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Introducing DRG-based financing in Hungary: a study into the relationship between supply of hospital beds and use of these beds under changing institutional circumstances

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ABSTRACT

Most hospital reforms carried out in Europe over the past few decades concern the supply of hospital beds and hospital financing systems. In Hungary, financing was not tied to hospital input or output until a Diagnosis-Related-Group system was introduced. This change provided an opportunity to study the effect of the new system, taking the supply of hospital beds into account. We studied the effect of the financing system and bed supply on four output parameters, average length of stay; admission rate; occupancy; and case-mix. The incentives of the financing system influenced the length of stay (shorter) and the admission rate (more admissions). Although the case-mix did increase, occupancy was not affected. The supply of more beds resulted in higher admission rates and a slightly lower efficiency (a lower occupancy rate). No interaction effects of (variations in) the bed supply and the financing system were found.

Keywords: Health care systems; Hospital financing; Hospital-bed use; Hospital-bed reduction; Comparative research

1. INTRODUCTION

In many European countries, governments have tried to restrain growth in the hospital sector over the past few decades [1,2]. The hospital sector accounts for a large share of the health care budget in most countries. The measures were mainly based on assumptions about hospital dynamics that had either to do with hospital capacity or with hospital financing. Concerning hospital supply, Roemer's Law has

long been a prevailing view. In 1958, Roemer [3] studied the effect of hospital bed expansion in one region and found that this led to more hospital use, despite the absence of major changes in the morbidity of the population. This effect has become known in health services research as Roemer's Law, 'a bed built is a bed filled' [4,5]. Based on this principle, governments reasoned that costs could be restrained by shrinking bed supply, assuming that overcapacity existed. However, later studies revealed that Roemer's Law does not appear to be valid in all cases. Van Noordt et al. [6] point to differences in the relationship between supply and use when different health systems or time periods are compared. Van Doorslaer and Van Vliet [7] came up with similar findings and suggested that changing institutional circumstances might influence Roemer's Law. Wiley et al. [8] came up with similar suggestions in a recent study on differences in length of stay. A second major thrust of reform concerned how to pay the hospital bill. Changing funding systems or restricting financial means to a certain maximum have been popular measures. The effects on hospital bed use, however, were seldom studied systematically. This study seeks to clarify the way hospital financing systems influence the use of hospital care, giving special attention to the effect of these systems in diverse bed-supply situations.

The introduction of a Diagnosis-Related-Group financing system (DRG system) in Hungarian hospitals provides an opportunity to study how change in the hospital payment system affects the production of hospital bed days (in short, hospital production). In a DRG system, hospitals are reimbursed according to the diagnosis of the patient. The system provides categories for grouping patients with similar characteristics. Each group of patients is expected to receive similar treatment and thus to require similar resources [9,10]. For each group, resource use is estimated and translated to a fixed amount of reimbursement for the hospital. Neither actual length of stay nor actual treatment will influence the amount reimbursed. All over Europe, the DRG system is at the centre of attention [9]. Some countries are experimenting with this system, like Portugal, France, and Sweden. Hungary, however, is the first European country that has actually used the DRG system for reimbursing hospitals nation-wide. Data on hospital use in Hungary have been collected by the National Health Information Centre of the Ministry of Health (Gyo´gyinfo´ k). These data have been used to study the effect of the new financing system. By studying the effect on the county level, the effect of bed supply on bed use could also be included. There is a considerable spread in hospital bed supply per 1000 inhabitants among Hungarian counties (ranging from 3.3 to 10.8 beds per 1000 inhabitants). The research question of this paper relates to the effect of conditions provided by
the hospital payment system and the supply of hospital beds on the utilization of hospital beds.

What is the effect of changing the hospital payment system and of hospital bed supply on hospital bed use in Hungary?

2. BACKGROUNDS

2.1. The introduction of the DRG system in Hungary

One objective of the health care reform was to stop the deterioration of health among the Hungarian population [11]. Control could be shifted from the government to the users [12] by introducing competition, thereby ensuring better care [13]. New financing systems were introduced to achieve this objective. For acute hospital care, a DRG-based system was chosen. The system was introduced gradually. In 1986, an experiment was set up in Tolna County for seven hospitals. In 1987, this experiment was expanded to 28 hospitals. These experiments had a dual purpose. First, they were used to adapt the DRG system that had been designed for the United States to make it suitable for the Hungarian situation. Second, they were used to calculate the costs for each DRG. The hospitals in the experiments were not

actually reimbursed according to the DRG system. In July 1993, the system was introduced nation-wide (covering approximately 170 hospitals). To avoid large deviations from the former budget, hospitals were reimbursed on the basis of historical costs in the first year after the introduction. This was done as follows. A 'standard DRG' was defined and given weight 1. Then the average resource consumption of the patients in each diagnostic category was compared with this standard, and their DRG was assigned a relative weight. A weight of 1 was given a certain price (reflecting the costs of such a 'standard DRG'). That price varied between hospitals, reflecting historical costs. Gradual adjustments were supposed to level out the differences between hospitals. Due to a strong lobby by some of the large and higher-paid hospitals, there was little political support for making adjustments. As a result, the differences between the hospital budgets still exist. During the first year under the new system, the budget for each hospital was fixed at the national level. In this way, the overall hospital costs were kept under control. Used in this way, the DRG system forms a method of allocating the total budget rather than a means of reimbursement for actual costs.
Hungary has a tradition of negotiation. Before the introduction of the DRG system, government representatives and hospital management used to settle the hospital budget via negotiations. The number of hospital beds was taken as an indicator for the amount of the budget, but there was no check on the real amount of facilities. After the introduction of the new financing system, negotiations were not supposed to be possible anymore. However, it seems hard to root out that tradition. This results in a strong lobby in favor of maintaining hospital-specific DRG prices to prevent hospitals for deviations from the former budget.
Long-term care is not part of the DRG system. Within one hospital, both long-term and acute care wards can exist. The reimbursement of long-term care wards is based on the number of patient days.
The effects of the introduction of the DRG system in Hungary after 1 year of nation-wide application are reported by Nagy et al. [13]. They find the following effects.

. There are more diagnoses per case than in the year before the introduction.
. The classification of the main diagnosis tends to be the diagnosis with the highest DRG weight, even if this diagnosis is not the main justification for hospitalization.
. The case-mix index has increased (the case-mix index indicates the average severity of the cases and is calculated by taking the average of DRG weights).
. The actual average length of stay is lower than the normative length of stay for most groups.
. The average length of stay has declined by 10% from 10.9 days in 1992 to 9.8 days in 1993.

If hospital reimbursement had not been set by the national budget, hospital care would have cost at least 7% more.
Similar effects on length of stay and case-mix were found after the introduction of the DRG system in the United States [14–18].

2.2. Comparison with the DRG system in the United States

The United States was the first country to introduce a DRG system. The Hungarian system is based upon the American version. There are, however, some notable differences between the Hungarian situation and conditions in the United States that may influence the impact of the DRG system. In the US, the system is only applicable to medicare patients receiving acute care; care for other patients is financed by various payment methods. In Hungary, the DRG system is applicable to all patients receiving acute hospital care. In the US, the introduction of the DRG system coincided with the advent of managed care. Hence, the effects of the DRG

system and the effect of managed care cannot be separated in the US setting. Peer Review Organizations were created to review the medical appropriateness of individual admissions. Those organizations have final control over medicare payments to hospitals [18,19]. In contrast, Hungary has no managed care system. The financial consequences of the introduction of the DRG system in Hungary are less stringent than in the US because of the adjustments to the historic budget. Due to these differences, the results of the American DRG system are only partly applicable to the Hungarian situation.

2.3. The Hungarian DRG system and its incenti6es

To study the effect of the introduction of the DRG system, it is necessary to analyze the incentives it offers to the hospital board and the physicians. Specifically, we want to know how those incentives influence the behavior of both actors. As the US studies reveal, a DRG system provides incentives to keep patients for a shorter time, to assign cases to more severe groups, and to refuse to treat less profitable cases [20–22]. With respect to effect of the DRG system in Hungary, the impact of the incentives on these actors is discussed below.

It is fair to assume that any hospital will strive to maintain a sound financial position and a good public image. The DRG system forms the context within which a hospital will try to survive as an organization. In any business a good public image calls for satisfied customers. There are several ways for a hospital to satisfy its patients. First of all, quality of care is important. However, a discussion of that factor would go beyond the scope of this study. Besides quality of care, access to care is also important. Patients needing care should not be sent away. Once admitted, the stay should be long enough to ensure a relatively low-risk discharge. Therefore, we may assume that hospitals will not turn down patients who need care, even if the care required is not profitable to the hospital. The Hungarian DRG system offers a financial incentive to limit resource use as much as possible [23]. The combination of both incentives (financial and quality) will result in short stays that will not drop below a certain medically acceptable minimum (see also Westert [24]).

Contrary to the situation in the US [25], there is only one financing system in Hungary. Thus, there is no possibility for patients to be treated under another (for hospitals more profitable) financing scheme. It is more likely that hospitals will try to negotiate a new DRG for such resource-consuming cases than to simply turn them down. According to Vogler and Habl [26], patients with serious injuries from accidents or emergencies may have difficulty getting access to a hospital in Hungary. Hospitals generally claim that they have no beds available or are not equipped to treat these patients. In reality, it is more likely that these hospitals are not willing to burden their budget with these expensive patients.

Before the DRG system was introduced in Hungary hospital budgets were based on the number of beds in a hospital and the negotiation skills of its managers. This practice explains the anomaly that there are now two ways of counting beds, one registry gives the administrative number of beds (used in the former budget negotiations) and the other gives the actual number of beds. The discrepancy between the two figures can be rather large. For instance, the 1994 records of the Va´rosi KH-RI hospital in Orosha´za put the administrative number of beds at 559, of which only 467 were actually in use ([27])[1]. It seems safe to assume that there was no direct relationship between hospital production and hospital financing before the introduction of the DRG system. So, from a financial point of view, there was no incentive to increase the efficiency of hospital (in the sense of shorter stays). Under those circumstances, low occupancy rates were likely.

The DRG system is not used as a fixed payment scheme, which would set equal prices for a specific DRG in every hospital. Rather, the system is used to allocate

1 Hungary is not the only country with a discrepancy between administrative number of beds and actual available beds. The Netherlands also has fewer beds available than the official number. The opposite is found in the Belgium where more beds were in use in the 1980s than the officially registered

number.

the total amount of money available according to certain criteria. This total amount is determined at the national level. This is comparable to the German point system for the reimbursement of ambulatory specialists. For the individual hospital, a higher output may lead to a larger share of the total amount available. At the national level, this will result in greater output for a lower price. Since an individual hospital cannot influence the way all the others work the only option is to follow the pack and produce more (see also Vogler and Habl [26]).

In principle, each DRG case is reimbursed at a fixed amount, regardless of the length of stay. In Hungary, when the stay is below a certain minimum number of days, the hospital gets a lower reimbursement. For stays over a certain maximum, a small daily allowance is reimbursed for the extra days. The range between minimum and maximum stay is based on a normative length of hospitalization for this DRG case. The normative length of stay is derived from the average length of stay that was customary in Hungary for that DRG case before the introduction of the DRG system. This provides a financial incentive to reduce the length of stay to the minimum, as the hospital would thereby maximize its profit. To maintain a good public image, more serious cases should not be discharged too early. Therefore, the length of stay may be expected to stabilize between the average length of stay and the minimum length of stay. Indeed, Nagy et al. [13] found this effect.

Another financial incentive provided by the DRG system is to admit more cases to the hospital. Shorter stays make it possible to raise the admission rate (number of admissions per 100 inhabitants) and thus increase revenues.

The decision to hospitalize a patient is made by a physician. It should be noted that medical specialists in Hungary are in salaried employment. Compared with their Western counterparts, their pay is low. For instance, the average monthly salary at the National Institute of Surgery in Budapest in 1994 was 32 000 HUF (before taxes); the net income would be approximately 22 000 HUF. Housing costs at that time were at least 10 000 HUF for a 55 m_2 apartment. So a moderate-sized apartment would take up almost half of their monthly income. Working for a salary implies that any increase in productivity would not bring in more income.

From a financial point of view, the introduction of the DRG system is not likely to change the physicians' behavior, since their remuneration does not change. However, they do have a way to increase their income, namely by accepting 'gratitude money'. All the people who were interviewed in this study (see Section 3) confirmed that this system exists. It was described as a system with a rather 'social' character. Patients with a relatively high income pay more for their 'gratitude' than lower-income patients. The extent to which this system contributes to the income of physicians is not exactly known. There is no reliable information on the incidence of these practices. All we know is that the system exists and may contribute considerably to the physicians' income. Some estimates put the increase at 30–40% [28]. If 'pocket money' does contribute substantially to a physician's income, it may be more appropriate to speak of a mixed system, consisting of a salary and a fee for service. When interpreting the results, we have to bear this in mind. A fee-for-service system provides the incentive to admit as many patients as possible. When the care provided exceeds the amount that would have occurred when patients were fully informed this phenomenon is described as supplier-induced demand [29,30].

There has been little or no change in the physician remuneration system since the introduction of the DRG system. If hospitals want to change their strategies, they have to persuade the physicians to comply with this policy. There are two different ways they can approach this. First, the employer–employee relationship creates opportunities. Physicians are salaried and are thus dependent on the hospital. This relationship gives hospitals a certain degree of power to influence the behavior of their subordinates. Second, the incentive structure can be used. The pocket-money system already furnishes the right incentive — a convenient side effect of the informal arrangement. So although the introduction of the DRG system does not change the financial incentive structure of the physicians, hospitals will be able to

convince them to comply with the changing hospital policy.
The effects of the Hungarian DRG system were mentioned in previous research [13]. In this study, we investigate whether these effects on the utilization of hospital beds vary according to differences in the supply of beds. We assume that hospitals in areas where the supply of beds was low already had relatively short stays because of the relative shortage of beds compared with areas of high supply. Besides this, a lower admission rate is likely; obviously fewer people can be admitted due to the relative shortage of beds. Therefore, the decrease in length of stay due to the introduction of the DRG system will be lower in counties with a low bed supply than in counties where the supply is high. Also, the increase in admissions will be lower in the low-supply counties than in the high-supply counties. The above considerations led to the following hypothesis.

Hypothesis 1

1. Counties with a high bed supply will have a longer average stay and more admissions than counties with a low bed supply.
2. The DRG system will lead to shorter stays and more admissions.
3. The effect of the DRG system will be stronger in high-supply counties compared with low-supply counties.

We can describe these expected outcomes as 'external' effects, what the users ('consumers:patients') of the hospital notice about the new financing system. However, there will also be 'internal' or organizational effects, changes that affect the hospital as an institution. Due to the DRG system, there may be changes in the administrative system and reorganizations of inpatient care (for the sake of increasing efficiency).
Hospitals may use their facilities more intensively by decreasing the number of days a bed is left empty (for instance, because of cleaning, maintenance, inefficient planning or emergencies) and thereby increasing the occupancy rate. In low-supply counties, hospitals may not have this option simply because they have fewer beds. Roemer's Law indicates that hospital bed capacity will be used maximally. However, this does not necessarily imply that the maximum level of efficiency will be reached. When it is financially attractive to increase occupancy rates by increasing efficiency, this may be an interesting option. Another way in which hospitals may try to increase their output is by reporting that patients are sicker than they really are (i.e. giving them a more serious diagnosis). The underlying assumption is that hospitals may yield to the temptation to engage in creative administration practices because this is an area that is hard to check. An increase in the case-mix index is even possible within the bounds of 'good medical practice'. That is because of the degree of uncertainty inherent to the medical profession [31,32]. The advantage is that hospitals do not have to increase turnover (in the sense of more admissions) to increase their revenues. Low-supply hospitals have fewer opportunities to increase their turnover rates. 'Increasing' the case-mix will, therefore, be the preferred strategy among low-supply hospitals. In light of the above, the next hypothesis is stated as follows.

Hypothesis 2

1. After the introduction of the DRG system, the case-mix index will increase.
2. In counties with a low bed supply, the case-mix index will rise more strongly than in counties with a high bed supply.
3. After the introduction of the DRG system, the occupancy rate will increase.
4. The occupancy rate in high-supply counties will increase more than in low-supply counties.

3. DATA AND METHODS

Information on the Hungarian health care system was gathered from the published literature and conference reports. Additional information was gathered during a 2-week visit to Gyo´gyinfo´k (National Health Information Centre of the Ministry of Health). Several people who were involved in the introduction and implementation of the DRG system were interviewed. Besides personnel from Gyo´gyinfo´k, interviews were held with a physician (head of a surgical institute) and an executive of the Hungarian national health insurance fund. The introduction of the DRG system was organized by Gyo´gyinfo´k. Gyo´gyinfo´k was also responsible for the implementation of the system. All hospitals collected their data individually and sent this monthly to Gyo´gyinfo´k. There, the data were processed and an invoice was prepared for the sick fund. The hospitals were informed about their financial status and hospital production. The data used in this study are derived from this database.

Data used to analyze the DRG system go back to 1992, which is taken as the baseline year (the year before the DRG system was introduced). The data collected for that year refer only to the DRG system. The financial consequences of the system did not come into play until July 1993. The most recent data available on the utilization of hospital beds are from 1995. The most recent data on hospital bed supply are from 1994 (December 31). Prior to 1992, data were collected by a completely different procedure, so the results could not be made comparable to the new data. Before the DRG era, the data of every tenth patient was collected; furthermore, the protocol used a totally different classification of diseases. To compare the two periods, data of 1992 (pre-DRG) and 1995 (DRG era) will be used. The years 1993–1994 are considered a period of adjustment, during which the hospitals had to become used to the new system. So 1992–1995 will be used in the analyses.

The data were subjected to a regression analysis on the county level. This was the only level for which information was available on number of beds, population size and travel (i.e. border crossings) of patients. Unfortunately, the data do not include occupancy rates. However, hospital bed days per 100 inhabitants and turnover rate (average number of patients per bed per year) were available. We use these variables as a proxy for occupancy rate[2]. Increasing occupancy rates will presumably correlate with increasing turnover rates and increasing bed days. The observations were pooled, but correction for autocorrelation was not necessary, due to the introduction of the dummy variable for financing system.

The hypotheses posed that hospital production parameters are a function of hospital bed supply, hospital payment system, and the interaction between payment system and bed supply. In equation:

hospital production_*f*(bed supply, payment system, bed supply x payment system)

To test the first hypothesis, a regression equation was estimated, consisting of bed supply and financing system as independent variables and average length of stay and admission rate as dependent variables:

Hypothesis 1:

$$Alos = \alpha_1 + \beta_{11}beds + \beta_{12}DRGsys + \beta_{13}beds \times DRGsys$$
$$Adm = \alpha_2 + \beta_{21}beds + \beta_{22}DRGsys + \beta_{23}beds \times DRGsys$$

where alos is the average length of stay in days, adm the number of admissions per 100 inhabitants, beds number of beds per 1000 inhabitants, DRGsys is the financing system (1992 = 0, 1995 = 1).

More beds lead to longer stays (according to Roemer), so β_{11} is expected to be positive. The DRG system gives incentives for shorter stays, and thus β_{12} will be negative. In high bed supply counties, this effect will be stronger than in low-supply counties; β_{13} is thus expected to show a negative sign. More beds lead to higher admission rates, so β_{21} will show a positive sign. The DRG system gives incentives to increase admissions, so β_{22} will be positive. In high-supply counties, this effect will be stronger than in low-supply counties; thus β_{23} will show a positive sign.

Hypothesis 2:

$$\text{case-mix} \times \alpha_3 \times \beta_{31}\text{beds} \times \beta_{32}\text{DRGsys} \times \beta_{33}\text{beds} \times \text{DRGsys}$$
$$\text{turnover} \times \alpha_4 \times \beta_{41}\text{beds} \times \beta_{42}\text{DRGsys} \times \beta_{43}\text{beds} \times \text{DRGsys}$$
$$\text{beddays} \times \alpha_5 \times \beta_{51}\text{beds} \times \beta_{52}\text{DRGsys} \times \beta_{53}\text{beds} \times \text{DRGsys}$$

2 It would have been possible to calculate the occupancy rate from the available data. However, we chose not to do so because the available data were already computed and rounded off, thus creating too much risk for systematic error.

where case-mix is the average DRG weight produced by a county, turnover the average number of patients per bed per year, and beddays is the number of bed days (patient days) per 100 inhabitants.

In the event of a bed shortage, it is likely that only the more severe or urgent cases can be admitted. Fewer beds would then lead to a higher case-mix index, giving a negative sign to β_{31}. The case-mix index is expected to increase after the introduction of the DRG system, leading to a positive β_{32}. The increase will be larger when the supply of hospital beds is small, leading to a negative sign of β_{33}.

For lower supplied counties we might expect a higher turnover rate (higher efficiency) to overcome the relative scarcity of beds compared with higher-supplied counties, leading to a negative sign of β_{41}. Because of the same scarcity of beds, a lower production of bed days is expected, giving a positive β_{51}. We expected that occupancy rates would increase after the introduction of the DRG system, resulting in a positive sign for β_{42} and β_{52}. For occupancy rates, we expected counties with a larger bed supply to have more possibilities to improve efficiency. Therefore, β_{43} and β_{53} will be positive.

4. RESULTS

4.1. Characteristics of the Hungarian counties

Hungary consists of 20 counties. The largest county in terms of population size is the city of Budapest, with approximately two million inhabitants. The other counties have considerably fewer inhabitants (average 440 000 inhabitants) but cover much larger surfaces. In 1994, Hungary had 150 hospitals that provide acute care; 38 of these institutions were in Budapest. The rest of the counties had on average six hospitals each, with a minimum of three (in No´gra´d, this is also the smallest county in terms of surface area, apart from Budapest) and a maximum of nine (in Baranya). The size of the hospitals — in terms of beds — varies considerably. The county hospitals are mainly large institutions with around 1000

beds for acute care. The smallest hospitals, those with 50 beds or less, are mostly specialized — for instance, maternity hospitals. In 1992, Hungary had 6.5 beds per 1000 inhabitants. The county with the largest supply is Budapest, with 10.8 beds per 1000 inhabitants. The neighboring county, Pest, has the lowest supply, with 3.3 beds per 1000 inhabitants. The other counties range from five to eight beds per 1000 inhabitants. Hospital bed supply was not stable from 1992 until December 1994. On average, the number of beds per 1000 inhabitants increased by 0.3. The largest increase was found in Baranya, where the supply rose by 0.9 beds per 1000 inhabitants (in 1992, Baranya had 7.2 beds per 1000 inhabitants). The largest decrease was found in No´gra´d, where 1.2 beds per 1000 were removed (initial bed supply, 6.7 per 1000).

Sometimes patients living in one county are hospitalized in another county. These border crossings may influence the bed capacity in each county. Therefore, the impact of border crossings on hospital production was taken into consideration. On average, 87% of the patients treated lived in the same county as where they were hospitalized. There are, however, three counties that can be considered as outliers, since the share of patients from outside these counties was over 30%. The first outlier county is the city of Budapest, with only 62% of the patients coming from its own county. This is not surprising, since the main medical institutions are situated in the capital. The county of Pest surrounds the capital. Most patients who come from outside Budapest to be treated in the capital originate from this county (17%). This is not a very surprising finding since the supply of beds in Budapest is very large (10.8 beds per 1000 inhabitants), whereas Pest has an extremely low bed supply (3.3 beds per 1000 inhabitants). We considered taking both counties out of the analysis because of the disruptive effect of these outliers. However, since we have a limited number of observations, we decided not to purge those two counties but to combine their data and treat them as one county. The other two outlier counties were Baranya (61% local patients) and Gyor-Sopron-Moson (64% local patients). However, in both instances 28% of the patients originating outside the county did not come from any of the other counties in Hungary. Baranya is situated at the border of the former Yugoslavia. Refugees from the former Yugoslavian Republic have been using the medical facilities in this county, which may explain this phenomenon. For Gyor-Sopron-Moson, a county at the Austrian and Czech border, no satisfactory explanation was found. The volume of border crossing from within Hungary is negligible for both of these counties. However, the bed capacity available to the local population can be on balance be seen as lower because of these foreign patients. The analyses were carried out with a dummy variable to control for any effects specific to those two counties. This did not produce outcomes that were different from those found in analyses without this variable.

4.2. Developments in hospital bed use

Before turning to the results of the analyses, it is helpful to get a general overview of the development in hospital production in Hungary from 1992 until 1995 (see Table 1).

The increase in admissions and case-mix (case-mix is an indicator for the average severity of the cases) and the decrease in length of stay are as expected and as reported in earlier work by Nagy et al. [13]. Turnover rates have also increased. More interesting for the scope of this study is the variation between the counties. In some counties, the changes were considerable, in others almost negligible. Over the years, there has been a tendency for the length of stay to become more equal among the counties. The variation between counties within a given year is diminishing. For 1992, the S.D. of length of stay is 1.10; for 1995, this figure is only 0.48.

The number of admissions showed the opposite pattern; the variation in admission increased over the years. For 1992, the S.D. is 1.77; for 1995 it is up to 2.87. The case-mix increased steadily without change in variation (S.D. 0.03 for each year). On the average, the number of bed days per 100 inhabitants has decreased.

However, a large variation in change is observed between the countries.

4.3. The effect of bed supply and financing system

This section discusses how hospital utilization is influenced by the bed supply and the new financing system. Table 2 displays the results of the analyses of the main effects of the bed supply and the financing system.
Regarding the average length of stay, there is a tendency towards shorter stays in a DRG environment. Apparently the strategy of decreasing length of stay is profitable within this system. Hospital bed supply has no effect on stays. The introduction of the DRG system leads to increasing admission rates. Even the higher-supplied counties have higher admission rates. Both results comply with the expectations. The assumption that the introduction of the DRG system leads to a higher case-mix index appears to be valid. Surprisingly, the effect of bed supply on case-mix is the opposite of what we expected to find. More beds lead to a higher case-mix. The turnover rate is also influenced by both bed supply and financing system. A larger supply leads to lower turnover rates. One extra bed per 1000 inhabitants lowers the turnover rate by 1.5 person per bed per year. The DRG system leads to increasing turnover rates. The production of hospital bed days per 100 inhabitants is higher in higher supplied counties. There is no significant effect of the introduction of the DRG system on hospital bed days. Thus, there is no evidence that the DRG system has caused hospital beds to be used more efficiently in the sense of having higher occupancy rates.
Interaction between financing system and bed supply (beds x DRGsys) could not be demonstrated. The analyses with the interaction term did not show any significance for this term. Moreover, the explained variance (adjusted R_2) did not differ from the model without interaction. Therefore, the model with the interaction term was rejected. Thus, hypotheses 1c, 2b and 2d cannot be confirmed. There is no evidence for different effects of the introduction of the DRG system under different supply circumstances.

[TABLE 1]

[TABLE 2]

4.4. Conclusion and discussion

First we will discuss the 'external' effects of hospital bed supply and the DRG financing system. External effects were described above as effects that the users (consumers / patients) of the hospital notice. Larger bed supply leads to more admissions and more bed days, which can be interpreted as a confirmation of Roemer's Law. These effects might result from larger supply. However, financial incentives for physicians may also play an important role in explaining this relationship. Officially, physicians receive salaries, which gives them no incentive to increase their productivity. However, the practice of 'gratitude money' provides an incentive for admitting more patients, giving credence to the 'supplier-induced demand' hypothesis. Since the remuneration system of physicians did not change with the introduction of the DRG system, the effect of its incentives could not be isolated in this study.
When studying the effect of bed supply in more detail, we see that larger bed supplies lead to more admissions and more bed days. Simultaneously, length of stay does not change and turnover rates drop. Apparently, beds are used less intensively, and are kept idle longer. Each extra bed will be used, but less efficiently, or less completely than in the previous situation. So, a bed built is a bed filled, though less

efficiently.
The introduction of the DRG system affects the use of hospital bed. Before the introduction of the DRG system, there were no clear financial incentives to shorten or lengthen hospital stays. After the introduction, we see a clear tendency to shorten stays. We also see evidence that the financing system affects admission rates when compared with the former system, which was not related to hospital production parameters. The DRG system provides incentives to admit more patients, and this is exactly what happens. The suspicion of Van Doorslaer and Van Vliet [7] — that institutional circumstances contribute to hospital bed use and therefore influence Roemer's Law — can be confirmed by these findings. We also conclude that hospitals have succeeded in persuading physicians to change their admission policy. Whether this is the result of the power of the hospital management as the employer or because of the financial incentives provided by 'gratitude money' remains to be seen. This question cannot be answered by this study. It does seem that the latter effect is less plausible. If the effect of the financial incentives of the physicians had been so predominant, it would have already been observed before the DRG system was implemented.
Next, we will discuss the internal or organizational effects. There is no evidence that the DRG system increased efficiency in the sense of leading to more effective bed use. Hospital bed days did not increase after the introduction of the new system. The turnover rate increased, but this can be ascribed to shorter stays, leaving occupancy rates unchanged (the production of hospital bed days was not affected by the change in financing system). The effect of the DRG system does not vary by bed supply. Apparently none of the counties was so under-supplied that lengths of stay already represented the minimum length of stay. Another explanation could be that the lower-supplied counties, although perhaps under-supplied, did not offer the (financial) incentives to treat as many patients as possible,
resulting in (longer) waiting lists. However, this is not a very plausible explanation, since Hungary has virtually no waiting lists; they only exist for a few very expensive treatments.
Creative administration, resulting in an increasing case-mix index, may be a strategy to manage the financial changes invoked by the DRG system. Previous research in the US revealed that although part of the increase of the case-mix was real, another part was due to 'upcoding', in favor of the hospital income [33,34]. Part of the increase may be due to changes between 1992 and 1995 that were not included in this study, like ageing of the population, an increasing use of day surgery, the introduction of new technologies. However, the phenomenon that in some hospitals the number of uncomplicated child deliveries diminished sharply and complicated births increased strongly, supports the suspect of at least some creative administration. An explanation for the effect of bed supply on the case-mix index might be that counties with a larger supply are typically those counties that have university hospitals, which may serve more serious cases. A higher case-mix index could be used to justify the higher supply, since sicker patients need longer stays. Of course the opposite could just as easily be true — a higher case-mix index could lead to higher bed supply. However, this is not very plausible. The former budget system was not dependent on the case-mix index but on the negotiation skills of managers. In that setting, a higher case-mix index is a valuable negotiation issue. It may be justified to conclude that hospitals try to gain maximal revenues with a minimal change in workload. However, increasing admission rates undoubtedly generate more work for physicians. Since physicians are officially in salaried positions, this would not be in their interest. The 'gratitude money', however, makes it financially profitable to increase admission rates, so we may assume they will cooperate with the hospital management. On the other hand, it might be the dependent position of physicians as employees of hospitals, which makes them comply with hospital policy. It would be interesting to investigate whether the compliance of physicians with hospital policy would reflect different formal relationships with hospitals.
We see that differences in bed supply do not influence strategies to handle the

new financing system. Higher-supplied counties do not have different reactions than lower-supplied counties. Regardless of bed supply, all counties show the same reaction to the new financing system. This can be taken as support for the proposition that hospitals (and physicians) try to gain maximal revenues with a minimal increase in workload.

After discussing the effects of the Hungarian bed supply and the DRG system, one question remains. Are these findings valid for countries other than Hungary? An important issue is the absence over control of hospital production that existed in this country. The appropriateness of the decision to admit patients was evaluated by the sickness funds not prior to admission but after the fact. This left the door open to an increase in arbitrary medical inventions. On the other hand, the increase in case-mix and in admission rates may not fully reflect reality; it may be ascribed to creative administration. However, administrative creativity might be possible in other countries too. An increase in case-mix was also found in the US. The relative lack of diagnostic certainty inherent to the medical arts makes these increases difficult to unravel. However, policy-makers should take this ambiguity into account. The actual savings to be derived from a DRG system might be lower than expected. So, although creative administration in Hungary may be more deeply entrenched than elsewhere, the direction of the creativeness in other countries will point in the same direction. Besides this, we may conclude that financial incentives give stronger impetus to admission policy than bed supply. When financial incentives dictate shorter stays, stays will become shorter even if the supply of beds is greater. So, a change in financing systems can be used as a tool to influence hospital utilization. However, it is imperative to safeguard the quality of care. Barnum et al. [23] have already drawn attention to this problem. Also, to prevent unwanted side effects, the incentive structure of all relevant actors and their power relationships should be taken into account.

Finally, we would like to comment on the design of the Hungarian DRG system. It is combination of hospital reimbursement based on hospital activity and a capped system with respect to the total hospital budget. A DRG system as such is not capable of preventing unnecessary admissions. In our opinion, the simultaneous introduction of a fund-holding system might be useful against unnecessary admissions. On the other hand, the combination of the DRG system and the fact that hospital spending was limited at the national level resulted in an increase in hospital activity without having to pay more for it at the national level. From a financial point of view, the combination of the DRG system and capping the national budget did lead to a more efficient use of hospital beds.

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TABLES

Table 1
Development in hospital beds and hospital output in Hungarian counties from 1992 to 1995[a]

	Average		Change from 1992 to 1995		
	1992	1995	Average	Minimum	Maximum
Admission rate	17.18	20.70	3.53	0.37	9.71
Length of stay	11.78	8.99	−2.78	−1.38	−5.29
Case-mix	0.93	1.07	0.13	0.08	0.21
Turnover rate	26.57	31.85	5.28	0.59	12.47
Bed days per 100 inhabitants	202.33	186.34	−15.99	−74.32	59.12
Beds per 1000 (official)	69.2	71.48	0.23	n.a.	n.a.
Beds per 1000 (actually in use)	64.6	67.46	0.23	−12.2	8.75

[a] Source, Gyógyinfók, Hungary.

Table 2
Effect of hospital bed supply and financing system on hospital utilization for Hungarian counties ($n = 38$)[a]

Dependent	Independent	Expected sign of b	b[b]	T	Sig. T	Adjusted R^2 for regression equation
Average length of stay						0.72
	Beds per 1000[c]	0	−0.03	−0.17	0.86	
	DRG system[d]	–	−2.79	−9.97	0.00	
	Constant		11.97			
Admission rate						0.60
	Beds per 1000[c]	0	1.86	4.91	0.00	
	DRG system[d]	0	3.64	6.03	0.00	
	Constant		5.05			
Case-mix						0.88
	Beds per 1000[c]	–	0.02	3.94	0.00	
	DRG system4)	0	0.13	15.93	0.00	
	Constant		0.79			
Turnover rate						0.54
	Beds per 1000[c]	–	−1.50	−2.61	0.01	
	DRG system[d]	0	5.60	6.11	0.00	
	Constant		36.36			
Bed days per 100 inhabitants						0.28
	Beds per 1000[c]	0	17.38	3.48	0.00	
	Financing system[d]	0	−14.95	−1.88	0.07	
	Constant		89.26			

[a] There are 19 counties (Pest and Budapest being combined) and two measuring points in time, giving 38 observations.
[b] β is the nonstandardized B-coefficient.
[c] These are the beds that are actually in use.
[d] The DRG system was coded 1, the former system 0.