Upcoding in a NHS*

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too preliminary to even have date for a version 0!!

Abstract

Evidence from the US pointed out, over the years, to the existence of upcoding in management practices. Upcoding is defined as classifying patients in DRG codes associated with larger payments. The incentive for upcoding is not particular to private providers of care. Conceptually, any patient classification system that is used for payment purposes may be vulnerable to this sort of strategic behavior by providers.

We document here that upcoding can also be present in a National Health Service where public, Government owned and managed, hospitals have their payment (budget) tied to the classification of treatment episodes. Using DRG data from Portugal we find that upcoding is being used by hospitals to increased their budgets.

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Contents

1 Introduction

Despite empirical documentation of the upcoding phenomenon in the Medicare relationship with US hospitals (also known as DRG-creep),[1] there is not much theoretical treatment of the issue. Moreover, no current theory or empirical evidence addresses the issue in the context of national health services. This is somewhat surprising as patient classification system are now common in many countries, several of them having a National Health Service and using DRG-like systems to pay providers of health care.

The use of prospective payment, based on patients classification systems has become widespread. A crucial aspect of payments by episode of coding of each patient. In the United States, the first country to have payments to health providers based on Diagnostic Related Groups (DRG), a concern often raised was that of upcoding (or DRG-creep). The practice of upcoding consists in shifting the DRG of a patient to another one yielding a higher payment from the third-party provider.

As countries with a National Health Service also adopt patient classification systems and prospective payments to public hospitals, the very same question can be asked: do we observe upcoding in the public sector? Should it be a concern in the context of the National Health Service?

We address these questions using data from an European National Health Service, from Portugal, and using an exogenous, politically-driven, change in DRG prices to assess whether public hospitals upcode in response to change in the relative price of DRGs. Portugal has a National Health Service since 1979, and in the early eighties introduced a version of the US DRGs. The system has been adjusted over time, both in terms of number and definition of DRGs, as well as the prices paid for each DRG.

During the early years, there was no clear link between the budget of each public hospital received and its activity measured by the value of DRGs. For a long time, budgets were yearly revised based on historic costs or deficits were run without managers caring about it as sooner or later fresh money

[1] See Silverman and Skinner (2004) and Dafny (2005) for recent accounts of upcoding.

from the Government would come in any way. Thus, the soft-budget constraint effect rendered relatively irrelevant the "price" given to each DRG and DRG prices were revise sporadically and without a sound underlying costs analysis.

By 2002, a major change occurred in the Portuguese health system, with new, more entrepreneurial-like, management rules being introduced in nearly half of public hospitals. Different management teams were brought in to the public hospitals. Their performance, either under the new or the old statutes, became under more scrutiny.

Even if no public hospital has become bankrupt, it has occurred a clear hardening in the budget constraint. Hospitals have now to contract with the Ministry of Health expected activity and overall budget. The information from the DRGs is now actively being used to establish these contracts. Thus, while under the old system, funding of hospitals was dominated by the soft budget constraint effect and no incentive for upcoding exists, under the new environment, upcoding delivers benefits to the hospital and therefore can become a matter of concern to the purchaser.

The changes in DRG prices occurred in the Portuguese health system provide an exogenous source of variation , not related to evolution in hospital costs. This provides us with variation to identify upcoding behavior within a NHS framework.

Since the price changes are not equally relevant to all DRGs we trace whether shifts in DRG coding toward higher priced DRGs were stronger in those cases where the relative price of a DRG changed the most.

An issue of interest is whether upcoding is more likely to occur in the set of hospitals that received the new type of statutes or is common to all hospitals, including pure public hospitals. The managers of the latter type of hospitals were also put under pressure as the transformed hospitals become a benchmark for them.

Our study explores the Portuguese exogenous DRGs price change that had occurred in 2006 using public hospital data from 2001 to 2008. As the result, we found that the Portuguese health system has evidence of upcoding in the more recent years. In particular, hospitals respond to price changes in DRGs including more patients into the DRGs that are more profitable. No distinction across types of hospitals is detected, regarding upcoding behavior.

The paper is organized into six sections. Section 2 presents a literature review. Section 3 describes the Portuguese Health System and the exogenous politically-driven change in prices. Section 4 presents a simple model generating our empirical predictions. Section 5 reports the methodology used and in section 6 we describe the results obtained. Section 7 presents concluding remarks. The full regressions can be seen in the Appendix.

2 Literature review

A recent theory treatment of upcoding is due to Kuhn and Siciliani (2008). Their focus is on how quality, "manipulative effort" (their upcoding aspect) and auditing interact with the payment rule defined by a third-party payer (which can be a national health service) to a provider. Upcoding takes in Kuhn and Siciliani (2008) a particular role: it increases the number of patients treated and the average DRG weight. The analysis assumes hospital management to be profit maximiser or surplus maximiser within the national health service.[2]

From their model, it follows quite naturally that higher prices generate higher manipulative efforts and higher output. More auditing effort reduced upcoding. The price instrument influences quality provided but auditing does not. Their work nicely explores this difference in the instruments available to the purchaser (third-party payer).

To our empirical purposes, their model is not directly applicable although the implications do carry out. We stick closer to Dafny (2005) implicit setup, in which demand is exogenous to the hospital and upcodingh consists in the classification of patients in a higher price DRG. Exogeneity of demand is, given the existence of well defined catchment areas, for Portuguese hospitals,

[2] Kuhn and Siciliani (2008) argue on behalf of their assumption with managerial discretion to use generated surplus even within the NHS.

the more reasonable assumption in our data analysis. Moreover, although some auditing exists, we do not have information on its results, and we cannot explore this dimension of the problem.

In what concern to the previous empirical literature, there is a vast one where the upcoding problem is pointed out for the United States. Dafny (2005) had explored the hospitals responses to a change in DRGs prices. As the result she found that hospitals had upcoded patients in order to increase profits, by reimbursements, being the upcoding no similar for all DRGs. Other studies had arrived at the same conclusion: Carter and Ginsburg (1985); Hsia et al. (1988); Steinwald and Dummit (1989); Carter, Newhouse and Relles (1990); Silverman, Skinner and Fisher (1999). Some studies, using specific DRGs could not confirm the upcoding behavior, although they highlighted huge evidences, as Silverman and Skinner (2004) and Psaty et al. (1999).

Part of the literature concentrated attention in the Case Mix Index (CMI), an index capturing the complexity of episodes, and based on the DRG weights. The literature tries to explain the reasons that led it to increase so much, since the beginning of the prospective payment system. Most studies are about the US private health care market, given that they were the first to implement it and where health spending had increased rapidly.

Carter and Ginsburg (1985), Hsia et al. (1988), Steinwald and Dummit (1989) and Carter et al. (1990) attempt to explain this increase in the CMI. Carter and Ginsburg (1985), using regression analysis, explained that, from the US 8.4% accumulated CMI increase since 1981 to 1984, 3.3% could be due to upcoding. Also Hsia et al. (1988), trying to measure the incorrect coding that had occurred under the PPS from 1984 to 1985 and using a review of medical records, found an error rate of 20.8% in the DRG codes. Besides they found also that small hospitals have greater error rate and that the reasons for that are mis-specification, re-sequencing and mis-coding. Steiwald and Dummit (1989), in a theoretical paper, argued that, behind the 20% CMI increase in US from 1983 to 1988, only 8% was due to formal changes in DRG weights, suggesting upcoding as the culprit for the remaining increase. Following this same objective and using a sophisticated code system, Carter et al. (1990) had decomposed de 2.4% increase in the US CMI between 1986 and 1987. They noted that one third of this value is due to upcoding.

On the other hand, Kroneman and Nagy (2001), asking for the same research question, using Hungarian data from 1992 to 1995 did not find relation between implementation of DRGs and increasing in the CMI.

An improvement on that literature was developed by Dafny (2005). She had examined the hospital responses to a change in prices of some DRGs in United States and the main conclusions were that hospitals upcode more in the DRGs where the price increase is greater, chiefly in the for-profit hospitals, and there is no increase in intensity or quality of care in these diagnoses.

And then, one might verify an agreement among the results conducted in 80 and 90s for the US, what makes clear the upcoding behavior that had occurred after the PPS implementation. Similar to that works and using a similar hypothesis to Dafny (2005), some authors had tried to associate a hospital ownership to the upcoding behavior of the market as a whole or to a specific DRG. Silvermann, Skinner and Fisher (1999), using a generalized least square, found that for-profit hospitals have the greatest increase after the adoption of DRGs, suggesting upcoding, for the US data in 1989, 1992 and 1995. Silvermann and Skinner (2004) tried to associate the hospital ownership with DRGs for pneumonia and respiratory infections, using data from 1989 to 1996 and did not prove the upcoding, although they had suggested, especially in these types of procedure that have higher difficult to detect the presence of severity. Xirasagar and Lin (2006) tested this relation with hernia operation and cataract surgery using Taiwans National Health Insurance Research Database for 2001 and applying diagnosis-wise logistic regression and they ended up with the result that large public teaching hospitals are more likely to admit these types of procedures than for-profit and not-for-profit hospitals.

Other research topics, indirectly motivated by the upcoding problem were published in the scientific community after the US rules modification on the health market. Lave (1985) noted that compression were occurring in the US DRG prices, in the sense that high cost DRGs had been set lower to their actual costs and low cost DRGs higher, what might have important implications on DRG creep. Psaty et al. (1999) had computed the potential costs per year for health failure procedures in US from 1986 to 1993, highlighting the size of the problem for the society.

Two other contributions are to be mentioned. Rauner and Schaffhauser-Linzatti (2002) observed the impacts in Austria after the implementation of the PPS in 1997. They got good indicators in terms of cost reductions and quality indexes for their hospitals; and Steinbusch et al. (2007) had conducted a comparative study among American, Australian and Dutch case mix reimbursement system, presenting the market, control system and case mix characteristics as the variable that could motivate or inhibit the upcoding. This is a relevant study in political terms that point out particular requirements that should be taken into account when planning to implement or improve a health system.

Previous research sets upcoding forward as an important issue at least for the US market in the first decade of utilization. One might think that upcoding is a transitory behavior in a way to accommodate the new rules.

3 The Portuguese health system

The Portuguese health care system is based on a National Health Service. Under the traditional public service approach to financing NHS hospitals, little incentive for upcoding exists. Although the hospital was awarded a budget at the beginning of the year, the values were typically well below the expenditures of the hospital in the previous year. Hospitals were aware, generally speaking, that budget reinforcements would be received, sooner or later. Thus, the payment system to the public NHS hospitals entailed no relation to DRG values.

In January 2003, a major change was introduced. Roughly half of the hospitals have seen their status changed, allowing for a more entrepreneurial-like management. Alongside with this formal change, the payment system also changed, with a stronger emphasis on the notion of making the budget truly prospective and based on expected expenditures. DRG costs and episodes were at the heart of initial computations before other considerations helped to define the final hospital's budget. Still, official budgets were below predicted expenditures and well below historical costs, rendering it almost useless as a management tool.

In 2005, with a new Government holding majority in Parliament entering office, a different approach was taken with regard to 2006 budgets for the NHS hospitals. A large budget increase was accepted officially, first in an extraordinary budget reinforcement in middle 2005, second in the initial budget for 2006, against a closer monitoring of hospitals' activity and expenditure growth. This included the creation of "contract-programs", that is, explicit contracts between the NHS hospital and the Ministry of Health, stipulating both quantities and overall payments to the hospital.

These changes introduced the financial incentive for upcoding, as higher complexity of cases would bring more funds in the future.

Since the approach to budget definition was not materially distinct to pure private hospitals and to EPE hospitals, incentives for upcoding were roughly similar. DRG prices changed in 2003 by Government decree and remained stable until early 2006. Then, no further change in prices existed in 2007 and 2008.

The price change was exogenously determined and politically driven. In particular, it had no relation ot the concerns of upcoding. Therefore, the context of the Portuguese health system (and of the National Health Service, in particular) provides a natural bed test to assess the extent of upcoding in public health care systems.

The implementation of the DRG system in Portugal had begun in 1984, with an agreement between the Ministério da Saúde and the Yale University, coordinated by Professor Fetter. The two main objectives of the treaty were to test the possibility of making use the DRGs since the database of the Portuguese hospitals and to develop information and financing system by DRGs. The results of the study were good enough in such a way that in 1987 they started the studies to use this sort of financing for the Portuguese National Health Service and in 1989 had initiated the transition period for the DRGs system of payment, which had completely modified the incentives to produce and improve the health goods. The operationalization was made in 1990, but not reflected in the payment system in a straightforward away.

The Portuguese NHS has currently two types of hospitals: "Hospitais do Sector Público Administrativo" (known as SPA) which have pure public administration; and "Entidades Públicas Empresariais" (known as EPE), where the administration of these was transferred to the private sector. The major difference is that hospitals EPE are operating under a more management like set of rules. The first EPE hospitals started operation in 2003, covering roughly half of the NHS hospitals, and over the years the set of EPE hospitals has been increased with SPA hospitals moving their statutes to EPE. And on this context, we are going to investigate whether the upcoding might worry an European public national health service or not.

From the Portuguese laws, we have the exogenous policy change, the 2006 price change in the DRGs. It was formalized by the Portaria no. 132/2003 of the Portuguese Health Ministry. Table 1 shows the DRG pairs where the modification in the weight or in the price was greater. An increase or decrease in the weight or in the price acts as an impulse for the responses given by each hospital. For example, from 2003 to 2006, the DRG 165 had increased its weight and price respectively 64,16% and 80,93%. It means that DRG 165 had become more profitable, given that the costs did not increase in the same magnitude. When this phenomenon happens, we have raised the impulse for the DRG creep. And the real increasing in weight and price of DRGs in Portugal are, probably, a huge impulse for the DRG creep. And then, using this sort of change we want to understand how hospitals respond to the price increases: they keep on the same way, given that the

Table 1: Variations in weight and price for some DRGs

DRG	Δ% weight	Δ% price	Δ% top/bottom in weight	Δ% top/bottom in price
34	-55,38%	-50,78%	10,81%	12,07%
35	-44,58%	-38,71%		
168	-65,46%	-62,05%	28,16%	31,07%
169	-37,31%	-30,98%		
110	-27,38%	-20,06%	57,39%	62,85%
111	30,00%	42,79%		
146	-14,14%	-5,47%	46,01%	50,40%
147	31,86%	44,93%		
150	-17,86%	-9,59%	62,96%	69,44%
151	45,10%	59,85%		
154	-12,57%	-3,84%	72,02%	79,22%
155	59,45%	75,38%		
157	-33,47%	-26,66%	73,29%	80,18%
158	39,82%	53,53%		
159	-21,87%	-14,04%	43,44%	47,07%
160	21,57%	33,04%		
164	0,23%	10,39%	63,93%	70,53%
165	64,16%	80,93%		
188	-14,05%	-5,07%	52,57%	56,26%
189	38,53%	51,19%		
205	11,89%	23,29%	45,07%	49,17%
206	56,97%	72,45%		
244	-9,28%	-0,52%	43,86%	47,86%
245	34,58%	47,33%		
257	-54,36%	-49,83%	19,09%	21,23%
258	-35,27%	-28,61%		
283	-62,76%	-59,03%	8,69%	9,50%
284	-54,08%	-49,52%		
398	-59,84%	-55,91%	10,63%	11,50%
399	-49,21%	-44,41%		

reasons for the change in prices are mainly to adjust hospital costs or the hospitals are taking advantages, upcoding, once that the control instruments used are not powerful enough to control hospital actions.

As a sample of the basic data, table 2 presents the values for DRG 34 and DRG 35 ("other problems in the nervous system, with and without complications").

Table 2: Basic data

	2001		2003		2006	
	weight	price	weight	price	weight	price
DRG 34	1.64	€3160.64	1.64	€3482.13	0.7317	€1713.92
DRG 35	0.78	€1499.65	0.78	€1652.19	0.4323	€1012.61

Source: Portaria 189/2001 of March 9, effective April 1^{st}; Portaria 132/2003 of February 5, effective March 1^{st}; Portaria 567/2006 of June 12, effective August 1^{st}.

The relative difference of DRG prices was 3482.13 - 1652.19 = 1829.94 in 2003 (applicable from 2003 onwards). It has become 701.31 in 2006. The change in the price difference is 701.31 - 1829.94 = - 1128.63 for this particular pair of DRGs. These differences computed for all pairs of DRGs are our exogenous variable of incentive for upcoding. Some of the DRGs evolved with a positive difference in prices, while others have a negative value (such as the pair DRG 34 / DRG 35 reported in table 2 above).

4 A quick illustrative model

There are two DRGs, high, H, and low, L. A number of patients n_i exogenously arrives each period. Patients have sickness with severity η, which is represented by a random variable with distribution F and density f. Each patient is classified into one of the DRGs by the hospital. Let η^* be the cut-off point defined by the hospital (doctors) such that for $\eta > \eta^*$ the patient is classified into the high DRG while for $\eta \leq eta^*$ it is classified into the low DRG.

Let $q_H = \int_{\eta^*}^{\bar{\eta}} f(\eta) d\eta, q_L = \int_{\underline{\eta}}^{\eta^*} f(\eta) d\eta$ be the number of patients in each

DRG. The cost function of the hospital is given by $C(q_H, q_L)$. The hospital receives from the third-party payer a tariff p_i for each patient included in DRG $i, i = H, L$, with $p_H > p_L$. Let $\hat{\eta}$ be the adequate classification of patients. Let $\Omega(\eta^* - \hat{\eta})$ be the penalty function from manipulation of DRG coding, with $\Omega'(\cdot) > 0, \Omega''(\cdot) > 0$.

Benefits to purchaser from treatment of patients is

$$S(q_H, q_L) = k \int_{\underline{\eta}}^{\bar{\eta}} \eta[sq_H + q_L] f(\eta) d\eta \quad (1)$$

The profit for the provider of health care is

$$\Pi = p_H(1 - F(\eta^*)) + p_L F(\eta^*) - C((1 - F(\eta^*), F(\eta^*)) - \Omega(\eta^* - \hat{\eta}). \quad (2)$$

From straightforward comparative statics on the optimal choice of η^* by the provider of health care, we have that an increase in the price difference across DRGs, $p_H - p_L$, results in a lower η^*, that is, more patients are put in the top DRG.[3] The expected effects are present, and the empirical analysis will be based on the necessary assumptions about the cost function.

5 The empirical approach

We follow closely the empirical strategy laid down by Dafny (2005). The main difference is that we add to her equation (3) a set of hospital characteristics plus a hospital fixed effect, as described below.

The other difference we explore relative to Dafny (2005) is the co-existence in the sample of hospitals operating under two distinct regimes. One of them is the traditional public sector management system, while the other is an entrepreneurial-like management model (although hospitals remain under complete public ownership).

5.1 The Data

[3] The second-order condition is assumed to hold, which requires that costs in the top DRG do not grow faster than in the low DRG, or that $\partial f / \partial \eta(eta^*) < 0$ and marginal costs do not increasing too differently across DRGs.

The data used comes from the Portuguese DRG database of all discharges from 2001 to 2008. Considering that the Portuguese NHS has evolved over time time, we have data from some hospitals which had become hospital centers. In order to accommodate this, we aggregated the data from singular hospitals as whether they are only one hospital, since the beginning of the sample.[4] For these cases, we assume fixed effects on hospitals. The hospital groups are: 1) Centro Hospitalar Barlavento Algarvio, composed by Hospital do Barlavento Algarvio and Hospital Distrital de Lagos; 2) Centro Hospitalar do Baixo Alentejo: Hospital de Beja and Hospital de Serpa; 3) Centro Hospitalar de Setbal: Hospital de So Bernardo and Hospital Ortopdico Santiago do Outo; 4) Centro Hospitalar do Nordeste: Hospital Distrital de Mirandela, Hospital Distrital de Macedo Cavaleiros and Hospital Distrital de Bragana; 5) Centro Hospitalar de Lisboa Ocidental: Hospital de So Francisco Xavier, Hospital Egs Moniz and Hospital de Santa Cruz; 6) Centro Hospitalar de Lisboa Zona Central: Hospital de So Jos, Hospital dos Capuchos and Hospital do Desterro; 7) Centro Hospitalar de Coimbra: Hospital dos Coves, Maternidade Bissaya Barreto and Hospital Peditrico de Coimbra; and 8) Centro Hospitalar do Alto Minho: Hospital de Santa Luzia de Viana do Castelo and Hospital do Conde de Bertiandos.

Due to the fact that the Hospital da Prelada and the Hospital Amadora-Sintra have particular characteristics, not present in all other hospitals, we chosen to exclude them from the sample, in order to avoid misleading results on regressions. We also excluded some smaller hospitals due to missing information.

We had selected a particular set of pairs of DRGs for analysis. They are a special group, which correspond to each two similar DRGs that differ only on the fact that the episode does have or have not complications. We have 288 DRGs grouped in 144 pairs. Each two codes like these are called a pair of DRG. For example, the DRG 7 is "procedimento nos nervos cranianos/ perifricos e noutras estruturas nervosas, **com**" CC and the DRG 8

[4]Experimenting with independent effects for hospital per hospital belonging to the same group did not influence the empirical results.

is “procedimento nos nervos cranianos/perifricos e noutras estruturas nervosas, **sem** CC”.

We believe the likelihood in which one agent might discover that the patient is wrongly coded between these two codes is small, because the capacity to distinguish a patient that needs to be coded in DRG 7 or 8 requires a specific knowledge that, in general only doctors have. In other words, for one agent realizes the upcoding, it requires auditing to detect, and it is costly. So, the upcoding is profitable. it must be mentioned that auditing does exist and codification is done by especially trained doctors. This helps to contain the extent of upcoding. Still, not much information is available about those audits.

5.2 Variables, equations and regression form

Our starting point is to define the difference between the reimbursements paid for one hospital considering the most expensive procedure the DRG with complications minus the DRG without complications price. Similar to Dafny (2005, p. 1533), equation (2), we define:

$$spread_{pt} = \begin{pmatrix} \text{DRG price in} \\ \text{the top code} \end{pmatrix}_{pt} - \begin{pmatrix} \text{DRG price in} \\ \text{the bottom code} \end{pmatrix}_{pt}, \tag{3}$$

where p indexes the DRG pair and t indexes the year. The DRG price is common to all hospitals. Given this absolute value, we take the difference in the difference, price difference in 2006 and price difference in 2003. Recall that prices remained stable in the other years.[5] The exogenous variable used to capture the marginal incentive for upcoding with the change in the price difference is defined as:[6]

$$\Delta spread_p = spread_{p\,06} - spread_{p\,03}. \tag{4}$$

The “mean age in pair” variable, $\overline{age}$, was computed as the mean age of all observations for each pair of DRGs, by hospital and by year. Year is

[5] We use as an approximation the full year, although the new prices started to have an effect only at the middle of the year. Since we report below yearly dummies, results need to be interpreted accordingly.

[6] Since we do not have yearly changes in prices, this is equivalent to the procedure used by Dafny (2005).

a variable from 2001 to 2008, which indexes the time of the observations. Lotation, cmi and waiting time was extracted from hospital reports obtained at hospital web pages or from Administração Central do Sistema de Saúde, a Portuguese department linked to the Ministério da Saúde. The mediumcost2 was computed from total cost of each hospital, for each year obtained at the same places where we took the other variables. The variable was then generated by the division of the total cost of each hospital, by year, for the total patients gone. Afterwards, the result was divided by 10^6; the other independent variables that appears on the regressions are dummy variables for each hospital used on the sample.

The dependent variable, $\phi_{p\,i\,t}$, is the percentage of the total patients in each pair included in the DRG with complications, by pair of DRG, by hospital and by year. To better read the results, we had multiplied the fraction by 100: $\phi_{p\,i\,t}$ = (number of procedures included in the top code DRG)$_{p\,t\,i}$ / (number of patients included in the top code DRG + number of patients included in the bottom code DRG)$_{p\,t\,i}$ where p indexes the pair of DRG, t indexes the year and i indexes the hospital.

The independent variables are the characteristics of each pair of DRG, year, CMI, lotation, medium cost, waiting time and in special, mean age of each pair of DRG and the change in the financial gain of upcoding.

The relevant equation is:

$$\phi_{p\,i\,t} = \alpha + \Theta pair_p + \delta year_t + \gamma H_i + \psi \Delta spread_p \times post + \beta \overline{age}_{p\,i\,t} + \Lambda X_i. \quad (5)$$

The δ vector of coefficients can be interpreted as the medium impact of the prices and weights changes on all pairs. Otherwise, the ψ coefficient measures the marginal effect that changes in the spread promote in the fraction. The β coefficient is the impact of mean age in each pair to the fraction and works as a control for the (possible) increase in severity of cases over time.

[table here with descriptive statistics]

Hospital characteristics available (number of beds, average costs per patient discharged, case-mix index and average length of stay) have different relations to the upcoding issue. The number of beds that a hospital has is usually determined at the construction phase, or posterior adjustments taking place at spaced intervals of time. It is unlikely to be correlated contemporaneously with upcoding. A different situation occurs for the case-mix index. The computation of this index is based on the DRG episodes that occurred in each hospital. Systematic upcoding also creates an upward pressure in the case-mix index. However, the final index value is computed normalizing the average national value to the unit value. Common upgrading does not necessarily change the relative position of each hospital. Nonetheless, it has the potential to be endogenous.

The remaining hospital characteristics, average cost per patient discharged and average length of stay, may or may not be directly associated with the upcoding. Whenever the upcoding does not imply a different course of action but merely a distinct classification code (and the corresponding payment), the observed costs and length of stay will be independent of the extent of upcoding. On the other hand, if classification of patients into a different DRG leads immediately to another treatment protocol, yearly average costs per patient treated at the hospital level are positively associated with the extent of upcoding.

6 Results

6.1 The basic results

Our first set of results replicates Dafny (2005). Similarly to what was found for the US, our estimates show an increasing trend in the share of patients in the top DRG. This is holds even after controlling for the effect associated with treatment, on average, of an older population. The overall average effect can be interpreted as upcoding, but it actually has started before the 2006 change in DRG prices. Probing further, we find that the coefficient ϕ has a positive sign, implying that larger price changes are positively associated with a stronger share of the top DRG.[7]

Table 3: Estimation results : Dafny (2005)

Variable	Coefficient	(Std. Err.)
mean_age_in_pair	0.41631**	(0.04369)
spread_0308	0.00066*	(0.00026)
yeard4	0.70901**	(0.24182)
yeard5	0.82186**	(0.27560)
yeard6	1.53190**	(0.34122)
yeard7	1.83526**	(0.37290)
yeard8	2.20449**	(0.43650)
Intercept	16.10221**	(2.57973)
N	41420	
R^2	0.06272	
$F_{(6,103)}$	21.74905	

Significance levels : † : 10% ∗ : 5% ∗∗ : 1%

This approach leaves outside the additional information resulting from hospitals' characteristics. Adding the set of five available hospital characteristics and hospital fixed effects, the estimates have the same qualitative features. The novelty lies in the positive and statistically significant effects associated with the index of case mix and the number of beds in the hospital. Larger hospitals are also the ones that have a higher technological differentiation that may not be fully captured by the case-mix index. The control for hospital characteristics does improve the statistical fit but does not alter the main conclusions.

Table 4: Estimation results : Dafny (2005) + H_i

Variable	Coefficient	(Std. Err.)
mean_age_in_pair	0.66479**	(0.05378)

Continued on next page...

[7]Estimation also included fixed effects for the DRG pair. Standard errors were computed considering cluster at the DRG pair level.

... table 4 continued

Variable	**Coefficient**	**(Std. Err.)**
spread_0308	0.00052†	(0.00027)
beds	0.01262**	(0.00130)
icm	2.68162*	(1.03158)
dm	0.20001	(0.20247)
mediumcost2	-0.17942	(6.84333)
yeard4	0.57050*	(0.22917)
yeard5	0.69951**	(0.26093)
yeard6	1.47815**	(0.32413)
yeard7	1.71766**	(0.33943)
yeard8	1.82023**	(0.40079)
Intercept	-10.72345**	(3.68843)
N	38336	
R^2	0.2225	

Significance levels : $\dagger$: 10% $*$: 5% $**$: 1%

The current trend of increased share of the top DRG seems to have an important shift after the 2006 DRG price change under both specifications. It is also the case that overall complexity, proxied by the average age of patients within the DRG pair, has increased over time.

As described previously, the distinction between pure public hospitals, SPA, and more private-management like hospitals, EPE, is potentially important. We test for it allowing time dummies and the marginal incentive to upcode to be different according to the type of statutes for the hospital.

Table 5: Estimation results : Dafny (2005): EPE vs. SPA

Variable	**Coefficient**	**(Std. Err.)**
mean_age_in_pair	0.41708**	(0.04374)
spread_0308	0.00076*	(0.00031)
yeard4	1.26949†	(0.74853)
yeard5	1.20020	(0.80548)
yeard6	1.69714	(1.03223)
yeard7	1.86219†	(0.95901)
yeard8	1.31304	(1.05781)

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... table 5 continued

Variable	Coefficient	(Std. Err.)
yd4	-0.43032	(0.56861)
yd5	-0.28380	(0.56014)
yd6	-0.13177	(0.68784)
yd7	-0.02527	(0.62207)
yd8	0.67677	(0.67054)
EPE_SPA_index	-0.28499	(0.47761)
vspread_EPE	-0.00040	(0.00040)
Intercept	16.42784**	(2.48038)
N	41420	
R^2	0.06303	
$F_{(13,103)}$	15.35753	

Significance levels : † : 10% ∗ : 5% ∗∗ : 1%

Table 6: Estimation results : Dafny (2005) + H_i

Variable	Coefficient	(Std. Err.)
mean_age_in_pair	0.66488**	(0.05378)
spread_0308	0.00067*	(0.00034)
yeard4	1.14954	(0.70028)
yeard5	1.13749	(0.79018)
yeard6	2.18492†	(1.12168)
yeard7	2.53626*	(1.05592)
yeard8	1.97833†	(1.14134)
yd4	-0.42914	(0.54443)
yd5	-0.32355	(0.55096)
yd6	-0.53657	(0.75152)
yd7	-0.61937	(0.66920)
yd8	-0.11981	(0.71090)
EPE_SPA_index	3.79239	(3.87906)
vspread_EPE	-0.00052	(0.00044)
beds	0.01270**	(0.00129)
icm	2.54184†	(1.29578)
dm	0.21838	(0.21781)
mediumcost2	-0.01168	(6.83421)
Intercept	-14.63006*	(5.79983)

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... table 6 continued

Variable	Coefficient	(Std. Err.)
N	38336	
R^2	0.22266	

Significance levels : † : 10% ∗ : 5% ∗∗ : 1%

Adding the possibility that impact of upcoding is different according to the status of the hospital does not bring any further insight. The two groups of hospitals do not seem different in this respect. The coefficients associated with variables *yd* measure the shift to the yearly dummies for hospitals that are under the EPE statutes. They are all statistically non-significant. Variable EPE_SPA_index allows for a distinct intercept term for EPE hospitals, and $vspread_EPE$ does it for the coefficient of marginal incentive for upcoding. None is statistically significant. Therefore, we conclude for the absence of difference between the two sets of hospitals.

6.2 A more long term view

An important issue to be addressed is whether the current trend is a long-term historical trend or started with the 2003 DRG price change. We addressed only the 2006 price change, which may just reinforced a change that already resulted from the 2003 price change.

Table 7: Estimation results : Long term view - without H_i

Variable	Coefficient	(Std. Err.)
mean_age_in_pair	0.42696**	(0.04239)
yeard2	0.68221**	(0.25269)
yeard3	0.49694†	(0.27489)
yeard4	1.17952**	(0.33380)
yeard5	1.30324**	(0.35457)
yeard6	1.60875**	(0.38740)
yeard7	1.98792**	(0.45797)
yeard8	2.28884**	(0.49195)
Intercept	14.91206**	(2.46854)

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... table 7 continued

Variable	**Coefficient**	**(Std. Err.)**
N	57226	
R^2	0.0672	
$F_{(7,103)}$	18.91304	
Significance levels :	† : 10% ∗ : 5%	∗∗ : 1%

Table 8: Estimation results : Long term view - with H_i

Variable	**Coefficient**	**(Std. Err.)**
mean_age_in_pair	0.66021**	(0.04960)
yeard2	0.42496†	(0.25056)
yeard3	0.18153	(0.24073)
yeard4	0.62767*	(0.29772)
yeard5	0.85580**	(0.29202)
yeard6	1.45222**	(0.32366)
yeard7	1.73893**	(0.37949)
yeard8	1.85422**	(0.40770)
beds	0.00973**	(0.00107)
icm	5.66891**	(0.81091)
dm	-0.18571	(0.15744)
mediumcost2	2.68990	(4.09737)
N	51934	
R^2	0.22579	
Significance levels :	† : 10% ∗ : 5%	∗∗ : 1%

Using the simplest regression model, without the impact of the price change per DRG, or just adding two initial years to the previous regressions, we find that years 2001-2003 seem to be somewhat different than the others. The changes occurred in 2003 may have created some incentives for upcoding, but another shift seems to take place in 2006, with the latest change in DRG prices.

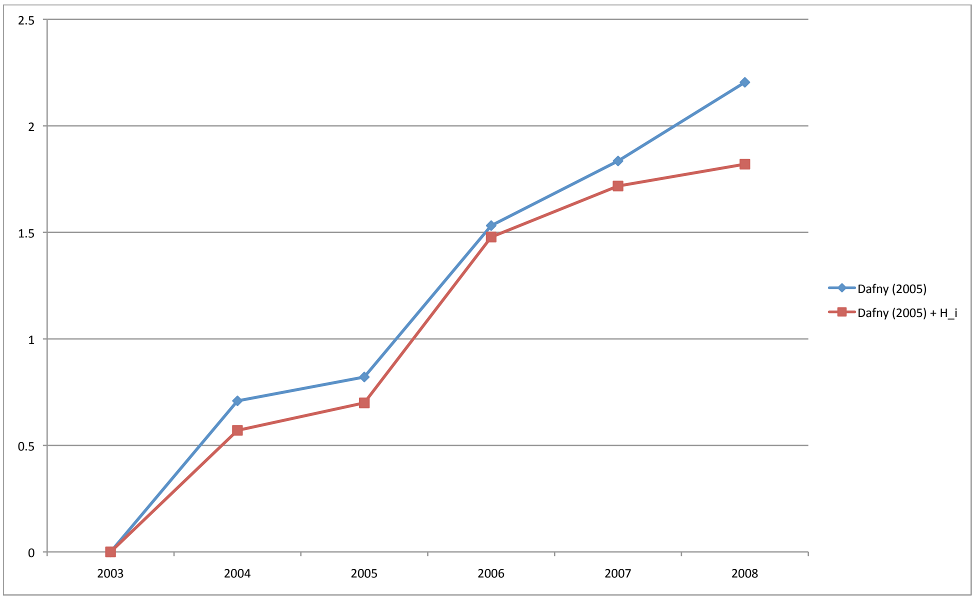

Figure 1: time evolution

6.3 Age effects

Age can be a discriminating variable. To assess its role in helping upcoding, we need to consider the average age in the top DRG and the average age in the bottom DRG.

Figure 3 is the average of the average age per pair of DRGs. Even at this aggregate level a couple of empirical facts are worth noting. First, the evolution before and after 2006 seems to be distinct. In the first years of our sample, average age within each pair of DRGs is increasing but at an intermediate rate between the top DRG growth rate of patients' average age and the bottom DRG growth rate. However, since 2006, we observe a clear shift toward average age at the DRG-pair level increasing faster than in the bottom and the top DRGs. This can only result from a composition change, characterized by a slower growth in average age of both DRGs caused by

Table 9: default

	Dafny (2005)-post	Dafny (2005)-post+H_i	Dafny (2005)	Dafny (2005) + H_i
2001	0	0	0	0
2002	0,6821	0,4249	0,5842	0,3463
2003	0,4969	0,1815	0,4293	0,1421
2004	1,1795	0,6276	1,1091	0,5877
2005	1,3032	0,8558	1,2281	0,7962
2006	1,6087	1,4522	2,0461	1,8124
2007	1,9879	1,7389	2,3446	2,0595
2008	2,2888	1,8542	2,7069	2,1926

older patients in the bottom DRG (which has a lower average age) moving to the top DRG (where they will be relatively young patients).

If age is associated with hight complexity and it is used as a lead signal to how sever it will be the case, a change in the criterion for inclusion in the top DRG of younger ages would result in an testable empirical prediction.

The following tables report the estimates related to the role of age. In case upcoding takes more patients but less complicated cases to the top DRG, and assuming age to be positively correlated to severity of the case, then we should observe average age decreasing in both DRGs of the pair.

The alternative hypothesis is that the patient mix has worsen over time, implying that average age of patients increases over time in both DRGs of each pair, and in a way unrelated to the change in DRG prices.

Thus, the two hypothesis have different implications to the coefficient of interest. We are interested in the overall trend of average age in both the top and the bottom DRG in the pair, and in the marginal effect associated with the magnitude of the price change.

The hypothesis of worst cases leads to a positive trend over time in both top and bottom DRG and non-significant statistically coefficient on price change. The upcoding hypothesis implies a negative trend reinforced by price sensitivity - a more pronounced effect is expected when relative prices change more.

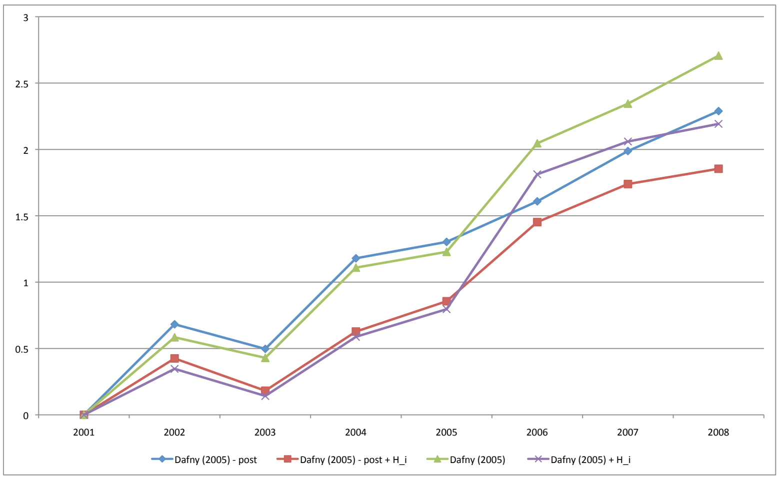

Figure 2: time evolution

We first report the analysis for the top DRG and then for the bottom DRG. The dependent variable is the difference of average of top/bottom DRG and the average age in the pair of DRGs. Fixed effects for pair of DRGs and hospitals were included (not reported in the tables).

Table 11: Estimation results : Age effects (DRG with complications)

Variable	**Coefficient**	**(Std. Err.)**
yeard2	-0.17663	(0.12854)
yeard3	-0.09951	(0.16611)
yeard4	0.02671	(0.15693)
yeard5	0.09731	(0.16661)
yeard6	-0.16183	(0.16404)
yeard7	-0.16290	(0.16751)
yeard8	-0.15729	(0.15919)
beds	0.00055	(0.00034)
icm	-1.54801**	(0.29799)
dm	-0.22444**	(0.07786)
mediumcost2	-16.65256**	(2.62519)

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... table 11 continued

Variable	Coefficient	(Std. Err.)
Intercept	8.40292**	(0.67750)
N	51934	
R^2	0.03441	

Significance levels : † : 10% * : 5% ** : 1%

Table 12: Estimation results : Age effects (DRG without complications)

Variable	Coefficient	(Std. Err.)
yeard2	-0.05515	(0.08260)
yeard3	-0.02825	(0.08622)
yeard4	-0.19253†	(0.10294)
yeard5	-0.28591**	(0.09721)
yeard6	-0.40258**	(0.11158)
yeard7	-0.42334**	(0.11487)
yeard8	-0.40518**	(0.11833)
beds	-0.00209**	(0.00031)
icm	0.42991†	(0.25000)
dm	0.20446**	(0.07037)
mediumcost2	5.04805**	(1.42616)
Intercept	-4.16824**	(0.56869)
N	51934	
R^2	0.04109	

Significance levels : † : 10% * : 5% ** : 1%

Taking first the results for the top DRG within each pair, we observe that in years 2002-2005, the difference was positive, afterwards is negative, though is most cases statistically non-significant (statistically significant effects occur only in 2007, with the average age in top DRG decreasing relative to average age in pair). For the bottom DRG, a very different picture emerges, as the difference over time increases always, being statistically sig-

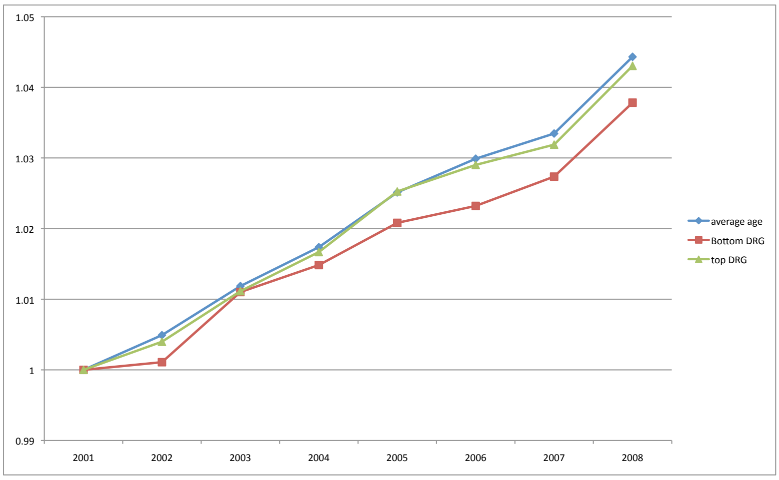

Figure 3: Average age

nificant since 2004. It means that average age within the bottom DRG is evolving at a smaller pace than the average across the pair of DRGs.

Taking together both tables, we have support to the basic fact evidence in Figure 3. Such evidence is consistent with the presence of upcoding.

6.4 DRG-pair effects

The control for each pair of DRGs was based on fixed effects at the level of the DRG pair. Thus, a natural robustness check is to test the presence of upcoding in each pair of DRGs making use of the cross-section dimension (hospitals) and the time dimension (6 years). We take two different versions: a level shift associated with the introduction of the new prices in 2006 and a linear trend change after the new 2006 DRG prices. Both types of estimates coincide in having, for most DRGs, no change due to the 2006 prices (and in many cases, no statistically significant trend for the share of the top DRG within the pair).[8]

[8]Results available upon request.

Table 10: Average age

	average age	Bottom DRG	top DRG
2001	57,4604	54,4184	62,4075
2002	57,7429	54,4775	62,6559
2003	58,1420	55,0182	63,1032
2004	58,4586	55,2261	63,4482
2005	58,9040	55,5511	63,9839
2006	59,1784	55,6815	64,2183
2007	59,3833	55,9073	64,3976
2008	60,0071	56,4770	65,0938

7 Final remarks

In a recent work, Dafny (2005) found that US hospitals were quick to react to DRG prices changes, and to profit considerably from upcoding, that is, classifying patients in those DRGs that allowed for a higher payment, and have done so more when the favorable price change was stronger.

A natural issue is whether upcoding is a US phenomenon or can it be found in other health systems as well. This question is particularly important as many countries over the last decade introduced patient classification systems. Purchasers of health care, be it Governments through national health services or sickness funds or health insurance companies, are increasingly using such patient classification systems for payment to providers.

We use data from a national health service with the following features. Demand to each hospital is basically exogenous, as patients have to comply with Government-defined catchment areas for each hospital. Hospitals have to classify patient episodes into a DRG-like system. Hospitals are not paid on an episode-by-episode basis but yearly budgets have been increasingly based on the DRGs and the DRG mix the hospital provides. DRG prices are set by Government ruling and have infrequent changes, and the background studies supporting the new prices are not known to hospitals. Thus, price changes can be seen as exogenous from the point of view of hospitals.

Our results have a mixed view on the issue. Upcoding, described by an increase in the share of the top DRG within pairs of DRGs, has increased over time (2001-2008), and more so in recent years. Moreover, not only upcoding has been occurring above what would be predicted by the simple ageing of population (assumed to be captured by the average wage of patients in the DRG pair), but has been more important when the price change was stronger. This points to the conclusion that even within national health services, management of hospitals does respond to incentives for upcoding patients.

The current results are preliminary. They point to the existence of upcoding as a relevant issue also in the context of a National Health Service.

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