Annals of Public and Cooperative Economics (2004), 75(4): 549-573

Efficiency and Program-Contract Bargaining in Spanish Public Hospitals

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Abstract

This paper analyses the evolution of productivity in Spanish public hospitals during the period characterised by the use of program-contracts. The results demonstrate that a significant improvement has occurred. The decomposition of the Malmquist productivity index shows that efficiency change has been the main contributor to productivity improvement. We also analyse the dynamic implications of program-contract bargaining. In particular, the data support the hypothesis that the bargaining process has been subject to a ratchet effect, i.e., the more a hospital does today, the more the hospital is asked to do in the future. This result threatens the credibility of the program-contract as an incentive system.

JEL classification: C61, D24, I18.

Key words: Malmquist productivity indexes, DEA, health, hospitals, ratchet effect

ACKNOWLEDGEMENTS

The authors gratefully acknowledge the helpful comments received from the Editor and two anonymous referees.

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Eficiencia y Negociación de los Contratos-Programa en Hospitales Públicos Españoles

Resumen

Este artículo analiza la evolución de la productividad de una muestra de hospitales públicos españoles durante el periodo caracterizado por la utilización de los contratos-programa. Los resultados muestran que se ha producido una mejora significativa. La descomposición del índice de productividad de Malmquist muestra que el cambio en eficiencia ha supuesto la principal contribución al incremento de productividad logrado. Se han analizado también las implicaciones dinámicas de los procesos de negociación de los contratos-programa. Concretamente, los datos soportan la hipótesis de que el proceso de negociación ha estado sujeto a un efecto trinquete, es decir, cuanto más actividad realiza un hospital hoy más se le pide que haga en el futuro. Este resultado compromete la credibilidad de los contratos-programa y su utilidad como sistema de incentivos.

Clasificación JEL: C61, D24, I18.

Palabras clave: índices de productividad de Malmquist, DEA, sanidad, hospitales, efecto trinquete

1. Introduction

The objective of this paper is to analyse the evolution of productivity in the Spanish health system during the period characterised by the introduction and implementation of *program-contracts*. Program-contracts were created to regulate the hierarchical relationship between the Spanish national health administration, *Insalud*, and each public hospital in their capacity as providers of health services. This managerial instrument was introduced in 1992 as a mechanism capable of improving efficiency in the provision of health services and went out of use in 1997. As a managerial tool, it was expected to induce a fundamental change in the structure of the health system, as it clearly tried to separate production and payment responsibilities, providing the hospitals with increased autonomy.

Program-contracts were negotiated annually and individually between each hospital and Insalud. The document explicitly determined the services portfolio of the hospital, production targets—as quantified by UPAs (weighted service units) and other services—and a budget, which was determined by applying certain service rates to production targets. The objective was to establish a prospective payment system, based on contracted activity targets. However, this goal was never reached in practice, as the final budget would always cover the total expenditure of the hospital. Furthermore, the contract was just a legal fiction; it could not be legally enforced because both parties belong to the same Administration (Cabasés and Martín, 1997). In fact, program-contracts incorporated the logic of a management by objectives strategy, i.e., decision authority is decentralised once the targets have been clearly specified.

The achievements of the program-contracts system can be briefly summarised as follows: 1) the exhaustive information gathered in the program-contracts contributed to a significant improvement of the information system—today it is possible, for example, to make direct comparisons between hospitals—, 2) it enabled a stronger budgetary control, 3) the bargaining and commitment implicit in the program-contract system promoted organisational learning and a cultural change at all levels of the health system, and 4) it led to increased levels of efficiency in the use of resources, as will be shown later in this paper. Among the weaknesses of the system, we can highlight the following: 1) a fundamental contradiction existed between the legal constraints typical of a bureaucratic structure and the transfer of residual decision rights to the hospitals, and 2) as an incentive system, the program-contract suffered a severe credibility problem, as the incentives attached to the accomplishment of the contract were ambiguous.

The paper is organised as follows. First we examine the temporal evolution of productivity in the Insalud hospitals from 1993 to 1996. We compute Malmquist productivity indexes and decompose them into four sources of variation: pure efficiency change, scale efficiency change, technical change and the scale change of the technology. Then, the existence of a ratchet effect on the sequential bargaining of the program-contracts is empirically tested. Concluding remarks are provided in the last section of the paper.

2. Productivity change during the program-contracts period

The establishment of program-contracts notably improved the availability of information about the use of resources by the Spanish public hospitals. These data can be used to assess the evolution of productivity indexes during the period characterised by the introduction and implementation of program-contracts. The computation of efficiency and productivity indexes involves comparing observed production practices with best production practices. There are several techniques that allow this comparison to be made, and generally involve either the econometric estimation of a (best practice) production frontier or the non-parametric estimation of a (best practice) production frontier. The former requires the estimation of the parameters of a functional form established *a priori* for the frontier, while the latter uses linear programming to measure the distance from the observed practices to the envelope of the best practices observed. In this paper we apply the non-parametric Data Envelopment Analysis (DEA) approach due to its ability to deal with multiple inputs and outputs and to separate pure technical inefficiencies from scale inefficiencies.

To compare the efficiency scores between subsequent time periods we will compute Malmquist productivity indexes. We will then decompose these indexes into the sources of productivity change, namely efficiency change and technical change. Several different decompositions of the Malmquist productivity index have been proposed in the literature. The most commonly used are Färe, Groskopf, Norris, and Zhang (1994), which assumes a constant returns to scale technology, and Ray and Desli (1997), which does not impose this assumption. A third decomposition was suggested by Simar and Wilson (1998), and Zofío and Lovell (1998), which extends the Ray and Desli (1997) decomposition. In particular, the technical change component in Ray and Desli (1997) is further decomposed into "pure" technical change of the frontier plus a residual measure of the scale change of the technology. This residual measure evaluates the separation between the constant returns to scale and the variable returns to scale technologies. In this paper, we will follow the extended decomposition of Simar-Wilson-Zofío-Lovell because it adds more information about the sources of productivity change.

The Malmquist productivity index was introduced by Caves, Christensen, and Diewert (1982) as the ratio of two distance functions pertaining to distinct time periods[1]. The productivity level of a decision making unit (DMU) may be measured by the relationship between the inputs employed and the outputs attained. In the case of a technology with just one input and one output, a simple productivity index can be computed using just quantity data as the ratio y_i^t / x_i^t, where y_i^t is the quantity of output produced by hospital i at period t and x_i^t the quantity of input employed by that hospital during the same period.

A difficulty arises with multidimensional production technologies, which involve comparing vectors of inputs and outputs. In these cases it is necessary to use some criterion to aggregate inputs and outputs. The resulting productivity index can be defined as $g^t(\mathbf{y}_i^t)/h^t(\mathbf{x}_i^t)$, where $g^t(\mathbf{y}_i^t) = \mathbf{u}^t \mathbf{y}^{t\,\prime}$ is an output aggregating function, with $\mathbf{u}^t$ being a weighting vector, and $h^t(\mathbf{x}_i^t) = \mathbf{v}^t \mathbf{x}^{t\,\prime}$ is an input aggregating function, and $\mathbf{v}^t$ a weighting vector. But how should the weights in the aggregating functions be chosen? An obvious possibility is to use the prices of inputs and outputs. However, it is not really necessary to use price data to compute a total factor productivity index. The Malmquist productivity index computes total factor productivity from the quantities employed of inputs and the quantities obtained of outputs. It is constructed as a ratio between distance functions and the computation of those distance functions implicitly generates appropriate weights for inputs and outputs.

Given that distance functions are computed by comparing one DMU and another DMU that acts as referent or benchmark, we must define a relative productivity index as the ratio between the absolute productivity index of the DMU that is being evaluated and the absolute productivity index of the benchmark DMU. This relative productivity index (*RP*) can be defined as:

$$RP_i^t = \frac{g^t(\mathbf{y}_i^t)/h^t(\mathbf{x}_i^t)}{g^t(\mathbf{y}_*^t)/h^t(\mathbf{x}_*^t)} \qquad [1]$$

where the symbol * represents the DMU that attains the highest ratio of absolute productivity, i.e. the benchmark DMU. Note that the relative productivity index of the benchmark DMU must take a value of one, whereas the other DMUs will have relative productivities of less than one.

It is possible to compute the *RP* index using distance functions (Shephard, 1953), but we must first formulate some assumptions about the production technology, namely constant returns to scale (i.e. first degree homogeneity) and separability of inputs and outputs. The output distance function is defined with respect to that technology as[2]:

$$DC_i^t(\mathbf{x}_i^t, \mathbf{y}_i^t) = \min\left\{\theta : (\mathbf{x}_i^t, \theta^{-1}\mathbf{y}_i^t) \in T_{CCR}^t\right\} \qquad [2]$$

where T_{CCR}^t represents the CCR technology, which satisfies the assumptions in Charnes, Cooper, and Rhodes (1978) of constant returns to scale (CRS) and free disposability of inputs and outputs. The distance function indicates the proportion to which the output vector should be expanded, holding the input vector constant, in order to obtain the productivity level of the benchmark DMU. As such, it is a measure of relative productivity. The value of the inverse of the distance function for a hospital can be computed by solving the following linear program:

$$1/DC_i^t(\mathbf{x}_i^t,\mathbf{y}_i^t) = \min \quad \frac{\mathbf{v}^t \mathbf{x}_i^{t\,\prime}}{\mathbf{u}^t \mathbf{y}_i^{t\,\prime}}$$

$$s.a \quad \frac{\mathbf{v}^t \mathbf{x}_j^{t\,\prime}}{\mathbf{u}^t \mathbf{y}_j^{t\,\prime}} \geq 1 \quad , \quad j \in J \qquad [3]$$

$$\mathbf{u}^t, \mathbf{v}^t \geq 0$$

where J represents the set of DMUs used to construct the empirical reference technology and which are generically denoted with the subindex *j* to distinguish them from the DMU that is being evaluated, i. The program finds the weights that maximize the relative productivity of DMU i. The objective function measures the distance that separates this DMU from the benchmark in terms of productivity. Thus,

$$RP_i^t = DC_i^t(\mathbf{x}_i^t,\mathbf{y}_i^t) \qquad [4]$$

The Malmquist productivity index introduced by Caves *et al.* (1982) measures the variation in the relative productivity of a DMU between two time periods, holding the reference production technology—i.e., the benchmark DMU—,

$$M_{CCD}^t = \frac{DC_i^t(\mathbf{x}_i^{t+1},\mathbf{y}_i^{t+1})}{DC_i^t(\mathbf{x}_i^t,\mathbf{y}_i^t)} \qquad [5]$$

Note that the only difference between the distance functions in the numerator and the denominator are the activity vectors of the DMU being evaluated. The benchmark technology is constructed in both periods from the data of period *t*. The same effect could be measured using the period *t+1* technology as the benchmark technology,

$$M_{CCD}^{t+1} = \frac{DC_i^{t+1}(\mathbf{x}_i^{t+1},\mathbf{y}_i^{t+1})}{DC_i^{t+1}(\mathbf{x}_i^t,\mathbf{y}_i^t)} \qquad [6]$$

To avoid choosing arbitrarily between taking the period *t* or period *t+1* technology as the reference to compute the Malmquist productivity index, the usual way to proceed is to take the geometric mean of both extreme indexes:

$$M_{CCD}(\mathbf{x}_i^{t+1},\mathbf{y}_i^{t+1},\mathbf{x}_i^t,\mathbf{y}_i^t) = \left[\frac{DC_i^t(\mathbf{x}_i^{t+1},\mathbf{y}_i^{t+1})}{DC_i^t(\mathbf{x}_i^t,\mathbf{y}_i^t)}\frac{DC_i^{t+1}(\mathbf{x}_i^{t+1},\mathbf{y}_i^{t+1})}{DC_i^{t+1}(\mathbf{x}_i^t,\mathbf{y}_i^t)}\right]^{1/2} \qquad [7]$$

If $M_{CCD}(\mathbf{x}_i^{t+1},\mathbf{y}_i^{t+1},\mathbf{x}_i^t,\mathbf{y}_i^t)>1$, the index reflects a productivity growth that may come from different sources. First, it is possible that the DMU improved its level of efficiency relative to the benchmark DMU—i.e., the hospital under evaluation improved more than the benchmark hospital—. This efficiency improvement of the DMU is commonly referred to as *catching up*. Second, the available technology may have improved—recall that we have fixed the technology—. This effect is known as *technical change*. Färe, Groskopf, Norris, and Zhang (1994) proposed the first decomposition of the Malmquist index to separate these two sources of productivity variation,

$$M_{CCD}(\mathbf{x}_i^{t+1},\mathbf{y}_i^{t+1},\mathbf{x}_i^t,\mathbf{y}_i^t)=\frac{DC_i^{t+1}(\mathbf{x}_i^{t+1},\mathbf{y}_i^{t+1})}{DC_i^{t}(\mathbf{x}_i^{t},\mathbf{y}_i^{t})}\left[\frac{DC_i^{t}(\mathbf{x}_i^{t+1},\mathbf{y}_i^{t+1})}{DC_i^{t+1}(\mathbf{x}_i^{t+1},\mathbf{y}_i^{t+1})}\frac{DC_i^{t}(\mathbf{x}_i^{t},\mathbf{y}_i^{t})}{DC_i^{t+1}(\mathbf{x}_i^{t},\mathbf{y}_i^{t})}\right]^{1/2}= \quad [8]$$
$$=\text{efficiency change}\cdot[\text{technical change}]=\Delta EF_i^{t,t+1}\cdot\Delta T_{CCR,i}^{t,t+1}$$

The first ratio in [8] reflects the relative efficiency change of the DMU evaluated—variation in the distance to its contemporaneous frontier—, while the second ratio (in brackets) shows the productivity change that can be attributed to a movement in the CCR (benchmark) frontier between periods *t* and *t+1*. Notice that even though this last component refers to technical change, it incorporates the subindex *i* because it is computed from the activity vectors of DMU *i*. Thus, the technical change index measures the movement of the frontier at the input level of the DMU that is being evaluated, and is defined as a geometric mean to avoid having to decide between periods.

The efficiency change index may in turn be decomposed into two indexes. One of them measures the change in pure technical efficiency—and must be computed with respect to the variable returns to scale (VRS) technology—, while the other one measures scale efficiency change. The VRS frontier has the advantage of providing a more appropriate treatment of heterogeneity that can be associated with hospital size, insofar as there may be important differences in productivity patterns among small, medium, and large hospitals. The VRS frontier provides, for each hospital, the best possible production vector that a hospital of that size can achieve. The index is computed as

$$DV_i^t(\mathbf{x}_i^t,\mathbf{y}_i^t) = \min\left\{\theta : (\mathbf{x}_i^t, \theta^{-1}\mathbf{y}_i^t) \in T_{BCC}^t\right\} \quad [9]$$

and is the output distance function defined with respect to the T_{BCC}^t technology that satisfies the assumptions in Banker, Charnes, and Cooper (1984)[3]. The BCC technology drops the CRS assumption, imposing only convexity. The BCC production set is said to satisfy variable returns to scale (VRS). We can compute a residual scale efficiency index by comparing the two distance functions defined above:

$$SE_i^t(\mathbf{x}_i^t,\mathbf{y}_i^t) = \frac{DC_i^t(\mathbf{x}_i^t,\mathbf{y}_i^t)}{DV_i^t(\mathbf{x}_i^t,\mathbf{y}_i^t)} \quad [10]$$

Thus,

$$\Delta EF_i^{t,t+1} = \frac{DC_i^{t+1}(\mathbf{x}_i^{t+1},\mathbf{y}_i^{t+1})}{DC_i^t(\mathbf{x}_i^t,\mathbf{y}_i^t)} = \frac{DV_i^{t+1}(\mathbf{x}_i^{t+1},\mathbf{y}_i^{t+1})\cdot SE_i^{t+1}(\mathbf{x}_i^{t+1},\mathbf{y}_i^{t+1})}{DV_i^t(\mathbf{x}_i^t,\mathbf{y}_i^t)\cdot SE_i^t(\mathbf{x}_i^t,\mathbf{y}_i^t)} = \Delta PE_i^{t,t+1}\cdot\Delta SE_i^{t,t+1} \quad [11]$$

The Malmquist index is finally decomposed into three indexes that measure pure efficiency change (relative to the VRS frontier), scale efficiency change (comparing the VRS benchmark with the CRS benchmark) and an index of technical change (that reflects the movement of the CRS frontier).

The Färe, Groskopf, Norris and Zhang (1994) decomposition can be pushed a step further by identifying two components in the index of technical change. Ray and Desli (1997) proposed a computation of technical change using the VRS instead of the CRS production set as the reference technology. The difference between the Färe, Groskopf, Norris, and Zhang (1994) and Ray and Desli (1997) indexes of technical change can be interpreted as a residual measure of the scale change of the technology. The latter index indicates whether the projection of the DMU onto the VRS frontier is now closer or farther from the projection onto the CRS frontier (i.e. the optimal scale), or in other words whether the VRS is more or less separated from the CRS technology than it was previously. This four-component decomposition of the Malmquist index was developed by Simar and Wilson (1998) and Zofío and Lovell (1998), and can be represented as follows:

$$M_{CCD}(\mathbf{x}_i^{t+1},\mathbf{y}_i^{t+1},\mathbf{x}_i^{t},\mathbf{y}_i^{t}) = \frac{DC_i^{t+1}(\mathbf{x}_i^{t+1},\mathbf{y}_i^{t+1})}{DC_i^{t}(\mathbf{x}_i^{t},\mathbf{y}_i^{t})}\left[\frac{DC_i^{t}(\mathbf{x}_i^{t+1},\mathbf{y}_i^{t+1})}{DC_i^{t+1}(\mathbf{x}_i^{t+1},\mathbf{y}_i^{t+1})}\frac{DC_i^{t}(\mathbf{x}_i^{t},\mathbf{y}_i^{t})}{DC_i^{t+1}(\mathbf{x}_i^{t},\mathbf{y}_i^{t})}\right]^{1/2} =$$

$$\frac{DV_i^{t+1}(\mathbf{x}_i^{t+1},\mathbf{y}_i^{t+1})}{DV_i^{t}(\mathbf{x}_i^{t},\mathbf{y}_i^{t})}\frac{SE_i^{t+1}(\mathbf{x}_i^{t+1},\mathbf{y}_i^{t+1})}{SE_i^{t}(\mathbf{x}_i^{t},\mathbf{y}_i^{t})}\left[\frac{DV_i^{t}(\mathbf{x}_i^{t+1},\mathbf{y}_i^{t+1})}{DV_i^{t+1}(\mathbf{x}_i^{t+1},\mathbf{y}_i^{t+1})}\frac{DV_i^{t}(\mathbf{x}_i^{t},\mathbf{y}_i^{t})}{DV_i^{t+1}(\mathbf{x}_i^{t},\mathbf{y}_i^{t})}\right]^{1/2}\cdot \qquad [12]$$

$$\left[\frac{SE_i^{t}(\mathbf{x}_i^{t+1},\mathbf{y}_i^{t+1})}{SE_i^{t+1}(\mathbf{x}_i^{t+1},\mathbf{y}_i^{t+1})}\frac{SE_i^{t}(\mathbf{x}_i^{t},\mathbf{y}_i^{t})}{SE_i^{t+1}(\mathbf{x}_i^{t},\mathbf{y}_i^{t})}\right]^{1/2} = \Delta PE_i^{t,t+1}\cdot\Delta SE_i^{t,t+1}\cdot\Delta T_{BCC,i}^{t,t+1}\cdot\Delta S_i^{t,t+1}$$

where the original index of technical change (in brackets) has been decomposed into an index measuring the technical change of the BCC frontier, $\Delta T_{CCB,i}^{t,t+1}$, and a second residual index reflecting the scale change of the BCC frontier, $\Delta S_i^{t,t+1}$, where $\Delta T_{CCR,i}^{t,t+1} = \Delta T_{BCC,i}^{t,t+1}\cdot\Delta S_i^{t,t+1}$. Zofío and Lovell (1998) interpret this fourth component as a bias of technical change with respect to scale, because it reflects a change in the optimal scale of the technology[4].

It should be noted that the distance functions that are used to compute the indexes of technical change with respect to the BCC technology do not necessarily have a bounded solution. This happens because the radial projection of the firm's input-output vector towards the BCC frontier of another period—$DV_i^t(\mathbf{x}_i^{t+1},\mathbf{y}_i^{t+1})$, for instance—does not necessarily belong to that frontier. In the cases where this happened in our empirical application, for output oriented unbounded solutions we changed the orientation of the distance function to an input distance function to get a bounded solution that approximates the real movement of the technology. This solution seems appropriate because the problem with the unbounded solution in the computation of the output distance function reflects the fact that the movement of the technology was an input reducing or augmenting movement relative to the previous period[5].

To estimate and decompose the productivity indexes we used data on inputs and outputs of 68 Insalud hospitals over the period 1993-1996. The inputs include human resources and capital. Human resources are measured by two variables: DOCTORS and REST OF STAFF. We used the input BEDS as a proxy for capital (Ley, 1993; González and Barber, 1996). It is not so clear how to define the output variables. The UPA variable seems to be a good candidate, as it is constructed as a weighted sum of health services. However, a large part of these are inpatient-days in different services. Thus, the UPA indicator can be large if a hospital has a large average inpatient-stay. However, as reducing the average inpatient-stay is one of the explicit goals of the program contract, we cannot consider that a hospital is doing much activity just because it does not accomplish the average inpatient-stay target[6].

There are two ways to overcome this problem. One is to use another output variable such as the number of admissions. The other is to adjust the UPA variable to discount the effect of a failure to accomplish the average inpatient-stay target. Basically, this Adjusted UPA variable is constructed taking into account the real number of patients and the contracted average inpatient-stay[7]. We decided to use this adjusted UPA measure, because it incorporates more output information than the number of admissions does. Additionally, there is some activity that, due to its complexity, is extracted from the UPA computation. To control for possible differences in these activities, our model includes a second output, VES (Value of Extracted Services), which accounts for the value given to these services in the program-contract. Some descriptive statistics of the input and output data are provided in Table 1.

<<<<<<<<TABLE 1 ABOUT HERE>>>>>>>>>>>

Table 2 shows the results of the efficiency analysis. We show the temporal evolution of the three efficiency indexes: global technical efficiency (DC), pure technical efficiency (DV) and scale efficiency (SE). Standard deviations are shown in brackets. The results show a notable improvement in the three indexes of efficiency over the period considered. They also show that there are still possibilities for further improvement.

<<<<<<<<TABLE 2 ABOUT HERE>>>>>>>>>>>

The decomposition of the Malmquist productivity index is shown in Table 3. The results reflect an improvement in total factor productivity of about 8.3% during the period 1993-1996. The largest improvement, 7%, occurred over the period 1995-1996. The decomposition of the Malmquist index can be used to shed light on the sources of productivity improvement. Efficiency improvement occurred mainly over the period 1994-1995. Both pure efficiency and scale efficiency contributed to productivity with an average of 3.5% and 4.2% respectively. More importantly, over 72% of the hospitals in the sample improved the levels of pure and scale efficiency during the period. The performance is even better if we consider that efficient hospitals could not increase efficiency (by definition) and are included in the other 28%. Thus, most hospitals that could improve their productive practices during the period actually did so. Technical change also contributed to productivity improvement (3.3%), with most of this improvement being concentrated in the last period of the sample (1995-1996). Conversely, the scale change of the technology negatively affected the hospitals in the sample. However, this negative change only affected 33% of the hospitals, a result that points to a non-neutral shift of the technology.

<<<<<<<<TABLE 3 ABOUT HERE>>>>>>>>>>>

To explore the possibility that efficiency change and technical change did not produce similar effects in all hospitals, we have divided the sample into four groups according to size and complexity. We have taken the groups in which Insalud classified the hospitals, and size/complexity increases with the group label. Thus, Group 1 hospitals are the smallest hospitals located in areas with low population and do not include all the services. Group 4 hospitals in turn are complex hospitals located in the biggest cities. Overall, Group 3 hospitals have experienced the lowest improvement in productivity, although the fact that they were the most efficient group in 1993 may partially explain this result. Group 1 hospitals were the least efficient in 1993 but show the largest improvement in productivity. To assess the significance of these differences we used the Kruskal-Wallis test instead of conventional Analysis of Variance, as DEA scores are not normally distributed (see Brockett and Golany, 1996; Sueyoshi and Aoki, 2001). The test reveals that no significant differences arise with respect to productivity improvement.

<<<<<<<<TABLE 4 ABOUT HERE>>>>>>>>>>>

However, the analysis does reveal important differences between groups regarding scale efficiency improvement. The largest and the smallest hospitals show large improvements in scale efficiency, while hospitals in groups 2 and 3 show no average improvements in scale efficiency. The results also confirm a non-neutral shift of the technology. Technical change had a greater effect on hospitals in groups 1 and 4, whereas the effect on average-sized hospitals has been negligible. The index of scale change of the technology also reveals a change that tends to compensate technical change, because it negatively affects hospitals in groups 1 and 4.

Taken together, these results offer a very positive evaluation of the achievements in the program-contract period. The improvement in efficiency scores is consistent with the trend registered during the period 1991-1993 (see González and Barber, 1996). The decomposition of the Malmquist productivity index shows that scale efficiency and technical change had a greater effect on hospitals in groups 1 and 4, which were precisely the hospitals that had a lower global efficiency in 1993.

3. Program-Contract bargaining and the ratchet effect

This section examines data on the accomplishment of the program-contracts in order to analyse its effect on the sequential bargaining of the activity targets. The logic behind the program-contract system was to allow for a larger degree of decentralisation and managerial autonomy within the hierarchical structure of Insalud, although Insalud retained the control of the system. The hospital was expected to accomplish the targets specified in the quasi-bargaining process, and Insalud retained all the residual decision rights in case of disputes. The program-contract system is similar to a management by objectives system.

A fundamental part of a management by objectives system is the development of an incentive system that associates rewards and penalties with the accomplishment of the targets previously established. However, incentives were never made explicit under the program-contract system—recall that the program-contract is a contractual fiction that is not legally enforceable—. In the absence of explicit incentive rules, expectations arise and adjust on the basis of cumulative experience from the results and consequences observed in practice. In the end, such expectations determine the credibility of the whole system. The temporal process that generates expectations is illustrated in Figure 1.

<<<<<<<<<<<<FIGURE 1 ABOUT HERE>>>>>>>>>>>>

A comfortable accomplishment of the target may increase the target established during the bargaining process for the following period (ratchet effect). Once this behaviour is evident to the hospital, the effort decision must balance perceived rewards against the risk of future penalties—i.e., when good accomplishment results in a more difficult target for the following period—. Cumulative consequences (rewards and penalties) determine the credibility of the system and the bargaining process is only important if the system is credible—i.e., if accomplishment has consequences for the organisation—. For example, the lack of credibility of the "threat" of linking the budget to activity became apparent in 1995. Credibility erosion impairs the whole bargaining process when it becomes obvious that contracted terms are not totally assumed by the parties[8].

3.1. Empirical model

The existence of a ratchet effect in the program-contract bargaining processes has been confirmed by Ventura and González (1998) using data on hospitals from the Spanish region of Asturias. This paper extends those results to the Spanish case, using data from 68 Insalud hospitals from 1993 to 1997. This allows panel data regression techniques to be used, which have the advantage of controlling for the unobserved heterogeneity. A panel data regression model can be expressed as:

$$y_{it} = \alpha_i + \delta_t + \beta \mathbf{x'_{it}} + u_{it} \qquad [13]$$

where y is the dependent variable, $\mathbf{x}$ the vector of explanatory variables, and u is the random error term. Subindexes i and t refer to individual and time period, respectively. The coefficients α_i are called individual effects, and capture the time invariant effect of unobserved characteristics of each individual on the dependent variable (unobserved heterogeneity). Similarly, the coefficients δ_t are called time effects, and capture the effect of period t which is common to all individuals.

Individual and time effects can be considered fixed parameters or random variables. Unlike the fixed effects model, the estimation of a random effects model rests on the assumption that there is no correlation between the effects and the explanatory variables. The appropriate model depends on the specific setting of the analysis. When the specific value of the effect of a hospital is of interest, then the fixed effects model is more appropriate[9]. Also, the Hausman (1978) test can be run to test the hypothesis of no correlation between the effects and the explanatory variables. In our case, the Hausman test rejected the hypothesis in all the models estimated, strengthening the case for choosing a fixed effects model[10].

The ratchet effect means that the better the accomplishment in one period, the larger the increase in the targets for the next period. The number of UPAs established in the program-contract provides a reasonable target variable for the empirical model. However, the number of UPAs is affected by other bargaining variables. A larger number of inpatient-stays implies a larger number of UPAs. In turn, the number of admissions and the average inpatient-stay together determine stays and therefore UPAs. Thus, a larger number of UPAs can be reached by increasing the number of admissions, the average inpatient-stay, or both variables.

It is reasonable to assume that the annual variation in the UPA target will depend not only on the previous accomplishment of the UPA target but also on the previous accomplishment of the average inpatient-stay target. The reason is that the real average inpatient-stay of the hospital may be taken as a reference value when establishing the average inpatient-stay target in the new program-contract. However, this policy would favour a poor accomplishment of the average inpatient-stay target, i.e., those hospitals who had a larger average inpatient-stay can be favoured with a larger average inpatient-stay target, and will thus be in a good position to accept a larger increase in the UPA target[11]. If this were the case, the *unaccomplishment* of the average inpatient-stay should be positively related to the variation in the UPA target—where the unaccomplishment level is defined as the percentage by which the real average inpatient-stay exceeds the average inpatient-stay target—.

For a similar reason, the unaccomplishment of the target ratio of successive to first walk-in medical visits should have a similar effect on the variation in the UPA target. Reducing the visits ratio and the average inpatient-stay are both explicit goals of the program-contracts[12]. A larger visits ratio would allow a larger number of UPAs to be reached with the same number of patients (first walk-in visits). Thus, if a large real visits ratio translates into a large visits ratio target for the following year, this should also increase the UPA target.

There are at least two ways to incorporate the former discussion into the empirical model. The first one is to introduce two explanatory variables controlling for the potential effect of the unaccomplishment of the visits ratio and the average inpatient-stay targets. The second solution is to use the number of admissions as the dependent variable. The ratchet effect would measure the effect of the accomplishment of the admissions target on the variation in the admissions target established in the following program-contract. The results should be similar, although the second model loses some program-contract information (e.g., emergencies target). We will estimate both models. Model A uses the UPA as the bargaining variable and Model B uses the number of admissions.

Furthermore, the variation in program-contract targets may also depend on the hospital's efficiency level. A very inefficient hospital could increase service production (and thus the target) more than a very efficient hospital, without an additional increase in input endowments. Thus, efficiency scores should be inversely correlated with variations in targets. However, the program-contract provides no information on the level of relative efficiency of the hospital. The variables available are partial productivity ratios. For this reason, we will also use productivity ratios of UPAs and Admissions per employee (Doctors and Rest of Staff). Summarising, we will employ the following variables:

MODEL A

UV_{it}	Percentual variation in the UPA target for hospital i between $t\text{-}1$ and t: $$\left(\frac{\text{Target UPAs(t) - Target UPAs(t -1)}}{\text{Target UPAs(t -1)}}\right)\text{x100}$$
UA_{it-1}	UPA target accomplishment for hospital i in period $t\text{-}1$: $$\left(\frac{\text{Real Adjusted UPAs(t -1) - Target UPAs(t -1)}}{\text{Target UPAs(t -1)}}\right)\text{x100}$$
ASU_{it-1}	Average inpatient-stay target unaccomplishment for hospital i in period $t\text{-}1$: $$\left(\frac{\text{Real Average Stay(t -1) - Target Average Stay(t -1)}}{\text{Target Average Stay(t -1)}}\right)\text{x100}$$
VRU_{it-1}	Visits ratio target unaccomplishment for hospital i in period $t\text{-}1$: $$\left(\frac{\text{Real Visits Ratio(t -1) - Target Visits Ratio(t -1)}}{\text{Target Visits Ratio(t -1)}}\right)\text{x100}$$
UD_{it-1}	Average number of Adjusted UPAs per doctor in hospital i in year $t\text{-}1$.
UR_{it-1}	Average number of Adjusted UPAs per rest of staff in hospital i in year $t\text{-}1$.
EF_{it-1}	Technical efficiency scores (DC, DV and SE scores)

MODEL B	
AV_{it}	Percentual variation in the Admissions target for hospital i between $t\text{-}1$ and t: $$\left(\frac{\text{Target Admissions(t) - Target Admissions(t -1)}}{\text{Target Admissions(t -1)}}\right)\text{x100}$$
AA_{it-1}	Admissions target accomplishment for hospital i in year $t\text{-}1$: $$\left(\frac{\text{Real Admissions(t -1) - Target Admissions(t -1)}}{\text{Target Admissions(t -1)}}\right)\text{x100}$$
AD_{it-1}	Average number of Admissions per doctor in hospital i in year $t\text{-}1$.
AR_{it-1}	Average number of Admissions per rest of staff in hospital i in year $t\text{-}1$.
EF_{it-1}	Technical efficiency scores (DC, DV and SE scores)

Figure 2 illustrates the causal relationships involved in Model A (Model B is similar). Dotted lines represent the causal relationships we want to estimate. For each period t, the period *t-1* UPA target (TUPA) and real adjusted UPAs (AdUPA: real UPAs adjusted by the target average inpatient-stay and visits ratio) determine the target accomplishment (UA). The ratchet effect implies a positive relationship between that variable (UA) and the variation in the UPA target (UV). Moreover, this latter variable (UV) is affected by the unaccomplishment of the average inpatient-stay (ASU) and the visits ratio (VRU) targets, by the efficiency (or productivity) score of the hospital, and by the unobserved heterogeneity which is captured by the fixed effects.

<<<<<<<<<<FIGURE 2 ABOUT HERE>>>>>>>>>

3.2. Accomplishment data

The variables defined above were computed for each hospital-year from 1993 to 1997 (68 hospitals observed over 5 years) from the program-contracts data and real activity data. These data form a 4-year panel because of the one-year lag in the explanatory variables. Table 5 shows the evolution of the accomplishment of the UPA target in the hospitals of the sample. The average number of real UPAs performed was 2% below the program-contracts target levels. Group 1 hospitals show a better accomplishment than the other groups. The temporal evolution is satisfactory in that a trend towards a perfect accomplishment (i.e., 0%) is observed. However, it is not easy to identify the causes of this trend. One possibility is that targets had adjusted towards the real accomplishment possibilities of the hospitals as a consequence of the bargaining experience acquired, which should have resulted in a better accomplishment. However, it should be noted that the general pattern was not to exceed the target established in the program-contract. From the 272 observations only 100 exceed the target, i.e., 37%.

<<<<<<<<<TABLE 5 ABOUT HERE>>>>>>>>>>>

A similar pattern is observed in the Admissions target accomplishment. On average, the Admissions target was exceeded by 1% in 1996.

<<<<<<<<<TABLE 6 ABOUT HERE>>>>>>>>>>>

The following tables show the percentual variation in the program-contract targets, where a positive pattern is observed. In almost all cases the program-contract has increased the targets between two successive contracts, with these increases becoming larger in the later years. Groups 1 and 2 suffered the largest increases in the UPA target, while the largest increase in the Admissions target is observed in groups 1 and 3.

<<<<<<<<<TABLES 7 AND 8 ABOUT HERE>>>>>>>>>>>

3.3. Empirical results

Four different specifications of Model A were estimated. The results are shown in columns 1-4 of Table 9. The estimated coefficients confirm the existence of a ratchet effect in the successive bargaining of program-contracts between 1993 and 1997. The coefficient of the accomplishment of the UPA target (*UA)* is positive and statistically significant in all the specifications of Model A. Thus, the better the accomplishment of the UPA target, the larger the increase of the UPA target in the following program-contract. The coefficients of the unaccomplishment of the average inpatient-stay and the visits ratio variables (*ASU* and *VRU*) are also positive and significant at conventional levels. This result confirms our expectations, suggesting that the information about the real average inpatient-stay and the real visits ratio is used in the program-contract bargaining process as a reference to set the average inpatient-stay and visits ratio targets. This may introduce a perverse incentive to increase the real average inpatient-stay in order to induce a larger average inpatient-stay target, and therefore less real activity in the following program-contract.

<<<<<<<<<TABLE 9 ABOUT HERE>>>>>>>>>>>

The coefficients of the efficiency and productivity variables—columns 2, 3 and 4—have negative signs. This was to be expected under the hypothesis that the program-contract would exert more pressure on the most inefficient hospitals. The result is significantly different from zero for global technical efficiency (DC) and for scale efficiency (SE). Pure technical efficiency (DV) does not seem to exert a significant influence on the bargaining process. With respect to simple productivity variables, only the coefficient of the average productivity of Doctors (*UD*) is significantly different from zero at conventional levels. This result may be due to correlation between the productivity ratios. There is a strong correlation (0.60) between the productivity of Doctors and the productivity of the Rest of the

Staff (*UR*), giving rise to a multicollinearity problem in column 4. When we estimate the model with only one productivity variable (*UR* or *UD*), its coefficient turns out to be negative and significant.

In order to test the robustness of the results, a second model was run. Model B takes the number of Admissions as the main bargaining variable. Again, four specifications of the model were estimated, and the results are shown in Table 10. The estimations confirm the results obtained with Model A. The accomplishment of the Admissions target (*AA*) has a positive and statistically significant coefficient in all the columns of Table 10, revealing the existence of a ratchet effect in the bargaining of this target. The efficiency and productivity variables show similar effects to those already discussed for Model A, although global efficiency (DC) turns to be non significant at conventional levels. Labour productivity (both *AD* and *AR*) has a negative and significant effect on the dependent variable. There is no significant effect of pure efficiency (DV) on the variation of the Admissions target, but we detect a significant influence of scale efficiency (SE). Overall, Model B produces a better fit than Model A (a larger R^2). This result may be indicative of the importance of the Admissions target in the program-contract bargaining process. Given the explicit objective of reducing the average inpatient-stay and the visits ratio, the only way to significantly increase activity is by increasing the number of Admissions.

<<<<<<<<<TABLE 10 ABOUT HERE>>>>>>>>>>>

4. Concluding remarks

The need to use resources efficiently is a commonplace to any reform in the public sector. The program-contract was devised as a managerial instrument capable of improving the global efficiency of the Spanish public health system, grounded in the idea of separating payment from production responsibilities. The results of this paper show that the global evaluation of the program-contracts period (1992-1997) is positive.

Program-contracts significantly improved the information system, which is a basic requirement of any control system. It contributed to a greater budgetary control and it promoted organisational learning and cultural change at all levels of the health system. The results of this paper show that total factor productivity has improved about 8% over the period analysed. Pure efficiency and scale efficiency contributed 3.5% and a 4.2% respectively. The decomposition of the Malmquist index reveals that technological change also affected the productivity of hospitals, but that the positive effect of technical change was offset by a negative scale change of the technology that affected large and small hospitals. Thus, the main improvement was due to managerial efficiency and we believe that program-contracts made a significant contribution in this regard.

One of the main drawbacks of the program-contract is its credibility as an incentive system, in that the accomplishment of the targets is not explicitly rewarded. Instead, we have shown that the sequential bargaining of the contracts incorporates a ratchet effect, i.e., the better the accomplishment, the larger the target in the succeeding program-contract. Taken together, the absence of explicit incentives and the existence of a ratchet effect erode the credibility of the system because the resulting implicit incentive does not promote a higher effort in the decentralised productive unit (the hospital). An increased level of managerial autonomy and a more explicit and clear incentive system are thus required in order to fully exploit the potential gains from decentralisation. The new legal figures introduced in 1997 by the *Ley de Habilitación de Nuevas formas de Gestión*, such as *Fundaciones Públicas Sanitarias*, can be thought of as a second step toward an effective and efficient separation of functions, although the changes introduced so far will only have a moderate effect.

NOTES

[1] The index took its name from Sten Malmquist, who had proposed the construction of quantity indexes based on distance functions (Malmquist, 1953). See also Moorsten (1961).
[2] Distance functions can be defined with an input or output orientation. In our empirical application we will choose an output orientation and we therefore explain the methodology with an output orientation. It is very easy to extend these results to an input orientation using the appropriate input distance functions instead of output distance functions. In the particular case of the constant returns to scale technology, the value of the distance function is the same for both orientations (Färe and Lovell, 1978).
[3] The linear programs used to compute this index can be found in Banker, Charnes, and Cooper (1984). Basically, the BCC program introduces an additional constraint to [3] that forces each DMU to be compared with other DMUs, or a composite unit, of a similar size. A more exhaustive treatment of the non-parametric approach to efficiency measurement and the properties of the different distance functions employed can be found in Färe, Grosskopf, and Lovell (1994).
[4] See Ray (2001) for a discussion of alternative interpretations of this component.
[5] We checked other possibilities for resolving the unboundedness problem such as substituting the unbounded value by 1 or omitting the observation that caused the problem in the computation of averages. We found that the average results reported did not vary significantly regardless of the treatment given to unbounded values.
[6] Having a patient in a bed may be considered output, but it is not desirable *per se* as more time may be used than is necessary to provide the health services that the patient requires.
[7] Adjusted UPAs are computed by taking into account the number of patients in each category of service and the contracted length of the stay. Then we multiply each stay by its UPA weight and add them up. Adjusted UPAs also adjust for the composition of clinic visits. The program-contract specifies a target ratio between first walk-in visits and rest of the visits. Adjusted UPAs are constructed on the basis of first walk-ins and the visits ratio target.
[8] This discussion does not include other potential effects of the program-contract. In fact, it has introduced many improvements in the system: information system improvements, measurement of costs by service, the possibility of direct comparisons between hospitals, and the development of an organisational culture of measuring outputs, inputs and results.
[9] See Greene (1993: pp. 479-480) for a deeper discussion about the differences between the fixed and random effects models.
[10] The fixed effects model can be estimated using the Ordinary Least Squares Dummy variables estimator or using the WITHIN estimator.
[11] This actually implies the existence of a ratchet effect in the average stay accomplishment.
[12] Thus, a large accomplishment value for these two variables should be interpreted as a poor performance.

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Table 1. Descriptive statistics

	Average	Standard deviation	Min	Max
Outputs				
UPA	249969	223668	31567	941370
VES	495.0	595.6	0	3687
Inputs				
BEDS	451.6	377.5	64	1499
DOCTORS	238.7	214.2	42	929
REST OF STAFF	1276.0	1194.4	220	5340

Table 2. Temporal evolution of technical and scale efficiency

Years	DC		DV		SE	
1993	0.804	(0.11)	0.879	(0.10)	0.916	(0.09)
1994	0.786	(0.11)	0.864	(0.10)	0.911	(0.08)
1995	0.871	(0.09)	0.913	(0.07)	0.955	(0.06)
1996	0.856	(0.09)	0.902	(0.08)	0.949	(0.05)
Average	0.829	(0.10)	0.890	(0.09)	0.933	(0.07)

Table 3. Decomposition of the Malmquist index

Period	M_{CCD}	$\Delta EP^{t,t+1}$	$\Delta SE^{t,t+1}$	$\Delta T_{BCC}^{t,t+1}$	$\Delta S^{t,t+1}$
1993-1994	1.015	0.987	0.997	1.021	1.014
1994-1995	1.000	1.064	1.053	1.012	0.946
1995-1996	1.070	0.990	0.995	1.035	1.002
1993-1996	1.083	1.035	1.042	1.033	0.979
s.d.	(0.15)	(0.12)	(0.09)	(0.10)	(0.06)
%>1	72.0	72.0	75.0	60.3	33.8

Table 4. Decomposition of the Malmquist index by size (1993-1996)

	N	*Beds*	M_{CCD}	$\Delta PE^{t,t+1}$	$\Delta SE^{t,t+1}$	$\Delta T_{BCC}^{t,t+1}$	$\Delta S^{t,t+1}$
Group 1	21	0.98	1.113	1.003	1.107	1.063	0.956
		(0.52)	(0.19)	(0.13)	(0.14)	(0.14)	(0.09)
Group 2	26		1.080	1.068	1.008	1.015	0.990
			(0.14)	(0.12)	(0.04)	(0.07)	(0.03)
Group 3	9	3.62	1.034	1.048	0.989	0.985	1.017
		(1.03)	(0.07)	(0.10)	(0.02)	(0.07)	(0.02)
Group 4	12	17.41	1.073	1.010	1.044	1.053	0.967
		(13.3)	(0.10)	(0.06)	(0.06)	(0.06)	(0.03)
Kruskal-Wallis χ^2 test			2.18	3.94	26.7***	9.08**	15.4***

* Significance level 0.1 ** Significance level 0.05 *** Significance level 0.01

Table 5. Accomplishment of the UPA target

	1993	1994	1995	1996	Average
Group 1	-3.41	0.25	-0.08	1.83	-0.35
Group 2	-3.77	-2.73	-4.21	-1.86	-3.14
Group 3	-3.02	-0.12	-3.92	-1.45	-2.13
Group 4	-3.11	-1.80	-4.06	0.01	-2.24
Total	-3.44	-1.30	-2.87	-0.34	-1.99

Table 6. Accomplishment of the Admissions target

	1993	1994	1995	1996	Average
Group 1	0.06	2.01	0.90	3.66	1.66
Group 2	-2.79	-1.28	-4.01	-0.23	-2.08
Group 3	2.00	2.68	-2.06	-1.79	0.21
Group 4	-0.57	-0.14	-3.60	1.13	-0.80
Total	-0.88	0.46	-2.17	1.01	-0.40

Table 7. Variation of the UPA target

	93/94	94/95	95/96	96/97	Average
Group 1	2.30	1.84	3.03	3.25	2.60
Group 2	0.02	0.27	2.48	1.73	1.12
Group 3	0.43	-1.06	1.26	0.74	0.34
Group 4	-0.27	-1.23	1.08	1.58	0.29
Total	0.73	0.31	2.24	2.04	1.33

Table 8. Variation of the Admissions target

	1993	1994	1995	1996	Average
Group 1	3.54	5.21	2.96	2.86	3.64
Group 2	-0.81	2.05	0.32	2.44	1.00
Group 3	3.82	3.36	5.29	0.61	3.27
Group 4	-0.68	1.08	1.08	1.76	0.81
Total	1.17	3.03	1.93	2.21	2.08

Table 9. Model A results

Variable	1	2	3	4
Intercept	2.30 (7.43)***	12.2 (2.31)**	27.5 (2.34)**	21.3 (3.80)***
UA	0.567 (7.30)***	0.563 (7.17)***	0.567 (7.20)***	0.672 (8.19)***
ASU	0.240 (3.91)***	0.169 (3.77)***	0.169 (3.76)***	0.195 (3.20)***
VRU	0.064 (3.02)***	0.068 (3.30)***	0.068 (3.32)***	0.051 (2.42)**
DC		-11.06 (-1.76)*		
DV			-7.91 (-1.26)	
SE			-18.69 (-2.20)**	
UD				-0.016 (-3.28)***
UR				-0.012 (-0.51)
R^2	0.41	0.44	0.44	0.45

* Significance level 0.1   ** Significance level 0.05   *** Significance level 0.01

Table 10. Model B results

Variable	1	2	3	4
Intercept	2.39 (7.88)***	8.77 (1.52)	24.33 (1.87)*	30.3 (5.74)***
AA	0.784 (10.7)***	0.805 (10.7)***	0.812 (10.8)***	0.930 (12.6)***
DC		-7.67 (-1.10)		
DV			-4.07 (-0.59)	
SE			-19.63 (-1.89)*	
AD				-0.192 (-2.63)***
AR				-1.05 (-3.14)***
R^2	0.48	0.49	0.49	0.54

* Significance level 0.1   ** Significance level 0.05   *** Significance level 0.01

Figure 1- Formation of expectations and credibility of the system

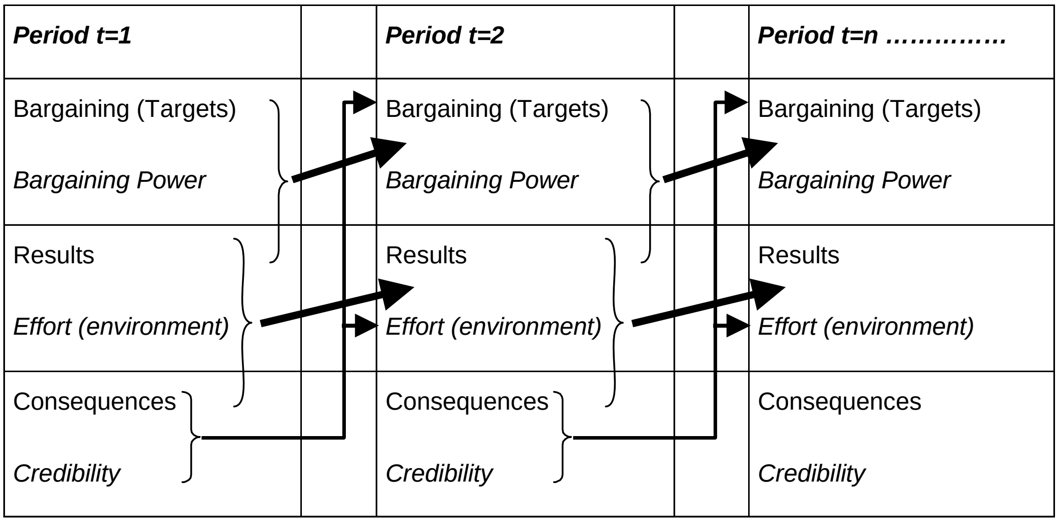

Figure 2.- Empirical Model A