid fever and Hepatitis, which increased in 120 and 750 percent respectively during the last years. Equally in the case of malnutrition in children under 6 years old, where the stagnation and increment is observed between 1982 and 1983 (2).

In the case of hospitals, which is the subject of this study, the public sector shows an evident delay compared to the private sector, and this is confirmed by the strong drop in the investment, as mentioned above. On the other hand during 1979 and 1983 the private sector allocated at least US$ 100 millions in equipment for its 3.000 beds.

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(1) Castañeda, T., "Contexto socioeconómico y causas del descenso de la mortalidad infantil a Chile", Documento de Trabajo No. 28, CEP, 1984.

(2) Jimenez, J., "La salud pública en Chile en 1985", Revista Vida Médica, Vol. 37, No. 1, Marzo 1985.

Originally this study intended to research on the effects achieved by the decentralization policy on the hospital sector that has been in process since 1979. The aim was to test the hypothesis that a more decentralized management of public facilities leads to a considerable improvement in the hospital effectiveness over that for hospitals in the orthodox public management system. As a matter of fact, hospitals under the new system are managed by private nonprofit organizations that handle fiscal resources much more freely than the public hospitals depending directly on the National System of Health Services.

Unfortunately for our purpose, the Ministry of Health denied the information needed to compare its facilities with the decentralized ones and the private ones. Information was however collected from hospitals under decentralized management and from private clinics chosen because of their size and other characteristics which made them similar in terms of case mix to small general public hospitals.

Consequently, this study covers the private sector and the public decentralized one. Some national statistics are available to refer to the public hospital system, but they are obviously not enough to meet the requirements of information initially considered.

The study is organized in the following sections. In section II a model for hospital productivity is outlined. It mainly describes the way in that four variables, i.e., patient socioeconomic level, patient illness severity, patient age, and medical inputs, hypothetically influence over the patient's length of stay. This latter variable is taken as the inverse of hospital productivity measured as patient discharge per hospital bed in a certain period. In section III we present the main characteristics of the 1.137 patients surveyed through the sample. We focused on these characteristics which are relevant to the model of hospital productivity. Special attention is given to the case mix issue between hospitals. In section IV the model is applied with patient's data for three different clinical services, that are Obstetrics and Gynecology, Surgery, and Internal Medicine. In each of these clinical services the data from the five hospitals was pooled together after checking for homogeneity of estimated coefficients. This led to the determination of similarities and differences between hospitals' productivity. Finally, in section V the main policy conclusions are presented.

II. A MODEL FOR HOSPITAL PRODUCTIVITY

The gross product of a hospital can be measured by the number of patients discharged during a certain period (1). Were all the cases of the same medical complexity, had all hospitals the same technology, human endowment and equipment, then productivity between hospitals could be easily compared. One indicator of such productivity could be patient discharge per bed really used in a given period.

$$1)\quad DAP_{ij} = \frac{\text{Patient discharge}_{ij}}{OR_{ij} * THC_{ij}} = \frac{\text{Patient discharge}_{ij}}{\text{total patients stay}_{ij}}$$

where "i" identifies the hospital,
"j" indicates the year,
DAP Daily average productivity per bed in use.
OR Occupancy rate of hospital i in the year j (in percentage)
THC Total hospital capacity which in a year is equal to 365 * number of beds.

It is easy to see that the inverse to this indicator of productivity correspond to the average length of stay (LOS) and obviously the larger the LOS the lower productivity is attained.

For any in-patient his LOS might be composed of three stages: diagnosis (D), medical treatment (T), and recovery (R) such that

$$2)\quad LOS = D + T + R$$

However, while T has to be accomplished as in-patient, D and R at least partially can be accomplished as out-patient.

If we still assume cases of the same medical complexity, what elements can influence over D and R such that different LOS are attained?

The socioeconomic level of the patient seems to be crucial to explain that differences. Briefly, let us first

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(1) Let us assume for simplicity that no out-patient service exists.

explain the price system at public and private hospitals. For all Chilean employees, enrollment to the social security system is mandatory. The social security system provides different benefits among which retirement pensions and health insurance are the most important. With respect to health insurance three different systems are available. For those workers enrolled at the "Servicio de Seguro Social" (SSS), usually the poorest ones, free service at public hospital is available. For those workers enrolled at other social security institutions two options for health insurance are available: on the one hand, the "Fondo Nacional de Salud" (FONASA), a public institution which pays part of the medical expenses of its members according to a pre-fixed price system; on the other, the "Institutos de Salud Previsional" (ISAPRE), private institutions which have different health insurance schemes depending on the monthly payment that each worker does. Any of the SSS workers is allowed to be enrolled either to the FONASA or to the ISAPRES but to use any of them he has to pay more than what he currently does. As for FONASA he gives 6% of his salary each month and pays 50 to 75% of the cost of each service he gets. As for the ISAPRE he would have to pay a higher monthly charge, and pay 0% to 40% of medical care services he receives. Besides, anyone can go to a public hospital and will be charged depending on his income level. Public hospitals accept FONASA patients and accept FONASA prices. Private also accept FONASA' patients but they usually charge more than FONASA prices and in that case the difference is the patient's responsibility.

Therefore, the socioeconomic level determines the type of health insurance that any formal worker is forced "to buy" through a payroll tax, and simultaneously the type of hospital where to go eventually. In Table II.1 it is possible to check this statement.

Looking at unpublished data from a survey over 1500 families in Santiago conducted by the mid of 1983, it is possible to realize that the ISAPRE insurance is high income oriented, while the FONASA one is mostly middle income oriented, and the SSS and direct use of the SNSS health coverage is low income oriented. Besides, those people from the survey who happen to be hospitalized during the period of three months prior to the survey attended to private hospitals as long as they enjoyed high income, while middle and low income people attended SNSS and other public hospitals.

Table II.1 HEALTH INSURANCE AND TYPE OF HOSPITAL ATTENDED BY QUINTIL, SANTIAGO, 1983
(COLUMN PERCENTAGE)

	HEALTH INSURANCE					HOSPITAL ATTENDED		
QUINTIL	FONASA	ISAPRE	SSS + SNSS	OTHERS	WITHOUT INSURANCE	PRIVATE	SNSS	OTHER PUBLICS(b)
1	6.5	3.7	43.3	12.0	27.6	a) 9.0	31.4	27.3
2	13.3	1.1	28.9	15.4	27.0	-	27.5	9.0
3	22.0	6.9	18.4	22.1	16.6	-	19.6	45.5
4	32.3	11.1	7.8	22.1	12.2	9.0	11.8	9.0
5	25.9	77.2	1.6	28.3	12.2	81.2	9.8	9.0
TOTAL	100	100	100	100	100	100	100	100
NUMBER OF PEOPLE	1623	189	2390	510	1496	11	51	11

SOURCE: J. Rodriguez, ILADES, Survey on social expenditure and income distribution, (Unpublished Table); 1983.
a) 6 private hospital specialized in labor accidents.
b) Military and public university hospitals.

Regarding the socioeconomic level of the patient as a factor which influence over D and R the argument is the following. A high income patient can pay private ambulatory diagnosis (medical out-patient care, X-ray, laboratory exams and other diagnostic procedures) which is available and efficient in medical terms. This means that he can be hospitalized with part or all of D fulfilled. Besides, he can enjoy good health care at home which means that R can be shorter. On the contrary, a low income patient whose only alternative is the public system - which is crowded at all levels of health care-, will be hospitalized without a large part of D already done. Even more, he probably does not have the opportunity of adequate convalescence at home what influences over R. Thus, for the same illness, the following would be expected:

$$3)\quad \frac{d(D)}{d(Y)} < 0 \quad ; \quad \frac{d(R)}{d(Y)} < 0 \quad ; \quad \frac{d(LOS)}{d(Y)} < 0$$

where Y = patient's income.

This hypothesis assumes an interaction process between patients and doctors through which several alternatives are discussed and decided, part of them based on medical criteria and the other based on the patient's, and/or his health insurance, disposition to pay.

A second element that should influence over LOS are the medical inputs (MI) which patients receive for the same disease. The hypothesis is that the more medical care that he gets the fastest the way he recovers. This hypothesis should be constrained to cases where health care is given exclusively to cure the patient, because when other objectives are present, for instance medical training, more medical care might not necessarily mean a shorter LOS (1). In the Chilean case, however, it is extremely difficult to compare private and public hospitals located in the Metropolitan Area excluding those institutions which have medical training programs. In fact, almost all public hospitals in Santiago, though not teaching hospitals, have partially some training programs. Therefore, some regard must be taken with respect to the variable MI when analyzing a public hospital. In terms of the model and being aware of some ambiguity between MI and LOS, it is possible to say that

$$4) \quad \frac{d(LOS)}{d(MI)} < 0$$

A third element that should be considered is the role of patient's age (A) over LOS. In this case it is convenient to distinguish between obstetrics and the other hospital cases. In the case of obstetrics it is possible to expect less problematic deliveries, with less complications in women with previous parturitions. On the contrary, in non-obstetric cases one would expect that the older the patient the longest the recovery (R) that he has. It is necessary to point out that the latest hypothesis should be true for obstetrics except for the fact that fertility normally stop in women in their late thirties.

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(1) One might also think that in the case of physicians paid per visit, medical visits might increase just for profit reasons. This might be relevant particularly in some of the internal medicine cases at private clinics because of the payment system.

Therefore,

5) $\frac{d(LOS)}{d(A)_1} < 0 \quad ; \quad \frac{d(LOS)}{d(A)_2} > 0$, where

1 = obstetric cases
2 = non-obstetric cases

Finally, a fourth element must be included in the model. This is illness severity (IS) which is expected to increase LOS. In the limit, that is when severity is extreme and the patient deceased, LOS is obviously interrupted. But while the patient is alive, illness severity must cross over D and R.

Thus,

6) $\frac{d(LOS)}{d(IS)} > 0$

Then, the model might be presented as follows:

7) $LOS = f(Y, MI, A, IS)$

However, up to this point nothing has been said about functional relationship among the independent variables. As a matter of fact, some relations are predicted. For instance between Age (A) and illness severity (IS) in terms that the older the patient the higher the probability of IS. That is.

8) $\frac{d(IS)}{d(A)} > 0$

Besides, it is reasonable to expect that medical inputs (MI) increase with illness severity (IS) and with Age (A).

Thus,

9) $\frac{d(MI)}{d(IS)} > 0$, and

$$10) \quad \frac{d(MI)}{d(A)} = \frac{\delta MI}{\delta IS} * \frac{\delta IS}{\delta A} + \frac{\delta MI}{\delta A}$$

Finally, it is also possible to predict a functional relationship between income level of the patient (Y) and the medical inputs (MI) that he receives. Thus,

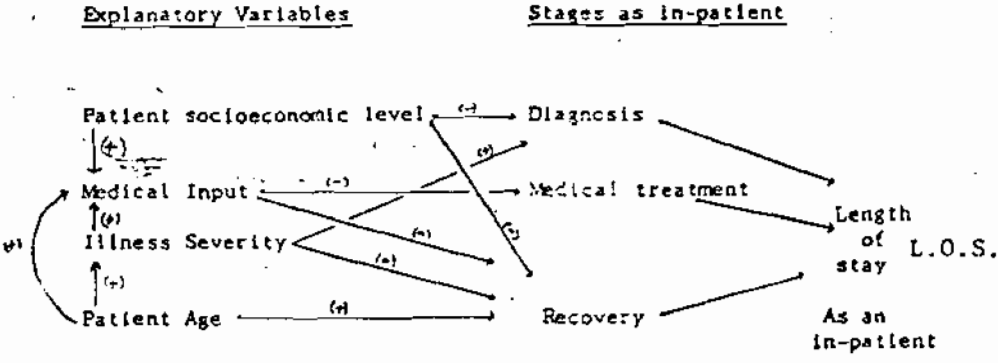
$$11) \quad \frac{d(MI)}{d(Y)} \; \rangle 0$$

Therefore, the total differential of (7) leads to

$$(2) \; dLOS = dY\left[1+\frac{\delta MI}{\delta Y}\right] + dMI + dA\left[\frac{1+\delta IS}{\delta A}\left[1+\frac{\delta MI}{\delta IS}\right] + \frac{\delta MI}{\delta A}\right] + dIS\left[1+\frac{\delta MI}{\delta IS}\right]$$

In the following graph all this relations are described.

Graph II.1.



III. 2. SAMPLE CHARACTERISTICS

a) Public and private patients and socioeconomic status

The study clearly shows socioeconomic differences between hospitals according to their patients' characteristics. Different variables can be used to prove it. District of patients' origin is one of them. Data obtained from a University of Chile's survey showed the following information on average family income by Metropolitan district.

Table III.1

Monthly family income by district, Metropolitan Area, 1982, and district origin of patients (%)

METROPOLITAN DISTRICT	DISTRICT AVERAGE	PATIENTS' DISTRICT ORIGIN (Column Percentage)				
	Monthly Family Income (Chilean Pesos, May 1982)	PRIVATE HOSPITALS No.1	No.2	No.3	PUBLIC HOSPITALS No.1	No.2
La Granja	2.930					
Pudahuel, Quinta Normal	3.455	3.4	3.2	5.1	24.0	12.8
Conchali, Renca, Quilicura, (a)	3.566	0.5	-	2.6	1.7	-
La Cisterna	3.811	-	-	-	-	-
San Miguel	4.359	1.0	4.5	6.5	3.0	2.3
San Bernardo	5.170	2.0	1.9	0.9	1.3	42.2
La Florida, Puente Alto	6.794					
Nunoa (b)	8.681	13.6	17.8	15.7	5.0	-
Santiago	10.411	5.4	12.1	20.9	46.8	0.9
Providencia, Las Condes, La Reina (c)	18.240	54.0	47.8	22.6	2.3	-
Other	-	9.8	14.7	16.5	15.3	11.7

(a) Patients' origin only from Conchali.
(b) Patients' origin from Nunoa and La Reina
(c) Patients' origin from Providencia and Las Condes

If origin of patients is compared with average family income by districts, it clearly shows that private hospitals preferable concentrate on patients from high income areas, whereas public hospitals move in the opposite direction. This situation can be regarded from other point of view by considering the type of patients' social security. Obviously the economic level of those affiliated to the Servicio de Seguro Social (SSS) is lower than the level of those belonging to FONASA (FNS) and this in turn is lower than the

level of those belonging to ISAPRE (1). On the other hand, it can be stated that those without social security that visit private clinics have a high income level, since they have to pay much more there than in public hospitals, and those not having social security and visiting public hospitals have a low income level since they are admitted freely or paying much less.

Table III.2

Patients by type of social security (%)

Type of social security	Private Hospitals			Public Hospitals	
	PR1	PR2	PR3	PUB1	PUB2
SSS	1.5	-	0.4	40.5	32.4
FNS	40.7	31.0	27.0	12.2	10.5
ISAPRE	26.6	41.0	57.0	-	1.4
Without insurance	25.1	22.0	6.5	44.3	51.4
Other cases	6.0	6.0	9.0	2.7	4.3
Total	100.0	100.0	100.0	100.0	100.0

Finally, if economic activity of patients is considered the same situation is found. In the following table, it can be showed that a greater rate of professionals, white-collar employees and entrepreneurs go to private clinics, and opposite to it, a greater rate of blue-collar workers and self-employed go to public hospitals.

(1) Traditionally blue-collar workers affiliate to the social security system (SSS); white-collar employees to FONASA (FNS) and high income families to ISAPRES.

Table III.3

Patients economic activity
(Percentage of the answers obtained)

Activity	Private Hospital			Public Hospital	
	PR1	PR2	PR3	PUB1	PUB2
Professional	35.0	15.0	27.0	3.8	4.0
White-collar emp.	13.0	12.0	16.0	5.3	2.9
Entrepreneur	4.0	10.0	3.0	0.8	-
Blue-collar worker	1.0	1.0	4.0	10.7	13.3
Self-employed	-	0.7	1.0	10.3	11.6
Inactive	47.0	61.0	53.0	69.1	68.2
% of no answer	39.0	9.0	-	3.0	4.2

Up to this point, nothing new has been proved, i.e., that public hospitals preferably assist poor patients whereas private hospitals admit patients of medium and high incomes.

The significance of this fact lies on two hypotheses that, if proved true, could influence the productivity of hospitals. The first one is that patients having better incomes are able to get to the hospital with most of their diagnostic examinations done. The second one is that for the poorest patients, home recovery implies risks of infection or bad quality care, what can be avoided if their stay in the hospital is longer. Naturally both hypotheses go for greater indexes of patient's stay in public hospitals.

However, and acknowledging that part of such hypothesis is reasonable, it can be argued inversely, that it is likely that the cost factor, being absent of the doctor's mind in the public hospital (1), may lead to procedures and habits that unnecessarily increase the length of stay.

(1) What he does take into account when working at a private clinic.

b) Public vs. Private Patients and Length of Stay

One of the most relevant statistics obtained from the survey is that of length of stay of patients. Next Table contrast them by hospital and services. (1)

Table III.4

Length of stay per patient (LOS), standard deviation (SD) and its relationship by hospital and services (pre-surgical days in brackets).

Clinical Service / Hospital	OBSTETRICS AND GYNECOLOGY			SURGERY			INTERNAL MEDICINE		
	LOS	S.D.	LOS/SD	LOS	S.D.	LOS/SD	LOS	S.D.	LOS/SD
PRI	3.64	.82	4.46	3.0 (0.09)	2.83	1.06	4.40	4.57	0.96
PP2	3.52 (0.20)	1.04	3.39	3.53 (0.24)	2.41	1.46	4.38	5.73	0.76
PR3	3.22 (0.06)	1.08	2.98	4.69 (0.44)	3.90	1.20	5.37	3.92	1.37
PUB1	3.42	2.15	1.60	8.77 (3.18)	5.85	1.5	13.28	8.97	1.48
PUB2	3.25 (0.26)	3.19	1.02	10.01 (2.81)	7.73	1.3	12.76	8.19	1.56

It is clear that in obstetrics and gynecology the length of stay is similar among all the institutions. However, it must be noted that public hospitals register a high number of abortions and other situations related to pregnancy that do not end in childbirth, what partially explains the high values for their standard deviations. If such cases are excluded, the length of stay for delivery are 3.58 and 2.44 for hospitals PUB1 and PUB2 respectively. In the latter,

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(1) Different services or departments have different kinds of problems and they carry with them particular patterns of behaviour among doctors. Surgeons have an "activist" behaviour, they feel they must "do something" and they don't like to be pasive observers. Internal medicine doctors are always in search for diagnosis; they privilege more intelectual and academic discussion than surgeons and they tend to be less prone to action than them. Obstetricians are more like surgeons, their problems are simpler and complications fewer. This is an input to understand why L.O.S. tends to be longer in Internal Medicine than in Surgery, and shorter in Obstetrics.

almost a third of the deliveries shows only one day of stay, case that was not observed in the rest of the surveyed hospitals. All the patients under that circumstance lacked of social security and only a minority had SUS. However, this hospital evacuated patients to a convalescence hospital 24 hours after normal delivery and 72 hours in the case of cesarean section (until the earthquake of March 1985) (1).

Nevertheless, in surgery as well as in internal medicine, public hospitals show longer lengths of stay than the private ones. In the case of surgery, private premises virtually do not show presurgical days, what means that patients arrive with most of their diagnosis established. Instead, in the public hospitals the average presurgical days are 3.3 and 2.6 for PUB1 and PUB2 respectively. The analysis of the relationship 'average days / standard deviation' shows that there is greater or less proportion of cases near the average (not necessarily indicating the distribution of frequencies). This means that a high relationship points at a greater proportion of cases with length of stay next to the average. For instance, in the case of obstetrics and gynecology such indicator shows that in the private institutions more women stay approximately 3 days than in the public hospitals. If it is considered that in the public hospitals there are cases that are not delivery, such relationship seems reasonable. In fact, private institutions have a set of more homogeneous cases and therefore their standard deviation is lower. In spite of it, such analysis applied to surgery shows a certain similarity among hospitals. In medicine, instead, public hospitals have a 'days / standard deviation' relationship higher than private ones (particularly with respect to PR1 and PR2), and a similar relationship between them, which suggests a greater homogeneity of cases, or alternatively stays of equal length, being rather independent from the type of cases. The latter would obviously reveal a questionable use of the installed capacity.

c) Public vs. Private Patients' Age

The age of patients must play a role in the length of stay, since it does play it in health. In this case it should be expected that the older the patient, the greater care he requires, i.e., longer stay. However in the case of people with strong socioeconomic differences, it should be said that probably in people older or the same age, the risk is higher among the poor.

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(1) It is reminded that this survey was taken during the last quarter of 1994.

In the following Table patient's age by hospital and clinical service is shown.

Table III.5

Average patient's age and standard deviation by hospital and clinical service.

Clinical service / Hospital	Obstetrics and Gynecology		Surgery		Internal Medicine	
	Age	S.D.	Age	S.D.	Age	S.D.
PR1	28.9	4.22	44.9	19.5	62.5	21.6
PR2	27.5	4.38	48.6	20.4	60.2	18.8
PR3	27.9	4.92	44.0	17.63	56.3	20.4
PUB1	25.8	5.56	46.6	17.61	47.3	20.9
PUB2	24.7	5.93	43.4	20.0	53.2	23.3

In the case of obstetrics and gynecology patients' age is very similar ranging from 25 to 29 years old. In surgery there are no considerable differences either, since patients' age fluctuates between 43 and 49 years. Instead, in medicine a significant distance is observed between 47 and 63 years old. In general, it can be stated that patients in public hospitals are younger than in private institutions.

d) Private vs. Public Patients and Medical Assistance

Statistics on medical assistance, examinations and pharmacy give an idea on the processes undergone by the patient either regarding intensity of the treatment or the type of treatment done.

Medical visits, especially the daily ones, show the intensity of care the patient is subject to.

Table III.6

Average Medical Visits per Patient discharged by Hospital and Service. (Its daily equivalent in brackets)

Clinical service / Hospital	Obstetrics and Gynec. Medical visits per patient	Surgery Med. Visits per patient	Internal Med. Med. visits per patient
PR1	4.2 (1.15)	3.93 (1.31)	4.71 (1.07)
PR2	4.57 (1.30)	5.79 (1.64)	8.15 (1.86)
PR3	3.84 (1.19)	7.55 (1.61)	8.95 (1.67)
PUB1	4.22 (1.23)	8.91 (1.02)	16.45 (1.24)
PUB2	4.1 (1.26)	8.6 (0.86)	10.39 (0.81)

A great similarity is seen in obstetrics and gynecology, while in Surgery and Medicine where total medical visits per patient are oftener in public hospitals, their daily equivalent are less in surgery and among the lowest in medicine. This implies more days of stay but not more intensity of the medical work in public hospitals.

If volume of laboratory examinations is considered as well as x-rays and diagnosis procedures by patient, expressed in equal prices by using FONASA fee values, it is noted that public hospitals are located among those using more exams while the patient is in the hospital.

Table III.7

Laboratory exams, x-rays and diagnosis procedures by patient, hospital and service (in units of fee and valued at the same price system) (*)

Clinical service / Hospital	Obstetrics and Gynecology	Surgery	Internal Medicine
PR1	2.55	12.03	45.85
PR2	5.58	19.54	56.33
PR3	4.67	13.82	33.29
PUB1	5.54	17.12	106.56
PUB2	6.73	30.2	35.41

(*) 1 unit of fee (unidad arancelaria) equals $ 100 Chilean pesos at the moment of the survey (1984).

It should be noted that there is some relationship between the percentage of patients that arrived in emergency and the amount of exams registered (cf. Table III.7 and III.8). The private hospital PR2 that shows more examinations has the highest percentage in urgencies, and a similar situation happens in the public hospitals.

Table III.8

Patients admitted in emergency situations by hospital and service. (Percentage over total)

Clinical service / Hospital	Obstetrics and gynecology	Surgery	Internal Medicine
PR1	1.4	4.3	n.a.
PR2	21.7	19.8	n.a.
PR3	4.4	2.9	n.a.
PUB1	26.2	1.9	n.a.
PUB2	37.7	20.0	n.a.

Table III.9

Pharmacy cost for patient, by hospital and services. (Common prices of "Formulario Nacional", in units of fees)

Clinical service / Hospital	Obstetrics and gynecology	Surgery	Internal Medicine
PR1	19.52	23.48	17.81
PR2	14.97	24.94	17.20
PR3	10.83	21.44	14.39
PUB1	12.25	14.22	16.85
PUB2	10.62	32.46	28.19

Information about pharmacy does not allow to infer comparative conclusions between private and public institutions. In none of the clinical services studied it stands out because of some common characteristic. Inside each service and hospital this variable will indeed be used as indicator of illness severity in the following econometric analysis.

e) The case mix issue

Hospitals are like multiproduct firms. Almost each patient is a different case. Therefore any gross hospital indicator of productivity, cost, and so on hides a case mix which is crucial for hospital comparison purposes. Case-mix is the frequency of diseases with its names or classification, grouped with certain criteria, that are observed in a given hospital. In certain sense the case mix with its percentages defines the profile and most important areas of work of a hospital.

The selection of the eight hospitals which constituted our initial sample was done based on this concern. All these hospitals are "general hospitals" in the sense that they have at least three of the following basic departments: internal medicine, surgery, obstetrics, or pediatrics. Besides, the study discriminates between cases belonging to each of those departments and in that sense it reduces but does not overcome the case complexity. In order to establish an explicative case mix, each disease may be classified according to:

a- System or part of the body involved.
b- Severity of the disease.
c- Concurrence of other complicating diseases.

A case mix so worked will give to the analyst a better insight of the kind of hospital with which he is working. This because some kind of diseases with certain complications and with a given severity, will imply different costs, logistics and professional demands.

In this study we have made our Case-mix with the criteria described above. We determined:

a) Four levels of severity for surgical interventions according to its technical complexity and organ (s) involved.

b) Three levels of severity for internal medicine diagnosis according to its mortality risk.

c) Presence or absence of additional diagnosis and its participation in aggravating the main or principal condition.

Case mix and length of stay

Each department has a distribution of frequencies of clinical diagnosis according to its structure and population. These frequencies are called case mix.

Departments of surgery, medicine and obstetrics of the five analyzed hospitals have been grouped in order to compare them.

From the point of view of the case mix it has been attempted to obtain some explanations for the average and dispersions in the days of stay in the clinical services of the studied hospitals.

Therefore a specific coefficient has been defined for each department which relates average days of stay with their corresponding standard deviation. Let us call it "coefficient Z" which is the inverse of the so called coefficient of variation:

$Z = \bar{X}$ days of stay / Standard deviation

The hypothesis is that the greater the "Z" coefficient, the greater the concentration of cases with tendency to a similar number of days of stay in the given hospital.

Case mix in obstetrics and gynecology

In the case of obstetrics and gynecology, taken from the maternity department, there is an already mentioned difference which is that while public hospitals include gynecological diagnosis in their case-mix, private ones do not do it, but concentrate exclusively on the obstetric aspect. We included anyway all gynecological cases in the obstetrics department case mix of private clinics for analytical purposes.

The average days of stay are similar when comparing cases exclusively obstetrical, and in some cases, older age means shorter stay. This is opposite to what has been found in internal medicine and surgery where older age is positively correlated to length of stay. The explanation of this difference may be that older age in obstetrics (over 30 years old) is related to more than one previous delivery or multiparity. This means that those mothers who have had normal deliveries before have more ability to shorten the process and avoid complications.

Gynecology includes abortion in our case mix, and it appears only in PUB hospitals and in PR3. It must be said that abortion is legally forbidden in Chile, but it is performed extralegally and its complications are the cause for hospital admissions. Private hospitals tend to disguise this kind of diagnosis.

Table III.10

Re-grouped obstetrical-gynecological diagnosis
(Absolute numbers and percentages)

Hospital Case	PR1 N	PR1 %	PR2 N	PR2 %	PR3 N	PR3 %	PUB.1 N	PUB.1 %	PUB.2 N	PUB.2 %
Normal deliv.	36	46.7	28	38.4	30	39.0	53	51.5	29	47.5
Forceps del.	8	10.3	1	1.4	6	7.8	3	2.9	0	0
Cesarean Sec.	26	33.7	24	32.9	26	33.7	18	17.5	9	14.7
Abortion	0	0	0	0	4	5.1	9	8.7	18	29.5
Pregnancy Compl.	0	0	0	0	0	0	12	11.7	2	3.3
Post-partum complications	0	0	0	0	1	1.2	0	0	3	5.0
Other Gynec.	7	9.3	20	27.4	10	12.2	8	7.8	0	0.0
TOTAL	79	100	73	100	77	100	103	100	61	100

Case Mix in Surgery

When the most frequent cases were grouped according to percentage of occurrence, 19 different categories were established in the surgical activity. These can be found in the Table III.11. Most common cases are biliary tract, hernias, appendectomies, gastrointestinal, urologic, and traumatological operations.

In the case of surgery, it is quite remarkable that the PUB1 hospital gets to a very high percentage (67.9%) with only 3 different kinds of diagnosis: gallbladder, hernias and peripheral vascular. (1) This greater concentration is correlated with a "Z" coefficient of 1.83 in the case of the bigger of the five services compared. When accumulating the five higher frequencies of diagnosis, PUB1 gets to a 77.4% of its total cases.

PR3 and PUB2 hospitals reach the next accumulative percentages with 45.7% and 44.2% respectively in the first 3 cases and "Z" coefficientes of 1.20 and 1.40. In these cases, the tendency towards higher "Z" coefficients is more or less ambiguous since hospital PR2 has almost the same concentration in the case-mix in its first group of cases while it has a Z coefficient of 1.44.

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(1) This is the usual case mix in surgical departments of public hospitals in Chile, were 30 to 43% of surgery is biliary tract related (Csendes et al, Revista Medica, Chile, III: 1065-074, 1983).

It must be noted that PUB1 is a typical surgery department case in a public hospital in which certain surgical activities are excluded, such as: urology, traumatology, otorhinolaryngology and gynecology, which have their own services and facilities. The private hospitals tend to obtain a case-mix more varied, therefore to spread it.

Finally, it is convenient to prove the difference between hospitals. In this sense, by analyzing the cases from the different hospitals it could be noted that case mixes are not strictly similar: On one hand, PUB1 concentrates on 3 groups of cases to reach 68% of the total and only one of them is frequent in the private hospitals (biliary tract). On the other hand, at this level PR2 and PR3 show certain similarity with PUB2. It is possible, therefore, that the different case-mix explains part of the unequal lengths of stay (1).

Table III.11

Grouped Diagnosis in Surgery
(Decreasing frequencies totalling +/- 60% of cases)

	PR1 NAME (%)	PR2	PR3	PUB1	PUB2
First Frequency	Proctology (12.7)	Trauma (18.2) Urology (13.6)	Biliary Tract (16.6) Traumatology (16.6)	Biliary Tract (28.9)	Biliary Tract (15.7) Digestive (15.7)
Second Frequency	Neck and Facial (11.1) Traumatology (11.1) Peripheric Vase (11.1)	Plastic (12.1)	Appendectomy (12.5)	Hernias (25.0)	Cancer (12.8)
Third Frequency	Biliary Tract (9.5)	Biliary Tract (10.6)	Urology (9.4)	Peripheric Vasc. (14.0)	Appendectomy (11.4)
Fourth Frequency	Oftalmology (9.5)	Hernias (7.6) Appendectomy (7.6) Proctology (7.6)	Hernias (6.3) Proctology (6.3)	—	Urology (8.6)
Accumulated Freq.	65.0%	77.3%	67.7%	67.9%	64.2%
Number of cases	63 (100%)	66 (100%)	96 (100%)	102 (100%)	69 (100%)
Coefficient x days stay / St. Dev.	1.09	1.44	1.21	1.83	1.40

(1) The cases of biliary tract surgery in PR3 have an average length stay of 7.25 days what obviously explains why that hospital has the highest average stay, and in this sense, it tends to prove the idea that the case mix of public hospitals help to get to high stays also.

Table III.12

Lengths of stay in days per diagnostic groups in public hospitals and average for private hospitals
(Surgery departments)

Cases in Surgery	PUB.1	PUB.2	PRIVATE
Gynecology	7.00	3.00	3.48
Proctology	9.75	7.00	4.26
Otorhino	5.50	-	1.2
Plastic	4.67	3.00	2.53
Biliary Tract	9.30	14.27	6.85
Cancer	9.75	18.00	4.11
Vascular perif.	9.00	6.00	2.71
Cardiovascular	17.86	-	4.00
Neck	6.50	-	1.67
Digestive	15.00	10.50	7.50
Hernia	6.04	7.30	3.00
Endocrinology	9.33	-	1.00
Urology	11.50	8.33	2.62
Trauma & Rheuma	3.50	6.28	4.03
Thorax	2.00	4.00	15.00
Mastology	12.00	3.00	2.66
Respiratory	4.00	-	-
Appendectomy	-	5.50	4.94
Other	17.00	13.00	
Oftalmological	-	5.00	2.38
Infectious	-	10.00	-
Renal	-	26.00	
Average	8.757373	9.800677	
Simulated Average (a)	4.341111	4.820847	

(a) Cases absent in private hospitals are excluded.

If we accept that given diagnoses are closely related to length of stay and simulate private averages in the two public hospitals, the mean length of stay of these falls down to 4.34 and 4.82 respectively. Both figures compare then with that of PR3 (4.69) what shows that their case mix, defined at the detail level used here, would not justify such a big difference of stay as the one found. It would be necessary, however, for a finer comparison, to poke more deeply into the health status of patients. It is accepted that there is a relation between severity and length of stay in a positive sense. If we would assume that public hospitals had more complicated and severe cases, the big difference with the length of stay observed in private hospitals would not be explained fully. Even more, in hypothetical situations of exclusively severe cases in public hospitals, which of course is not real, it would not account for the difference in comment.

Internal Medicine Case-Mix

When we analyze the higher frequencies in the internal medicine (IM) departments, the first remarkable issue is its extraordinary similarity in all hospitals.

Cardiovascular diseases account for more than a quarter in four of our five hospitals and the following groups are digestive and respiratory in all but one.

In the next table, frequencies and its precedence are shown for the IM departments in the hospitals that we studied.

Table III.13

Grouped diagnosis in Medicine
(Decreasing frequencies up to approx. 65% of cases)

Hospital / Frequencies	PR1 Name	(%)	PR2 Name	(%)	PR3 Name	(%)	PUB1 Name	(%)	PUB2 Name	(%)
First Frequency	C. vascular	(28.5)	C. Vascular	(27.0)	Digestive	(28.0)	C. vascular	(39.0)	C. Vascular	(27.4)
Second Frequency	Digestive	(14.2)	Digestive	(16.6)	C. Vascular	(17.5)	Digestive	(14.0)	Respiratory	(21.5)
Third Frequency	Respiratory	(10.2)	Cancer	(14.5)	Respiratory	(10.5)	Infectious	(9.3)	Trauma & Reuma	(11.7)
							Blood	(9.3)		
Fourth Frequency	Cancer	(8.2)	Neurologic	(10.4)	Infectious	(7.0)	Cancer	(6.3)	Endocrino	(9.8)
					Cancer	(7.0)				
Accumulated Frequency	61.1%		68.5%		70%		77.9%		70.4%	
Number of cases	48	(100%)	48	(100%)	53	(100%)	64	(100%)	51	(100%)
Coefficient X days stay	.93		.82		1.46		1.63		1.56	
S.D.										

In the preceding Table it is seen that public hospitals concentrate in few cases reaching rapidly over 60% of their respective totals. This is also clear in the coefficients which are high for PUB hospitals (1.63 and 1.56) and small for PR1 and PR2 (.96 and .82). Although these cases are also frequent in private hospitals they are less concentrated.

In order to specify more the possible effect of the case mix on the stay, the simulation performed for surgery is repeated, which changes the average stay by case of the private hospitals to the public hospitals. It can be seen in the next Table that under such circumstances, the mean stay

would fall to 6.15 and 5.13 respectively. If these averages are compared with private ones, it is verified that public hospitals compete again with PR3 (5.37) being this one between both PUB.

Table III.14

Length of stay per diagnostic groups in public hospitals and average of private (Internal Medical Departments)

Cases in Medicine	PUB.1	PUB.3	PRIVATE
Rheuma	19.00	17.00	10.00
Neurological	17.00	8.33	4.92
Blood	4.00	-	14.50
Cancer	11.25	-	6.00
Renal	12.67	16.50	2.14
Cardiovascular	13.58	10.71	4.41
Respiratory	12.17	16.73	4.50
Digestive	12.11	10.00	4.20
Infectious	17.67	25.50	10.20
Endocrine	24.00	8.60	7.33
Other	26.00	8.00	5.14
Skin	-	-	8.00
Hernia	-	-	4.00
Traumatology	-	-	4.43
Urology	-	-	1.00
Ginecology	-	-	2.67
Oftalmology	-	-	1.00
Average	13.28062	12.74903	-
Simulated average	6.155937	5.129038	-

Consequently, at this level of detail the case mix of public hospital do not show evidences which justify the gaps found with the private hospitals, although, as mentioned before for surgery, a more detailed analysis of each patient could prove a longer stay, but hardly at the present level.

IV. EMPIRICAL FINDINGS

According to the model for hospital productivity defined in section II, Length of Stay (LOS) as a function of patient socioeconomic level (y), medical inputs (MI), patient's age (A), and illness severity (IS). This general model is adaptèd for each clinical service to take into account some special cases. In order to diminish the case mix differences between hospitals in each clinical department several steps were accomplished:

(a) All gynecological cases in the services of surgery and internal medicine were transferred to the service of obstetrics and gynecology. This affected mainly the private hospitals' case mix since they almost did not have gynecological cases under the latter clinical department while the opposite was true in the public hospitals.

(a) In the clinical department of surgery as well as in internal medicine, some cases were eliminated. The criterion was to keep under analysis only those cases, grouped by principal diagnostic (see Tables III.12 and III.14) which were present simultaneously in each public hospital and in the private's as a whole. This meant the exclusion of the following cases by main diagnosis. In surgery: otorhino, cardiovascular, neck, endocrine, respiratory, appendectomy, oftalmology, infectious, renal, and without classification. In internal medicine: blood, cancer, skin, hernias, traumatology, urology, oftalmology (between the private hospitals only one of the cases left is not present in one of them: infectious diseases).

No further exclusions were made because the sample size would have diminished considerably in the cases of these two clinical departments.

Besides, in order to test the hypothesis of differences in productivity between hospitals, several Chow tests were applied to check for homogeneity of estimated coefficients. For that purpose, in each clinical service a specific model was adapted which applied to all hospitals and explains Length of Stay.

IV.1. Obstetrics and Gynecology

The specific model applied in this clinical department includes the variables: daily medical visits, patient age, exams, pharmacy, and different slope for pharmacy in the surgical cases (Caessarean or other gynecological diagnosis). The following equation was estimated for all hospitals together which fulfill the Chow test criterion in order of acceptance of the null hypothesis.

TABLE IV.1

Dependent variable : Length of Stay

Independent Variables

Constant	: 4.77 (*)
Daily Medical Visits	: -.715 (*)
Patient's Age	: -.031 (*)
Exams	: .063 (*)
Pharmacy	: .003
Pharmacy * Surgical cases	: .035 (*)

Dummy Variables for Hospital PR3

Constant	: -2.50(*)
Patient's age	: .049 (**)
Pharmacy	: .067 (**)

Dummy Variables for Public Hospitals

Constant	: -1.12 (*)
Pharmacy	: .06 (*)
Pharmacy * Surgical cases	: .034 (^)

Dummy Variables for PUB2

Exams	: .091 (*)
Pharmacy	: .049 (**)
Pharmacy * Surgical Cases	: -.132 (*)

(*) t) .99; (**) t) .95; (^) t) .90

R2 = 43.39; Adj. R2 = 41.02; F = 18.30.

This equation suggests several comments. In all hospitals the variable Daily Medical Visits (the labor input) has a negative coefficient which is statistically significant. There exists no significant difference in this variable between hospitals. There is no difference either in the case of patient age except for hospital PR3 where the absolute value of that coefficient is positive but near zero (0.018). In the other hospitals that variable has a negative coefficient what might reflect the effect of previous maternal experience over the length of stay.

The variable exams has a positive and statistically significant coefficient which means that diagnostic exams with the patient staying at hospital imply a longer stay. This effect is higher in the case of one public hospital (PUB2).

The pharmacy variable is supposed to measure the input of severity level over the length of stay. Besides, the different slopes for patients with surgery try to measure the impact of those more severe cases. In the cases of private hospitals PR1 and PR2 only the pharmacy for surgical patients shows a positive and statistically significant coefficient. In the other hospitals, the pharmacy variable shows a positive coefficient (almost the same for PR3 and PUB1). Besides, in terms of surgical cases that variable is still higher in PR3 and PUB1. In the case of PUB2 it is positive but lower than the coefficient for non surgical patients.

Finally, with respect to the constant term differences we have no specific comments.

As long as in this clinical department no significative difference in terms of patient length of stay was detected between hospitals, it is reasonable that the productivity model do not differ among them either, except for few characteristics. Besides it must be remembered that one public hospital (PUB2) had available convalescence beds for low income women after child delivery which eliminates one of the possible causes of patient's longer stay.

IV.2. Empirical findings in surgery

The following model was applied to the department of surgery in all hospitals.

$$LOS = \beta_0 + \beta_1 NS + \beta_2 DMV + \beta_3 PA + \beta_4 Ex + \beta_5 Ex*DES + \beta_6 Ex*DIS + \beta_7 Ph + \beta_8 Ph*DES + \beta_9 Ph*DIS,$$

where

LOS = Length of stay
NS = Number of surgeons
DMV = Daily medical visits
PA = Patient's age
Ex = Exams
Ph = Pharmacy
DES = Dummy variable for cases of extreme severity.
DIS = Dummy variable for cases of intermediate severity.

This model attempts to capture the influence of diagnosis exams, medical inputs, patient's age, and illness severity and complexity over the Length of Stay. The last variable is included through the number of surgeons, pharmacy, and two dummies (DES and DIS) which differentiate slopes in exams and pharmacy.

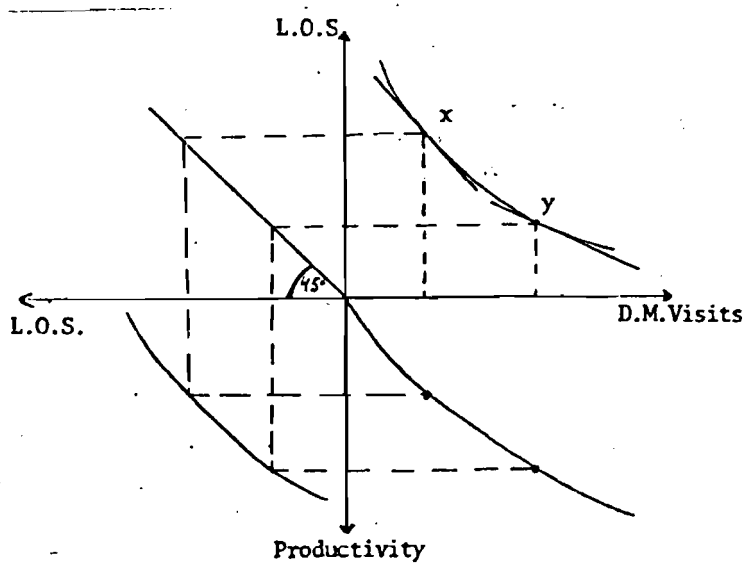
After several Chow tests the following equation was estimated. This equation shows several differences between the hospitals under analysis.

First, while the private's have a constant term equal to zero, the public's have a constant equal to 2.83. Since in the case of private hospitals almost no pre-surgical stay was detected while in public hospitals that variable took the value of approximately 3 days, then the constant term difference could be associated with that variable.

Second, while daily medical visits - which is one of the main policy variable under analysis -, takes the value of -.921 in private hospitals, it takes the value of -1.713 in public hospitals. If it is assumed that this variable represents medical labor productivity then the following hypothesis can be made. If medical labor is subject to decreasing returns, then Graph A represents the expected functional relation between daily medical visits and Length of Stay. The different slope estimated for public and private hospitals could be representing the situations showed in points X and Y. The first one corresponds to a lower input and a lower product (since minimum LOS is better). The lower slope at point Y would represent that more input implies more product but at a decreasing rate. However, it must be said

that there exists for simplicity an additional assumption behind Graph A in terms of considering the same production curve for both type of hospitals which is probably false.

Graph A: Medical Labor Productivity and Length of Stay



Third, the presence of exams during the patient's stay is definitely linked with a longer stay. Even though the different values that assume its coefficient in each hospital, its high and positive correlation with pharmacy (.66) makes very difficult to conclude anything useful for comparing purposes. Besides there exists also the medical evidence of links between amount of exams and type of diagnosis, that is, the case mix differences probably influence over the specific value of this coefficient. Something similar happens with respect to the variables number of surgeons and pharmacy. What does it mean that for hospital PUB2 the coefficient of number of surgeons is so high (compared with the one for the other hospitals) while the pharmacy coefficient is negative? Only in that hospital the correlation coefficient between those variables is large (.49) such that the probability of multicollinearity is reasonable. Fortunately these two variables only attempt to capture the effect of illness severity over the length of stay. For that reason the policy conclusions are not sacrified because of the difficulties involved in the interpretation of these coefficients.

TABLE IV.2

Dependent variable : Length of Stay

Independent Variables

Constant	: .000	(a)
Number of surgeons	: .957	(*)
Daily Medical Visits	:-.921	(*)
Patient's Age	: .029	(*)
Exams	: .042	(**)
Exams * Extreme Severity	: .011	
Exams * Intermediate Severity	:-.006	
Pharmacy	: .039	(*)
Pharmacy * Extreme Severity	:-.037	(**)
Pharmacy * Intermediate Severity	:-.000	

Dummy Variables for Hospital PR3

Exams	: .235	(*)
Exams * Extreme Severity	:-.257	(*)
Exams * Intermediate Severity	:-.267	(*)
Pharmacy	:-.030	(^)
Pharmacy * Extreme Severity	: .191	(*)
Pharmacy * Intermediate Severity	: .137	(*)

Dummy Variables for Public Hospitals

Constant	: 2.83	(a)
Daily Medical Visits	:-1.713	(*)
Exams	: .083	(*)
Exams Extreme Severity	: -.157	(*)
Exams Intermediate Severity	: -.007	

Dummy Variables for Public 1

Pharmacy	: .128	(*)
Pharmacy * Extreme Severity	: .223	(*)
Pharmacy * Intermediate Severity	: .045	

Dummy Variables for Public 2

Number of surgeons	: 2.154	(*)
Pharmacy	: -.053	(*)
Pharmacy * Extreme Severity	: .166	(*)
Pharmacy * Intermediate Severity	: -.004	

(*) t) .99; (**) t) .95; (^) t) .90

R2 = 77.36; Adj. R2 = 75.17; F = 35.27.
(a) Predefined constant terms.

On the other hand, one variable which showed no statistic difference between hospitals was the patient's age. As it was assumed the older the patient, the longer his stay at the hospital.

In Table IV.3 a different regression is presented. It differs from the preceding one just in a new dummy variable which takes the value 1 when the patient has state social security or no insurance at all but he stays at a public hospital. On the contrary it takes the value 0 in the case of patients that stay at private hospitals (no one has state social security in that case) and for those at public institutions who have FONASA health insurance. This dummy tries to capture the patient's socioeconomic effect over his stay being 1 for the poorest among the patients.

The new regression shows better R2, adjusted R2 and F test than the latter which proves the usefulness of adding the new variable. This one takes the positive value of 2.27 which is statistically significant and that shows the longer stay of the poorest among the patients. Unfortunately due to the exclusiveness of public hospitals in terms of poor patients it is not possible to determine the cause-effect relationship which is probably both side oriented: is the presence of poor patients the cause of longer stay at public hospitals or they stay more because they go to public hospitals?

TABLE IV.3

Dependent variable	: Length of Stay
Independent Variables	
Constant	: .000 (a)
Number of surgeons	: .825 (*)
Daily Medical Visits	:-.824 (*)
Patient's Age	: .029 (*)
Exams	: .043 (**)
Exams * Extreme Severity	: .011
Exams * Intermediate Severity	:-.006
Pharmacy	: .041 (*)
Pharmacy * Extreme Severity	:-.039 (**)
Pharmacy * Intermediate Severity	:-.001
Dummy relative Poverty	:2.270 (*)

Dummy Variables for Hospital PR3

Exams	: .238 (*)
Exams * Extreme Severity	:-.261 (*)
Exams * Intermediate Severity	:-.272 (*)
Pharmacy	:-.030 (^)
Pharmacy * Extreme Severity	: .194 (*)
Pharmacy * Intermediate Severity	: .139 (*)

Dummy Variables for Public Hospitals

Constant	: 2.83 (a)
Daily Medical Visits	:-2.562 (*)
Exams	: .080 (*)
Exams Extreme Severity	: -.149 (*)
Exams Intermediate Severity	: -.015

Dummy Variables for Public 1

Pharmacy	: .080 (**)
Pharmacy * Extreme Severity	: .241 (*)
Pharmacy * Intermediate Severity	: .071 (**)

Dummy Variables for Public 2

Number of surgeons	: 1.956 (*)
Pharmacy	: -.088 (*)
Pharmacy * Extreme Severity	: .163 (*)
Pharmacy * Intermediate Severity	: -.004

(*) t) .99; (**) t) .95; (^) t) .90

R2 = 79.11; Adj. R2 = 77.00; F = 37.45.
(a) Predefined constant terms.

IV.3. Department of Internal Medicine

In the case of the Department of Internal Medicine the basic model applied to explain the patient's length of stay included the following variables besides the constant term: daily medical visits, patient age, exams, pharmacy, and slopes for these two latter variables differentiated according to four levels of illness severity. Econometric results are presented in Table IV.4. Even though the Chow test allows to pool the data from public hospitals, the same was not possible with respect to private hospitals.

A second model was applied which included dummy variables to differentiate intercept for three specific illnesses, the most frequent in this service: cardiovascular, respiratory, digestive. The results are presented in Table IV.5. In this case, it is possible to group all hospitals but establishing several differences between them. Two private hospitals show a higher coefficient for the variable daily medical visits than the other private and one of them has higher intercept and pharmacy coefficients. On the other hand, the public hospitals show a very high intercept, a higher coefficient for daily medical visits plus other differences which deserve some analysis.

It is interesting to note that while the exams variable has no statistical significance for the private hospitals, it implies a longer stay for two levels of severity at public hospitals. Besides, the intercept for digestive illnesses is half of that for the public hospitals as a whole, but still higher than the corresponding one of the private's (which is not significantly different from zero in the case of PR1 and PR2, and equal to 3.39 in the case of PR3).

These findings would suggest the same hypothesis with respect to daily medical visits mentioned in the past section. The hospital PR2 which on average shows the highest medical intensity has the lowest coefficient on daily medical visits and that slope grows as long as we approach the public hospitals that on average have lower medical intensity. Furthermore, the presence of diagnostic exams carried on while the patient is staying at public hospitals means more days of stay. The variable pharmacy with different slopes according to illness severity shows a negative value (statistically significant) in the case of extreme severity in public hospitals. That figure has no interpretation for us. (1) With respect to patient's age, no significant difference between hospitals was found.

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(1) A high correlation coefficient between this variable and its corresponding to exam might be producing some degree of multicollinearity.

TABLE IV.4

Department of Internal Medicine
Dependent Variable: Length of Stay

Independent Variables \ Hospital	PRIVATE 1	PRIVATE 2	PRIVATE 3	PUBLIC HOSPITALS
C	5.51 (*)	1.23	6.37 (*)	9.73 (*)
Daily Medical Visits	-2.57 (*)	-.547 (*)	-2.18 (*)	-3.34 (*)
Patient's Age	.018	.021	.05 (*)	.04 (^)
Exams	.004	.018	-.005	.023 (*)
Exams * Extreme Severity	.012	-.004	-.135 (^)	.04 (**)
Exams * Intermediate Severity	-.022	.008	.013	-.016 (**)
Exams * Less Severity	.089(*)	-.005	-.043	.06 (*)
Pharmacy	.019	.601 (*)	.14 (^)	.124 (*)
Pharmacy * Extreme Severity	.101(**)	-.515 (^)	.25 (^)	-.094 (^)
Pharmacy * Intermediate Severity	.131 (*)	-.435(**)	-.11	.054
Pharmacy * Less Severity	-.135 (^)	-.467(**)	.004	-.032
R2	80.06	90.63	55.18	46.96
R2 Adjusted	73.63	86.56	50.18	41.31
F Test	12.45	22.26	7.83	8.32

Finally, a proxy variable for patient socioeconomic level was included (this is the same dummy variable also included in surgery). The results are shown in Table IV.6.

TABLE IV.5

Department of Internal Medicine

Dependent variable : Length of Stay

Independent Variables		Dummy Public Hospitals
Constant Term	: 2.47	8.[illegible] (*)
Daily Medical Visits	: -.775 (*)	-3.[illegible] (*)
Patient's Age	: .033 ( )	.03
Dummy Cardiovascular	: -.135	-3.[illegible]
Dummy Respiratory	: -.113	-.39
Dummy Digestive	: -.681	-4.37 (**)
Exams	: .024	-.054
Exams * Extreme Severity	: -.088	.068 (**)
Exams * Intermediate Severity	: -.048	-.01[illegible]
Exams * Less severity	: -.013	.080 (**)
Pharmacy	: .083	.111 (**)
Pharmacy * Extreme Severity	: .130 (**)	-.241 (*)
Pharmacy * Intermediate Severity	: .071 (**)	.055
Pharmacy * Less severity	: .109	-.181 ( )

Hospital PR1 and PR3

Dummy Daily Medical Visits : -1.111 (**)

Hospital PR3 (Dummies)

Constant Term	: 3.39 (*)
Pharmacy	: .137
Pharmacy * Extreme Severity	: -.038
Pharmacy * Intermediate Severity	: -.22 (^)
Pharmacy * Less severity	: -.196

(*) t > .99; (**) t > .95; (^) t > .90

R2 = 69.47; Adj. R2 = 64.22; F = 13.24.

TABLE IV.6

Department of Internal Medicine

Dependent variable : Length of Stay

Independent variables			Dummy Public Hospitals	
Constant Term	: 2.47		4.02	()
Daily Medical Visits	: -.773	*	-2.65	(*)
Patient's Age	: .033		0.04	(^)
Dummy Cardiovascular	: -.135		-1.98	
Dummy Respiratory	: -.113		-0.88	
Dummy Digestive	: -.681		-3.82	(**)
Exams	: .034		-.004	
Exams * Extreme Severity	: -.083		.060	(**)
Exams * Intermediate Severity	: -.002		-.007	
Exams * Less severity	: -.013		.078	(*)
Pharmacy	: .063		.109	(**)
Pharmacy * Extreme Severity	: .131	**	-.216	(*)
Pharmacy * Intermediate Severity	: .051	**	-.039	
Pharmacy * Less severity	: .109		-.184	(^)
Dummy relative Poverty	: 4.15	*		
Hospital PR1 and PR3				
Dummy Daily Medical Visits	: -1.111	**		
Hospital PR3 (Dummies)				
Constant Term	: 3.39	*		
Pharmacy	: .137			
Pharmacy * Extreme Severity	: -.038			
Pharmacy * Intermediate Severity	: -.88			
Pharmacy * Less severity	: -.138			
Dummy relative Poverty	: 4.15	*		

(*) t) .99; (**) t) .95; (^) t) .90

R2 = 71.02; Adj. R2 = 65.87; F = 13.77

The variable is positive and statistically significant. Besides, it absolute value is very high, specially if it is understood as days of stay. This fact, as it was mentioned in the case of surgery, shows that at public hospitals the low income patients stay longer than the others.

V. SOME POLICY CONCLUSIONS

The analysis of the five hospitals show almost definitely that productivity in surgery and internal medicine is lower in public hospitals compared with private institutions as long as length of stay is taken as a proxy measure of productivity (its inverse).

Further analysis must be made and hopefully with a larger sample that allows for both generalization at hospital level and the study of specific main diagnosis in order to determine more precisely the causes of this difference. The advantage of the kind of sample used in this research is that it allows the analysis of a whole service in each hospital. But its disadvantage is its size which does not permit a more precise study of main diagnosis. The case mix heterogeneity in each clinical service between hospitals -due to the different medical procedure that each specific illness demands-, constitutes a problem for the adaptiveness of the model for hospital productivity outlined previously. Therefore, even though there exits a benefit since it is possible to derive conclusions with respect to global productivity some doubts remain in terms of the influence of the different hospitals' case mix over the value of specific coefficients.

Apart from that, the hypotheses behind the model are mostly supported by the empirical findings.

The variable patient's age, except for the service of obstetrics and gynecology, the presence of diagnostic exams and illness severity (expressed through pharmacy and in surgery also through the number of surgeons) show positive and statistically significant coefficients with respect to the length of stay. The same happens with the dummy for relative poverty when used in the equations. On the other hand, the labor input measured through daily medical visits shows a negative and statistically significant coefficient with respect to length of stay.

The hospital comparison was done trying to pool together those cases which were present simultaneously in each clinical department of all hospitals. This meant the exclusion of those cases that were absent in some of the five hospitals in surgery and internal medicine. Under these conditions the hospital productivity model was tested in each of the clinical service and for each hospital. After several analyses and applying the Chow test for the acceptance of the null hypothesis the data were pooled together and the results were presented in Chapter IV. While in the department of Obstetrics and Gynecology no important difference was proved

between private and public hospitals, in the other two clinical departments several differences arose.

In the first place, a higher (negative) coefficient for the variable daily medical visits in public hospitals. This finding is interpreted as the lower productivity attained at public hospital due to lower medical intensity measured daily by patient. If it is assumed as usual that labor productivity grows at a decreasing rate, then this finding would suggest that increasing daily medical visits approaching the private hospital pattern would make possible to increase public hospital performance.

In the second place as long as the presence of diagnostic exams implies a longer stay and since at public hospitals the evidences generally show higher coefficients for that variable, the policy suggestion is to implement at public hospitals a more efficient system of ambulatory diagnostic exams, technologically and administratively speaking. From the point of view of the procedures done to patients it could be seen that the public hospitals are among those where more diagnosis exams are performed. This tends to confirm that people arrive to private hospitals with this stage already done what is verifies by the way in the lowest pre-surgical length of stay at the department of surgery.

Finally, the value that takes the dummy variable "relative poverty" tends to support the hypothesis stated at chapter II. In that sense it is convenient that convalescence beds be considered for public hospitals in terms of policy design. In that way the hospital potential capacity can increase with lower investment and less variable costs per patient compared to new hospital beds. In fact, these discharge premises with a less sophisticated staff would lead to more beds available per day and would assure recovery periods under proper care and at lower costs per patient.

There are some specific cases in which possible suggestion arise in relation to particular medical problems.

(a) Comparison between some averages of stay of public and private hospitals as in the case of cancer -unfavourable for the public hospitals (11.25 days versus 5 days)- necessarily leads to conclude and recommend particular policies that may improve the level of diagnosis and treatment as an out-patient for these patients. In this area there exists modern means for advanced diagnosis and efficient treatment that promote a reduced use of hospital resources. Collaboration of the community in this kind of problems through intermediate institutions between the hospital service and the patient must be promoted.

(b) By analysing the statistics for obstetrics and gynecology of public hospitals, abortion appears as an important cause of hospital leaving. This means that somehow policies of family planning are not reaching one of their main objectives declared in a country like Chile.

Two additional comments must be included in these final remarks. Firstly, the analysis of Chilean public hospital financing system (described in Annex 4) seems to be convenient because the system does not probably contribute to more productivity. This system pays the hospitals according to medical actions but not for specific diagnosis cases (like the U.S. D.R.G.'s ones). There exists no incentive in such a system to look for the optimal set of medical actions in order to cure the patient in the most efficient possible way either in medical terms or economic terms. Therefore, hospital efficiency in all its dimensions rests exclusively on the hospital administrators' habilities, the physicians' ethics and proficiency (as well as those of the paramedical personnell), and on the pressure that demand imposes over each institution.

Secondly, it must be said what would it mean to have more free beds per day from the point of view of more potential discharges that could take place. If the occupancy rate is assumed constant, a 10 percent fall in the patients' stay would enable more than 10 percent of increase in the assisted patients. This, expressed in terms of discharges in 1982 from public hospitals, would mean 114.000 additional potential hospital admissions. That figure does not surprise if the evolution of discharges and the average length of stay in Chile since 1919 is examined. In this case a great correlation is established. As a matter of fact, length of stay together with the availability of hospital beds satisfactorily explain the historical evolution of patient discharges in Chile (see Annex 2). Consequently, measurements that reduce the average length of stay might be of crucial importance and can be highly considered as alternative to new investments in hospital construction.

ANNEX 1 SEVERITY CRITERIA

In order to study the eventual correlations between level of illness severity and patient length of stay, some medical criteria of grouping diagnosis were formulated. This grouping was based on the first diagnosis written by the physician on the patient's clinical card. No further diagnosis was considered up to this point. Groupings were designed for surgery and medicine.

Severity of surgical interventions:

EXTREMELY SEVERE	Cardiac, great vessels, thorax, grand intestinal resections.
VERY SEVERE	Biliary duct, gastrectomy, hip replacement, prostatectomy, hysterectomy, breast extirpation, vagotomy, laryngectomy.
LESS SEVERE	Safenectomy, Rectal polypectomy, Appendectomy, fracture corrections, low urinary tract, hernias, eye, tubal sterilization.
SIMPLE	Abscesses and cysts (skin), minor fractures, tonsillectomy, plastic surgery of nose and external ear, endoscopy and laparoscopy, simple biopsies.

Severity in Internal Medicine:

EXTREMELY SEVERE	Sepsi, Myocardial Infarction, Vascular brain stroke, Cardiac failure, Digestive tract bleeding, Arterial thrombosis, Acute pulmonary edema, hipoglicemic coma, etc., aortic aneurysm, leukemia, pancreatitis, respiratory failure, cardiac arrest, convulsions, etc.
VERY SEVERE	Neumonia and bronchipneumonia, Nefritis, cardiac rythm disorders, TBC, Neumothorax, intoxications, bronchial asthma, gastric and duodenal ulcer, coronary vascular disease, renal failure, dehydration, intestinal occlusion, endocarditis, etc.

LESS SEVERE — Rheumatoid arthritis, diabetes mellitus, chronical bronchitis, Arterial hypertension, Anemia, Hepatitis, pulmonary atelectasic, livercirrhosis, gastritis, diverticulisis, hyperthyroidism, icterícia, obstructive jaundice, otitis, multinodular goiter, acute diarrhea, etc.

Unavoidably, classification at this stage is arbitrary, since there are some diagnosis that can have in themselves different levels of difficulties.

Levels of severity compared in 5 hospitals.
(Internal Medicine and Surgery)

Hospital / Level	PR1 %	PR2 %	PR3 %	PUB1 %	PUB2 %
Simple	44 (36.6)	46 (43.3)	51 (31.5)	44 (26.2)	49(40.5)
Less Severe	35 (29.1)	37 (27.6)	50 (30.8)	56 (33.3)	40(33.0)
Severe	41 (34.3)	51 (38.1)	61 (37.7)	68 (40.5)	32(26.5)
Total cases	120	134	162	168	121

From this classification it can be said that hospital PUB1 is the one having more severe cases (50.5%), followed by PR2 (38.1%) and PR3 (37.7%). PUB2 is the opposite case with the highest percentage of simple cases (40.5%). The private hospitals studied have excellent Departments of Intensive Care where they assist the most severe cases. This could explain its relatively lower percentage of extreme cases.

ANNEX 2

Relationship of discharges with lengths of stay and hospital beds.

ln hospital discharges	C	ln Average LOS (days)	ln Beds	R2
	-2.486	-.907	1.09	99.7

(all t > .995)

Data Employed

Year	Average L.O.S. (days) (a)	Number of beds (a)	Hospital (a) Discharges	Estimated Nr. of Dis.
1919	21.2	10.715	131.800	131.582
1929	20.9	14.516	187.100	185.727
1939	19.7	21.680	290.100	303.760
1949	17.8	27.590	428.800	433.413
1960	13.8	30.425	666.300	607.669
1970	11.4	35.932	869.800	866.828
1973	10.9	37.202	922.600	937.775
1979	9.4	37.686	1.055.200	1.088.994

(a) Fuente: E. Medina, "Factores que condicionan la eficacia del sistema de salud", en: Desarrollo Social y Salud en Chile, H. Lavados ed., CPU, 1982.

ANNEX 3: SAMPLE AND METHODOLOGY

The area of study was delimited in the end to five hospitals due to restraints of the centralized public sector. The five hospitals were 3 private and 2 public establishments (the latter of decentralized administration) (1).

Three public hospitals denied permission to survey their patients. According to their characteristics they are big and general hospitals.

Service: / Hospital	Medicine	Surgery	Obstetrics	Other	Total Number of beds
Hospitals Studied:					
PR1	multipurpose beds				180
PR2	multipurpose beds				120
PR3	multipurpose beds				80
PUB1	80	107	159	568	914
PUB2	41	68	49	49	207
Hospitals not studied:					
PUB3	107	182	302	464	1055
PUB4	64	107	224	385	780
PUB5	72	72	131	92	367

A determined number of patients was surveyed in each hospital by taking the information from their medical and administrative records.

(1) Public centralized hospitals are managed by personnel depending on the central level. In this case, one is of public property administrated by a non-profit Corporation and the other is property of a private foundation that receives public funds to assist patients who benefit from the Government.

(2) For analytical purposes, gynecological cases which in private hospitals often appear under surgery and medicine, are later re-grouped under obstetrics and gynecology.

Sample

Therefrom a number of precise cases per clinical service was taken. The next Table shows hospitals and number of cases surveyed by service.

Medical service Hospital	Obstetrics and gynec.	Surgery	Internal Medicine	Neonatology	Total
Private1	70	70	50	14	204
Private2	53	86	48	0	187
Private3	68	105	57	0	230
Public1	103	104	64	30	301
Public2	61	70	51	33	215

The patients were selected according to the clinical department they belonged and without any other criterion but admission order.

Survey

A survey was designed and distributed together with an Instruction Manual among the officials for statistics in each hospital. They were instructed about the way of writing down the information and completing the assigned number of cases by service.

The patient's identification required was: sex, age, district of residence, education, activity, social security system and characteristics of the Chief of home.

The information referring the hospitalization was: number of medical visits, exams and processes; surgical interventions, type, amount of previous days, urgency, hours of duration of the surgical intervention; pharmacy, unitary dosage per drug; discharge diagnosis; length of stay and patient's state at the moment of discharge.

ANNEX 4: PAYMENT MECHANISMS FOR HOSPITALS

The Chilean Experience

Procedures by which resources are allocated to hospitals seems crucial in terms of cost control in the health services.

Traditionally in Chile, public hospitals were assigned a budget in annual terms according to a plan of medical activities. This budget was given in monthly quotas from the central government. This system was criticized because planned budget went short at month Nr. 10 or 11 of the year and hospitals needed supplementary money.

Since 1978 a new mechanism was established by the Ministry of Health (1). This mechanism, called "Facturación por acciones prestadas" (F.A.P.), instructs hospital administrations to list medical actions, multiply by a given price, and total all in order to charge the Fondo Nacional de Salud (FNS) monthly. It represents the first attempt to correlate productivity and financing. The main problem though, was that prices were fixed by FNS on exclusively administrative basis and were considered low and unrealistic by experts. Over the whole of public hospital expenses this system went progressively to account for more or less 30-35% being the rest basically pay-roll, which was paid directly by FNS to hospitals.

Since January 1985, the FAP system for public hospitals has been modified in the following aspects.

- Prices are equivalent to level one of FNS in its "Arancel de Medicina Curativa" (2).
- After totalling all medical actions done in the previous month, some important deductions are made:
  a) Cost of pay-roll
  b) Depreciation of building and equipments
  c) All other direct fundings done by FNS to the hospitals.

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(1) Bize, Ricardo: "Mecanismos y Procedimientos de Operación del Fondo Nacional de salud", en H. Lavados "Desarrollo Social y Salud en Chile, 3a. Parte, CPU, Santiago, 1982.

(2) Price list constructed according to a cost study done in 1982 of most of medical actions, over 1000, used to pay medical bills of FNS "Medicaid" patients (+/- 25% of Chilean population).

Preliminary reports say that this new system has led most of Chilean hospitals to deficitary results.

DRG System in the U.S.

Diagnostic Related Groups is a new third-party payment system being established in the U.S. This means according to Pointer & Ross (1):

> "Unit of payment from services to specifically defined products or diagnosis-related groups of illnesses. Second, the basis of payment is shifting from costs or charges, to established payment rates. Third, payments increasingly will be determined prospectively -that is, before care is delivered- rather than retrospectively, or after service is given".

DRGs are 467, grouped in 23 major diagnostic categories (MDC), all following the International Classification of Diseases (ICD) established according to the organ or system of the body involved.

Each DRG has a price assigned, and each patient correspond to a given DRG according to its sex, age, principal diagnosis, secondary diagnosis, procedures performed and discharge status. The price is calculated on the base of the average cost for a Medicare discharge multiplied by a weighted DRG.

Incentives and the Funding System

The payment systems for hospitals leads to some considerations on incentives and productivity.

In the Chilean case, it was said, funding is being done by fixed government paid salaries for professionals and auxiliary personel together with cost per service financing. This system implies little or no incentives for manpower and important incentive to increase the number of services given per case. The meaning of this two mechanisms is to have no relation with the outcome of patients admitted to hospitals.

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(1) Pointer D.D. & Ross M.B.: "DRG, Cost per case management", Modern Health Care, February 15, 1984.

In the long run, doctor's conscience and moral status (1), and demand pressure will be the only parameters to influence the efficiency of public hospitals.

DRG system being implemented in the USA seems to be a more rational approach to the problem because it gives a reasonable incentive to medical efficiency, with the complexity and implications of the problem of dealing with human lives and sufferings.

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(1) Together with the quality of administration and the amount of pressure given by the demand for services.