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THE USE OF TECHNOLOGY IN PORTUGUESE HOSPITALS – THE CASE OF MRI

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Abstract

We study the determinants of MRI use across Portuguese NHS hospitals for patients belonging to specific DRGs.

Using data on individual hospital admissions, we estimate a probit model including individual-, hospital-, time- and region-specific variables in order to explain the probability of a patient being sent for MRI.

Results convey a tightening effect on the hospital's budget constraint in the end of each year. Hospitals seem to account for regional characteristics when defining adoption patterns. Individual-specific variables are good predictors of MRI use. Measures taken by the Government only impact the short run. Finally, the gains from an MRI scan, as far as the probability of death is concerned, occur mainly for less severe patients.

Keywords: technology use; MRI; Portuguese hospitals; patients' survival.

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1. Introduction

The expenditure with the Health sector has been steadily increasing in developed economies during the last decades. About half of this growth is due to technological progress, according to the Congressional Budget Office (2008). Some authors go even further and claim that it is not technology itself that is driving up health expenditures, but rather the way it is (inefficiently) adopted and used – Chandra and Skinner (2011).

The aim of this project is to give an insight on the factors that determine the way technology is used. More specifically, we focus on the case of Magnetic Resonance Imaging (hereby MRI) scans carried out at Portuguese National Health System (NHS) hospitals over patients with specific medical conditions, given by a set of Diagnosis Related Groups between 2006 and 2010.

We propose a probit model that accounts for four dimensions that can possibly explain the probability of a patient being sent for an MRI: time, hospital characteristics, individual characteristics and region specificities. If variations in the use of MRI scans cannot be explained by the characteristics of each patient and the associated episode, then they reflect differences either in adoption or in clinical procedures across hospitals.

Overall, we find evidence of a tightening effect on the hospital's budget constraint in the end of the year, meaning that there is a fall in the number of patients being sent for MRI. Results also convey that hospitals adapt their technology adoption patterns to the characteristics of the region they are located in. Measures taken by the Government only impact the short run and the gains from an MRI scan occur mainly for less severe patients.

The remainder of this project goes as follows. The next section presents a brief survey of relevant literature and section 3 gives some background on MRI technology.

Methodology is covered in section 4, whereas section 5 presents some descriptive statistics. Section 6 characterizes the datasets and variables used in the empirical analysis, whose results are presented in section 7. Section 8 develops on the effect of an MRI scan on patients' survival. Finally, section 9 concludes.

2. Literature Review

We begin with general considerations regarding the link between technological innovation and health care spending growth and only then we move to literature specifically aimed at studying technology adoption and use.

The Congressional Budget Office (2008) looks in detail into the factors underlying the growth of health care spending in the US. The authors associate about half of the long term growth in health expenditure with technological breakthroughs, their adoption and diffusion.

Both Chandra and Skinner (2011) and Baiker and Chandra (2011) elaborate on the idea that it is not technological progress itself the responsible for the rise in costs, but the mechanisms promoting an inefficient use of technology. In the former piece of literature, the authors defend that countries not adopting treatments with low cost-effectiveness ratios end up with great cost increases and small improvements in health outcomes. In the latter, it is pointed that productive inefficiency can arise from a wrong order of technology adoption (low-value technologies being adopted before high-value ones), which can alter the shape of the production function so that we end up with increasing marginal returns, meaning that one would like to further increase health spending.

As far as technology adoption itself is concerned, there are two theoretical models worth mentioning. In Barros and Giralt (2011), the authors relate the rate of

technology adoption with the nature of the payment system in place. Conclusions are that only the homogeneous DRG payment scheme leads to the optimal level of technology adoption by the hospital. Both the heterogeneous DRG system and the cost reimbursement are associated with over-adoption.

Dengler (2006) models the decision of hospitals on the time of technology adoption accounting for two sources of inefficiency: a business stealing effect and a preemption effect. The model is tested against U.S. panel data and the preemption effect is found to be significant but of small magnitude, meaning that there is no big advantage in being the leader rather than the follower as the former cannot prevent the latter from adopting. Hence, it is the business stealing effect that dominates.

The focus on MRI technology is common in the literature. Using U.S. data, Baker (2001) finds evidence that a larger share of managed care activity is associated with a lower adoption probability. Also, being either a large or a specialized hospital has a positive impact on the likelihood of adoption, while variables such as urbanization and the number of hospitals in the neighborhood have a negative effect. Controlling for the presence of MRI substitutes – i.e. computed tomography (CT) – yields similar results. Teplensky et al. (1995) also elaborate on MRI adoption by U.S. hospitals. Using Cox regression, they find that it is very much driven by the desire of the hospital to be seen as a technological leader and by expectations of future revenues.

Oh et al. (2005) propose a model of determinants of MRI and CT diffusion in which they account for purchasing power, patient's needs, physicians demand, Government regulations and the degree of flexibility of payment methods, both to hospitals and to physicians. The model is tested using cross-sectional data on all OECD countries for 2000. Using multiple regression analysis, they find evidence that both total

health expenditure *per capita* (a measure of purchasing power) and flexible payment methods to hospitals positively influence the diffusion of CTs and MRIs.

Kung et al. (2005) use a panel data setting consisting on data regarding Taiwan's population and use multiple regression analysis as a means to explain the determinants of average uses of both CT and MRI per 1000 people per year. Conclusions are that the number of hospital-based physicians, the number of hospital beds, the number of MRI units and the ratio of female population have a positive impact on the average uses of MRI while the average regional income has a negative one. Results for CT are similar.

3. Background on MRI

MRI is an imaging technique that allows for producing high quality images of body tissues, which began to be commercially available in the 80's. Its pace of diffusion was too slow when comparing to similar devices (CT), which may result from the combination of a large initial investment with the operational costs and necessary site preparation. The fact that the clinical role of MRI was still not well-established, implying a high degree of uncertainty regarding the profitability of the devices may also have played a role (Hillman and Schwartz, 1986).

When MRI scanners became available, many people saw this technique as a less costly substitute of exploratory surgery and predicted a fall in health expenditure as a considerable number of surgeries would be replaced by MRIs. However, its nature also makes more people willing to use it, so that the final effect turned out to be an increase in total health expenditure (CBO, 2008).

4. Methodology

First of all, it is worth defining the concept of Diagnosis Related Groups (DRG). It is a method used to classify patients who are admitted at a hospital according to their

clinical status and consumption of resources. That is, patients who are made similar diagnosis and hence are expected to consume a similar amount of resources during their stay at the hospital are classified in the same DRG.

To begin with the analysis, we look at the DRG (AP21 version) codes for medical procedures in order to identify those that correspond to MRI scans. These are codes 8891, 8892, 8893, 8894, 8895, 8896, 8897 and 8899. The next step is to identify the ten DRG groups whose patients got more MRI scans. Indeed, because there are so many groups and it would be hard to extract any evidence by considering them all together, we focus on the ten which present a higher absolute frequency of patients getting MRIs. One should note that this approach disables us to account for an eventual second MRI got by the same individual. However, due to the relatively rare occurrence of second MRIs, we do consider the consequences of such simplification to be negligible. For 2010, the corresponding DRGs are 2, 11, 12, 13, 14, 25, 243, 533, 810 and 832. An ordered rank of these ten DRGs using as criteria the number of patients sent for MRI follows.

Table 1: The ten DRGs with higher absolute frequency of patients sent for MRI[1]

DRG	# Patients getting MRI	# MRIs	# Patients getting >1 MRI	Total DRG episodes	% getting MRI
14	2.071	2.130	59	15.159	13,66%
533	634	678	44	5.830	10,87%
2	503	510	7	2.110	23,84%
243	456	496	40	3.505	13,01%
832	455	469	14	2.978	15,28%
11	422	430	8	907	46,53%
25	372	381	9	1.878	19,81%
13	324	429	105	740	43,78%
810	294	300	6	3.316	8,87%
12	293	339	45	1.216	24,10%

[1] DRG14, the one whose patients are more often sent to MRI scans corresponds to intracranial hemorrhage or cerebral infarction.

As conveyed by column 4, the number of individuals being subject to more than one MRI is low and only in the case of DRG13 one could claim the proposed approach to be flawed. Still, the fact that a relatively high percentage of DRG13 patients get more than one MRI is most likely related to specificities of the associated condition[2].

Also worth considering is the percentage of patients classified in the ten DRGs who were sent for an MRI. In fact, when one looks at the ten above listed DRGs, it is impossible to tell whether the majority of patients classified under that DRG code needs such examination or if it is just the case that there is a large number of patients being classified under that code. Column 6 presents the figures in relative terms for 2010 and one can conclude that the percentage of patients sent for MRI varies a lot depending on the respective DRG, which is probably a consequence of the specificities of the condition associated with each DRG. However, the DRGs that exhibit the highest absolute frequency of patients sent for the examination are not those presenting the highest percentage of patients getting an MRI.

At this point, one might argue that the DRGs whose patients got more MRI scans may vary over time and hence the approach hereby followed would not be correct. Yet, there seems to be some persistence regarding this rank of DRGs. As a matter of fact, for the datasets corresponding to the remaining years the DRGs making it to the ranking are exactly the same, despite some changes in the order. Hence, we shall stick with this list of DRGs for the rest of the analysis, implying no loss of generality.

A feature of the data worth exploring is the evolution of the number of patients being sent for an MRI scan over the year as a tightening effect on the hospital's budget constraint might occur at the end of the year. The next section develops on this matter.

[2] DRG 13 corresponds to multiple sclerosis and cerebellar ataxia.

As far as regression analysis is concerned, the dependent variable is the probability of an individual being sent for MRI, which, by construction, only takes values between zero and one. Therefore, we use the probit model as an attempt to find out which factors do actually play a role in explaining the probability of a given individual being sent for an MRI scan.

Another approach to the problem would be a two-part model in which hospitals decide first on whether to adopt MRI technology or not and then decide on how many patients to send for MRI. The probit model is chosen over this alternative because we lack information regarding the place where the MRI was done (inside the hospital vs. outside the hospital in case the hospital does not own the equipment). Thus, we cannot know exactly which hospitals adopted MRI technology and when they did so, which makes the two-part model option unfeasible.

We account for individual-, hospital- and region-specific factors when specifying the probit model. As for time variables, these are included as well in order to capture both the tightening on the hospital's budget constraint in the final months of the year and the overtime trend of MRI use. The general model specification is the following[3].

$$\Pr[MRI=1] = \Phi(\beta_0 + \beta_1 IND + \beta_2 TIME + \beta_3 HOSP + \beta_4 REGION) \quad (1)$$

, where MRI is a dummy variable equal to one in case the individual is subject to an MRI during his stay in the hospital and zero otherwise. IND, $TIME$, $HOSP$ and $REGION$ are vectors including the individual-, time-, hospital- and region-specific variables, respectively.

[3] For a more formal presentation of the probit model and deeper understanding of its specificities, see Cameron and Trivedi (2009).

In the end we test whether MRI helps survival by running a probit model whose dependent variable equals one in case the patient has died during his stay at the hospital and zero if not. The dummy variable capturing whether the individual was sent for MRI is included in the regressors, together with other individual- and hospital-specific variables.

5. Descriptive Statistics

In the current section we look at the evolution of the number of patients being sent for MRI scan over the year. One expects it to fall in the last months of the year relatively to the remaining months due to the possible tightening of the hospital's budget constraint. As a matter of fact, such behavior does show up in the data. Using data for 2010, in the case of DRGs 2, 14, 25, 533 and 832 there is a clear downward trend in the number of patients getting MRIs in the last months of the year. As for the remaining DRGs there is only evidence of a decrease for the figure corresponding to December. Still, that figure is the lowest of the year in the vast majority of the considered DRGs. The graphs depicting the evolution of the number of patients belonging to each DRG that were sent for MRI scans in 2010 are shown in the appendix. It is worth noting that the possibility of 'avoiding' an MRI is influenced by the degree of severity with which the condition corresponding to a certain DRG is associated to[4].

This pattern of behavior is common to all the years considered in the sample. However, descriptive evidence is not enough to state that the tightening of the hospital's budget constraint plays a role in explaining differences in treatment for similar patients. In order to address this point, one needs to perform regression analysis.

[4] Indeed, some graphs depict a higher decline than others. This occurs both in absolute and in relative terms – 15,6% for DRG2 against 69,8% for DRG533.

6. Data

In this project we use two data sources. First, we use data on individual hospital admissions at NHS hospitals collected by Administração Central do Sistema de Saúde ranging from 2006 to 2010. Individual-, time- and hospital-specific variables are either taken from these datasets or built upon them.

More specifically, individual variables include a dummy for gender, taking value one for females and zero for males; the patient's age expressed in years and its square; an interaction term between gender and age; the number of procedures the patient is subject to and the number of diagnosis he is made, as controls for illness severity; and the mortality rate referring to the individual's DRG for the hospital where he is treated, during the three months previous to his release date.

Time variables consist on the admission year and eleven dummies ranging from January to November in order to account for the admission month.

Hospital variables include a dummy taking value one if the hospital had already been transformed in an EPE[5] at the admission time and zero if not; another taking value one if the hospital belongs to a hospital center at the admission date and zero otherwise; a third one equaling one if a contract was celebrated with the Ministry of Health for the corresponding year and zero otherwise[6]; one taking value one in case of teaching hospitals and zero otherwise; two other dummies taking value one in case of District

[5] An EPE hospital is considered to be out of the Government sphere as far as its budget is concerned, as it enjoys an enterprise-like status. Though their expenditures need not be predicted in the General Budget, EPE hospitals are subject to financial control by the Government. Conversely, SPA hospitals belong to the public sphere and their expenses must be predicted in the General Budget.

[6] These contracts are aimed at fixing not only the objectives of the hospital in terms of health care production for a certain time frame, but also the payment that the hospital will receive as a function of its achievements.

and Level 1 hospitals, respectively – Central hospitals are set as benchmark[7]. Hospital size is captured by the total number of patients admitted during a certain year.

We complement the analysis with regional variables taken from Instituto Nacional de Estatística. These are the average income, the percentage of high school and college graduates, the number of physicians per 1000 inhabitants and the percentage of elderly population. We add regional population and population density (simple and squared terms). Variables capturing income and education are available per NUTS II, whereas the remaining ones are available per NUTS III.

We match each individual in the dataset with the region where he receives treatment rather than that where he lives. This allows to test whether hospitals located in different regions differ in clinical practices and adoption patterns.

Regional variables play an additional and important role. They avoid a possible endogeneity problem caused by the introduction of the mortality rate referring to the individual's DRG for the hospital where he is treated during the three months previous to his release date. Indeed, some of the factors simultaneously affecting this regressor and clinical practices are related with the demand side and, thus, included in $REGION$.

The final sample consists in 194.516 individual observations belonging to the ten above mentioned DRGs from which 26.703 were sent for an MRI scan.

7. Empirical Analysis and Results

We run a probit model whose dependent variable is a dummy taking value one in case the individual is sent for MRI and value zero otherwise. The independent variables are those mentioned in the previous section. The results follow in column (1) of table 2. Recall that the coefficients of a probit regression tell us the direction of the

[7] A hospital is classified as either Central, District or Level 1 according to its geographic influence.

marginal effect but not its magnitude. Therefore, whenever marginal effects are mentioned, these are evaluated at the means of the independent variables.

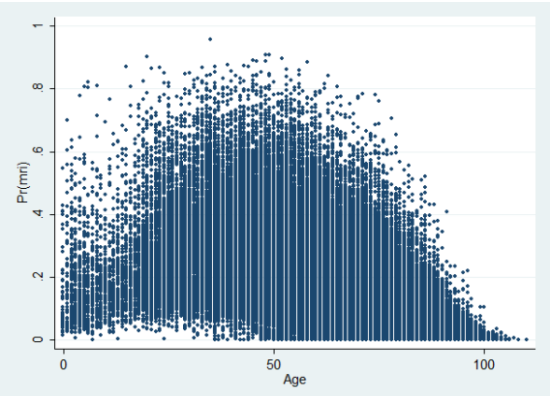
Table 2: Results of probit model estimation

Pr[Mri]	(1)	(2)
Gender	-0.412***	-0.416***
Age	0.033***	0.034***
Age squared	-0.001***	-0.001***
Gender * age	0.006***	0.006***
Total number of procedures	0.099***	0.104***
Total number of diagnoses	-0.052***	-0.050***
Mortality rate	-3.069***	-3.061***
Admission year	-0.032***	0.130***
Admitted in January	0.031*	0.031*
Admitted in February	0.048***	0.042**
Admitted in March	0.068***	0.068***
Admitted in April	0.070***	0.062***
Admitted in May	0.075***	0.066***
Admitted in June	0.045**	0.042**
Admitted in July	0.078***	0.076***
Admitted in August	0.090***	0.093***
Admitted in September	0.084***	0.085***
Admitted in October	0.091***	0.088***
Admitted in November	0.074***	0.076***
Epe hospital	-0.167***	0.122***
Hospital center	-0.085***	-0.041**
Contract with Min. of Health	-0.036**	-0.017
Total patients admitted / 1000	0.007***	0.001**
District hospital	-0.142***	-3.223***
Level1 hospital	-0.614***	-2.683
Teaching hospital	-0.253***	-3.278
Average Regional income	0.005***	-0.000
Region population > 65 (%)	-0.046***	-0.021
# physicians per 1000 inhabitants	0.001	-0.339***
High school graduates (%)	0.047***	-0.023***
College graduates (%)	-0.111***	-0.011
Region population / 100000	-0.155***	-1.259***
Region population / 100000 squared	0.002***	0.057***
Population density / 1000	-0.506***	15.798***
Population density / 1000 squared	0.001***	-0.010***
Constant	60.05***	-256.9***
Hospital fixed-effects	No	Yes
N	194516	194122
R2	0,1599	0,1928

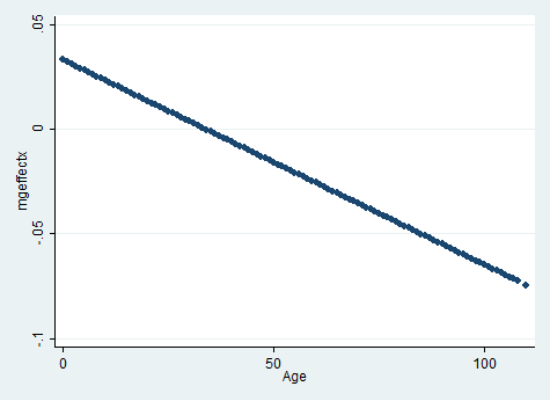
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Overall, the pseudo-R^2 of the model is about 16%, which is fairly reasonable as there are many other factors influencing the probability of an individual being sent for MRI that are not being accounted for in the model. Only the coefficient referring to the number of physicians in the region is not statistically distinguishable from zero.

The patient's age has an interesting pattern of behaviour. Its impact on the probability of being sent for an MRI is positive up to a certain threshold, exhibiting decreasing marginal returns. After that point, we have that the impact of age on the probability of an individual being sent for MRI is negative. By plotting the patient's age and predicted values of MRI one can observe an inverted-U relationship with an inflection point around 33 years old[8]. The exact impact of this variable on the probability of being subject to an MRI depends on the individual's age – it is associated with an expected drop of 0,035 percentage points evaluated at 69,816, the mean of age.



Graphic 1: Scatterplot of individual's age and predicted values of MRI.



Graphic 2: Total marginal effect of age.

The fact that the patient is female is associated with lower probability of being sent for an MRI, pointing to the existence of gender discrimination regarding MRI use.[9] As far as the interaction term is concerned, its coefficient tells us how the impact of age varies according to gender. We have that the interaction term between gender and age

[8] This coincides with the domain of the ages of patients being sent for MRI, which ranges from 0 to 104.
[9] See Perelman, Mateus and Fernandes (2010) for more on gender differences. They study the case of cardiac heart disease in Portugal and conclude that there is evidence of such discrimination favouring men, especially either prior to acute disease detection or in the case of emergency episodes.

bears a positive coefficient. Since the direction of the marginal impact of age varies depending on the value taken by the regressor, it is useful to look at the effect evaluated at the mean. That is, at the mean, the marginal effect associated with age is negative, so we have that its magnitude is lower if the patient is female. In case we are at a point where the marginal effect of age is positive, then being a female is associated with a probability of being sent for an MRI that is higher than that for males.

The mortality rate of the corresponding DRG, for the hospital where the patient was treated, during the three months previous to his release date is also associated with a drop on the probability of being sent for an MRI as its coefficient bears a negative sign. The impact of the severity of the patient's condition, in turn, plays an ambiguous role in explaining the probability of being sent for MRI. In fact, the effects of one extra procedure and diagnosis on the probability of MRI use go in opposite directions: the former is associated with an increase whereas the latter has a negative impact. This result suggests that what matters for the decision on whether to send a patient for MRI is not *how many* diagnoses he is made, but rather *which* diagnoses he is made.

Regarding the time variables, there is evidence of a tightening effect on the budget constraint of the hospital as all the monthly dummies bear a positive coefficient. Therefore, one can conclude that a patient admitted in any month from January to November has a higher probability of being sent for an MRI scan than a similar patient that is admitted in December, other things equal. Hence, we have a difference in procedures that is actually reflecting an inefficiency as it cannot be explained by individual-specific characteristics but rather depends on the time of the year the patient enters the hospital. Additionally, there seems to be an overtime decreasing trend on the probability of an individual being sent for MRI. It is worth highlighting the fact that

both these patterns of behaviour vary with the type of hospital that is being considered. The following table summarizes the results per type of hospital.[10]

Table 3: Time variables per type of hospital

Hospital	Overtime trend	Tightening of budget constraint
All	Negative	Yes
Central	Positive	Yes
District	Not significant	Yes, though not always significant
Level 1	Positive	Not significant

For the hospital specific variables, we have that an individual being treated in hospital which is either an EPE or part of a hospital centre has a lower probability of being sent for MRI than a patient who receives treatment at a hospital which is either an SPA or does not belong to a hospital centre. Likewise, being treated in a hospital which celebrated a contract with the Ministry of Health is associated with a probability of being sent for MRI that is lower than the one of a similar patient treated in a hospital that did not celebrate such contract.

The size of the hospital is positively associated with the probability of MRI use as the coefficient associated with the number of patients admitted during the year bears a positive sign. Conversely, receiving treatment either at a district hospital or a level 1 hospital is associated with a lower probability of MRI use than in the case of central hospitals. This reinforces the idea that the size of the hospital plays an important role as hospitals classified as central hospitals are larger than the others. The fact that the hospital is a teaching hospital exerts a negative impact on the probability of being sent for MRI, compared to those which are not teaching hospitals.

Now focusing on the determinants of health care demand, there is evidence on the fact that the probability of an individual being sent for MRI is higher in regions where average income is higher. The percentage of people above 65, in turn, bears a

[10] Corresponding regression tables are presented in the appendix.

negative sign suggesting that regions with higher percentage of elderly people tend to use less technology. Education has an interesting effect as a larger percentage of high school graduates is associated with a greater probability of MRI use. However, the higher the percentage of college graduates, the lower the probability of MRI use.

It is worth to develop further on the mechanism trough which these region specific variables affect the probability of an individual being sent for MRI as adoption plays a central role in it. The reasoning goes like this: take a hospital located in a low average income region; most likely, its expectations regarding demand for health care in general and for hi-tech health care devices in particular are much lower than those of a hospital located in a wealthier region because wealthier people demand more health care. Hence, anticipating this lower demand, the hospital is likely to buy less (or even do not buy at all) MRI equipment since it may feel that the large investment is not worth it. As a consequence, other things equal, individuals living in regions with lower average income are less likely to be sent for MRI because there are less scans. An analogous thinking applies to the remaining region-specific variables.

The coefficients of the urbanization variables suggest that the probability of MRI use is lower in more urbanized areas as the overall effect of the urbanization variables at the mean is negative. This result is similar to that obtained in Baker (2001).

Including the hospital fixed effects in the model is a way of considering differences in clinical practice and hospital preferences regarding technology adoption. In order to account for the hospital fixed effects in the model, we introduce 80 dummies in the previously estimated model and set hospital P98 as benchmark. The 80 dummies

correspond to 80 of the 81 hospitals in the sample.[11] This model uses fewer observations as those referring to hospitals P12, P32, P46, P55, P63 and P65 are automatically dropped by Stata on the grounds that they predict failure perfectly. P69 is also omitted because of collinearity. Results are presented in column (2) of table 1.

The pseudo-R^2 of this model is 19, 28%, above that obtained by omitting the fixed-effects, meaning that hospital characteristics do matter when it comes to predict the probability of MRI use. This is probably due to differences in the adoption rule across hospitals. The results are somehow different from those of the previous specification. While the impact of individual-specific variables is very similar to the previous one, the time, hospital- and region-specific variables suffered some changes. In the former case, there is still evidence of a tightening effect on the hospital's budget constraint, but the overtime trend of MRI utilization becomes positive. In the case of the hospital-specific variables, we have that being an EPE hospital has now a positive effect on the probability of an individual being sent for MRI. Both the variables corresponding to the hospital where the patient is treated being part of a hospital centre and to hospital size keep exerting similar impacts on the probability of MRI use. The remaining hospital variables lose their significance. As for the region-specific variables, both the number of physicians and the percentage of high school graduates in the region are associated with a lower probability of the patient being sent for an MRI scan. Regarding the variables capturing the degree of urbanization, the number of inhabitants living in the region still exerts a negative impact when evaluated at its mean, but population density now contributes towards a higher probability of MRI use. The remaining variables contained in this vector become statistically undistinguishable from zero.

[11] One should be aware that the probit model does not accommodate well many dummy variables and including 80 dummies might harm previous results.

We also address the question of whether patients who were transferred from another hospital to the current one have a higher probability of being sent for MRI. Overall, we conclude that the reason why these patients are transferred is more likely to be linked to the fact that the chances of *having access to an MRI scan* in the hospital of origin were low[12], rather than with more severe medical conditions.[13]

At this point we replace the time variables that have been used throughout the analysis by interactions between the admission year and the admission month – i.e. binary variable that equals one if the patient is admitted in January 2010 and zero otherwise. This allows every admission month to have a different impact on the probability that the individual is sent for an MRI depending on the admission year, whereas before the impact was the same regardless of whether the patient was admitted at the hospital in January 2008 and in January 2010.

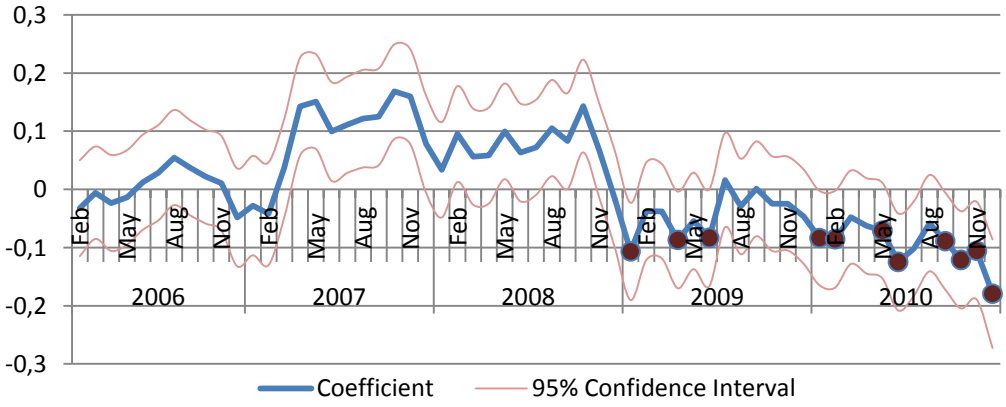
Therefore, the initial model is estimated again, now including these new time-specific variables rather than the old ones. Eleven equations are estimated: one including all DRGs and ten others including only one DRG - it may be that the effects on the probability of an individual being sent for an MRI scan vary across DRGs and such possibility was disregarded in the previous analysis. A constant is included and January 2006 is set as benchmark. Additional variables are included when necessary in order to account for seasonality effects such as the fall in the number of patients sent for MRI during the summer months. The hospital fixed-effects are disregarded from now on. The results are discussed in the following lines and presented in the appendix.

[12] Note that here what is important is not whether the hospital has MRI equipment or not. Since the MRI scan can be made out of the hospital, what matters is the access that patients have to the examination.
[13] This matter is further developed in the appendix.

As for the model considering the ten DRGs altogether, the sign of the coefficients bear by individual, hospital and region-specific variables, remains unchanged relatively to the first model specification.

The analysis of the results of the ten probit models regarding each DRG individually is not going to be exhaustive. A brief comparison with those obtained for the whole dataset follows. As far as the significance of the coefficients is concerned, we have that several variables are no longer statistically distinguishable from zero. Among those that more often lose their significant are the interaction term between gender and age, the binary variable capturing the celebration of a contract with the Ministry of Health and variables such as population density and population squared. Conversely, the number of physicians in the region gains statistical significance in eight of the ten cases, though its sign varies depending on the DRG that is considered. Regarding both the sign and magnitude of the marginal effects, the vast majority of the effects previously found continues to show up.

Particular emphasis is to be put on the negative coefficients of the new time variables. Indeed, one can associate them with specific events affecting the economic and social spheres, which can be linked with the Health sector and affect the use of MRI technology. The graph below depicts the coefficients associated with the time variables for the regression including all the DRGs.



Graphic 3: Coefficients of the time variables admission year*admission month.

First, we highlight the curious pattern of evolution of the series depicted above: 2007 and 2008 are very similar to each other, presenting a relatively flat trend; in the end of 2008 there is a clear negative jump in the series and from that point on there seems to be a slightly negative trend along the years of 2009 and 2010 (note that, again, these two years are very similar to each other).

The bold dots represent the months whose probit coefficients are both negative and statistically significant: January, April and June, 2009; January, February, May and June, 2010 and the period ranging from September to December, 2010.

The negative coefficient associated with January 2009 may be linked with the Supplementary General Budget and the revision of the Stability and Growth Program which took place during that month. The negative sign corresponding to January and February 2010 can be linked with the General Budget that was approved in January and included the usual measures aimed at containing public expenditure in the Health sector. The period ranging from May to June 2010, in turn, follows the implementation of a plan developed by the Ministry of Health that was specifically aimed at reducing expenditure in Portuguese hospitals, which started in late May. As for the final months of 2010, they follow the announcement of the 3rd Stability and Growth Program, which occurred on the 29th of September of that year.[14]

As for the remaining bold dots, we could not find any relevant event occurring at the time that could affect technology use by Portuguese hospitals. Nevertheless, one recognizes that the effects of the austerity measures mentioned in the previous paragraphs are in the right direction as a decrease on the probability of a given individual being sent for MRI is reflected in a fall in overall MRI costs. However, it

[14] One should highlight that this association does not imply any causality and has no statistical grounds. It may no more than a time coincidence.

seems that the effect of the austerity measures fades away too rapidly, highlighting the fact that if the Government wants to limit the public expenditure with the Health sector, then it should opt for a structural reform rather than short term measures.

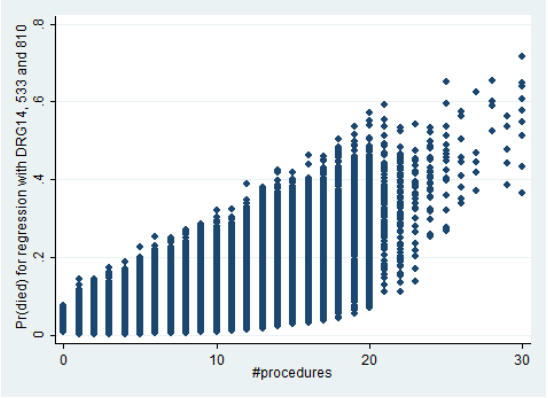
8. MRI effect on patients' survival

Finally, we test whether being sent for an MRI does have a positive impact on the patient's probability of survival. We take DRGs 14, 533 and 810, which are those whose patients more often die and estimate the following probit model.

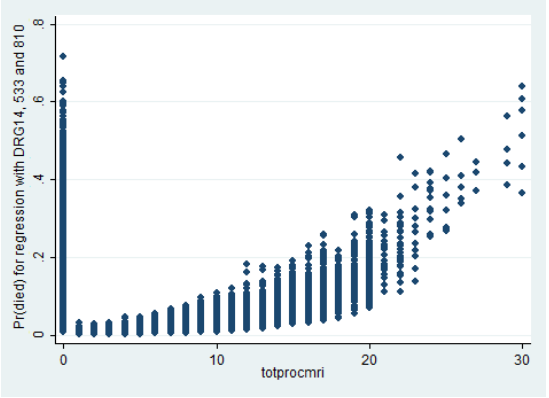
$$\Pr[\,DIED{=}1] = \Phi(\beta_0 + \beta_1 MRI + \beta_2 IND{+}\beta_3 HOSP) \qquad (2)$$

, where the dependent variable takes value one if the patient died and zero otherwise. The independent variables are a binary variable equaling one if the patient was sent for an MRI and zero otherwise and two vectors containing the previous individual and hospital variables. Two variables are added to the former vector, which are interactions between the two measures of illness severity and the fact that a patient is sent for MRI.

We run four probit models, one for each DRG and another one gathering all the three DRGs. For mean values of both measures of illness severity, being sent for an MRI does help patients' survival as the total impact of being sent for such examination on the probability of death is negative. This occurs in each of the four regressions.



Graphic 4: Scatterplot of number of procedures and predicted values of the probability of death for patients belonging to the 3 DRGs.



Graphic 5: Scatterplot of number of procedures and predicted values of the probability of death for patients belonging to the 3 DRGs, who were sent for MRI.

The new interaction terms allow us to determine where the main gains in survival come from. Indeed, comparing graphs 3 and 4, one observes that the main gains from an MRI scan occur mainly for the less severe cases. The scatterplots for the other interaction term have a similar shape.

The above scatterplots also convey the fact that a high percentage of the most severe patients is already being sent for MRI – 4 out of 5 patients who were subject to 29 procedures were sent for the scan. However, those who experience the higher gains from the examination are those suffering from less severe conditions. Thus, in case of a contraction on the budget constraint of a hospital, priority should be given to less severe patients rather than to more severe ones as the former are those who benefit more from the scan. Conversely, in case of patients suffering from very severe conditions (particularly those who are made a large number of diagnoses) being sent for an MRI does not improve patients' survival – this is can be due to an incomplete control of illness severity. Such result seems counterintuitive but comes clear-cut from the total effect of a discrete change of *MRI* from 0 to 1 on the probability of death, which depends on severity of the patient's condition: the coefficient associated with the interaction term of *MRI* with the number of diagnoses the patients is made bears a positive sign and its absolute value exceeds that of the interaction term associated with the number of procedures. In this sense, patients suffering from more severe conditions are probably too ill to benefit from the examination.

Note that one cannot state that an MRI exerts a negative impact on survival as it is no more than a diagnosis tool. Moreover, patients yield benefits from the scanning, other than those related to the probability of death. Such benefits are disregarded in our

analysis as these could not be measured properly. If total benefits instead of benefits in terms of probability of death were considered, then conclusions could be altered.

9. Conclusions

This project intends to clarify on the determinants of MRI use for patients with specific medical conditions, who were admitted at Portuguese NHS hospitals during the period ranging from 2006 to 2010.

Overall, individual variables are found to be very good predictors of MRI use, as expected. Indeed, not only their coefficients are very significant, but also their magnitude is independent of model specification. Variables capturing hospital characteristics also play a role, though many lose their significance when hospital fixed-effects are considered in the model specification. As for region-specific variables, one can say that hospitals seem to account for the characteristics of the regions where they are located when deciding on their adoption patterns.

There is evidence of a tightening effect on the hospital budget constraint in the end of the year. This inefficiency suggests that the management of the hospital budget can be improved. An option to be considered would be not sending for MRI less severe cases occurring in the beginning of the year as a means to save resources for more severe cases taking place in the end of the year. Whether correcting this inefficiency will lead to savings is not clear as the number of patients sent for an MRI scan would most likely not fall. Nevertheless, it would certainly increase patient's welfare. Indeed, the total benefits from sending to an MRI a patient who is in a very severe condition are likely to be higher than the costs of not sending someone whose condition is not that severe. Hence, sending for MRI the more severe cases taking place in the end of the

year instead of less severe ones occurring in the beginning of the year can be seen as socially desirable according to the Kaldor-Hicks compensation criteria.

MRI scans are found to help patients' survival, mainly for those suffering from less severe conditions. In the case of patients suffering from more severe conditions, the benefits from an MRI scan in terms of probability of survival are dominated by illness severity. Nevertheless, this result is not to be taken too far as there are other benefits from the MRI scan rather than those related to the probability of death. On top of this, the fact that illness severity is also being poorly measured by the total number of procedures and diagnoses is likely to have contributed to the result. Still, if one only cares about patients' probability of death, then a policy implication can be drawn: in case of a fall on the resources available to a given hospital, priority should be given to less severe cases as these are those who benefit the most from an MRI - the examination is likely not to yield any significant benefits as far as the probability of death of patients suffering from more severe conditions is concerned. By adopting this policy we are improving welfare. Indeed, patients in more severe conditions do not significantly benefit from the scan, whereas those suffering from less severe conditions do benefit from it – this is a Pareto move as it allows patients in less severe conditions to be better off without harming those in worse medical conditions (their welfare remains constant). Note that, again, the number of MRIs most likely will not fall. The only change is that the patients being sent for the examination are in a better medical condition.

All in all, given the nature of the inefficiencies found in the use of MRI across Portuguese NHS hospitals for patients suffering from specific conditions, it is not clear whether correcting them would allow for cost reductions. Still, there is definitely room to increase patient's welfare, while keeping constant the amount of resources spent.

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A Work Project carried out as a part of the requirements for the Award of a Masters Degree in Economics from the NOVA – School of Business and Economics

THE USE OF TECHNOLOGY IN PORTUGUESE HOSPITALS –

THE CASE OF MRI - APPENDICES

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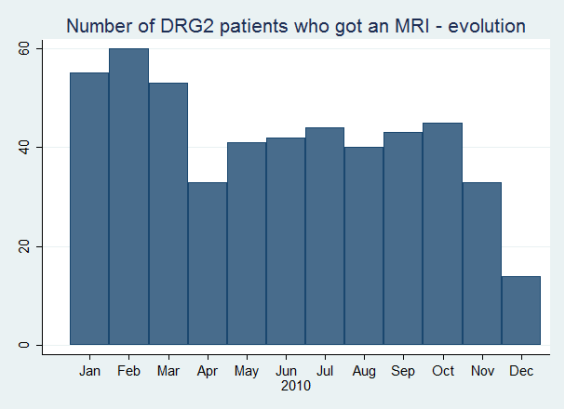
STUDENT NUMBER 414

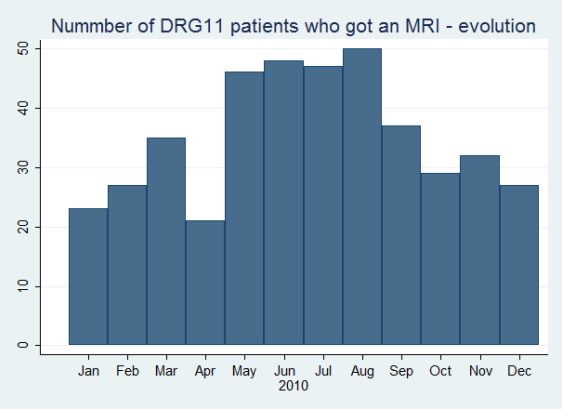
A Project carried out in the Applied Policy Economics area, under the supervision of:

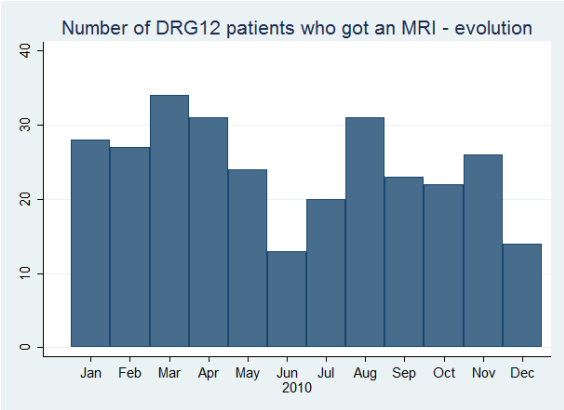
Professor Pedro Pita Barros

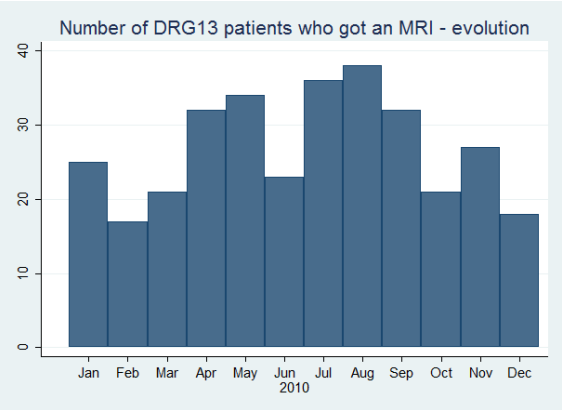
Lisbon, January 6th 2012

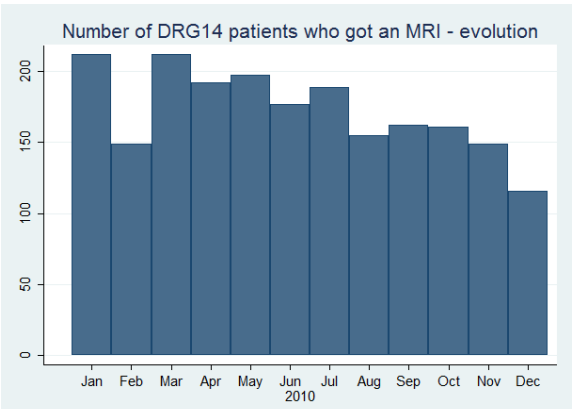
1. Graphs depicting the evolution of the number of patients sent for an MRI scan over the year 2010, per DRG

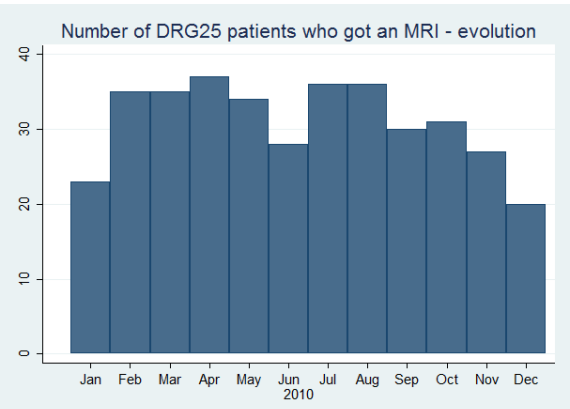


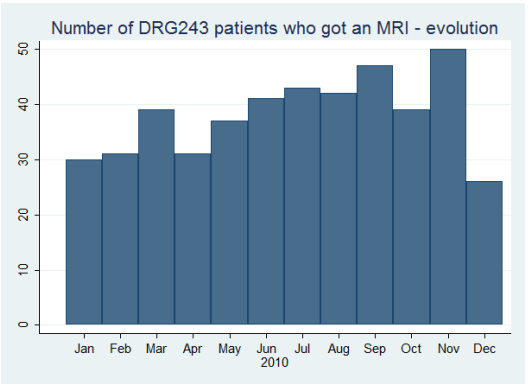


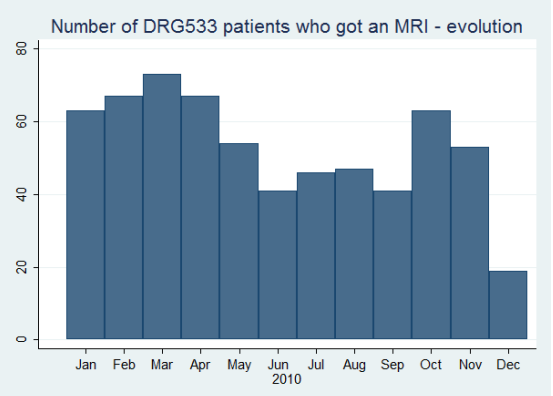


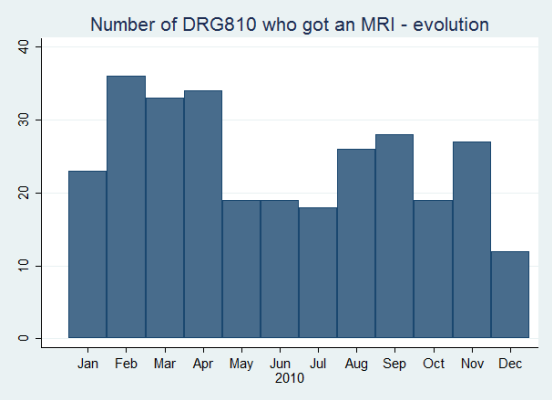


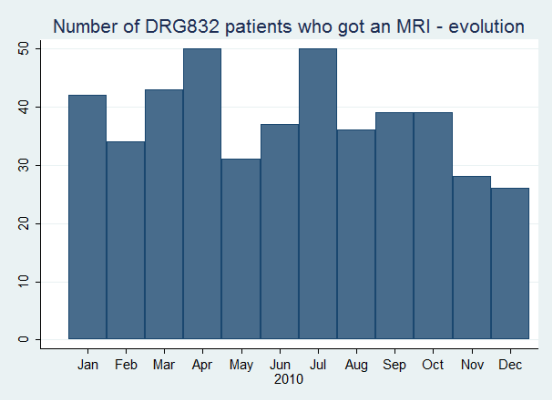












2. In-depth look at the behaviour of time variables, per type of hospital

When one considers the several types of hospital altogether in the regression analysis, one finds evidence of a negative overtime trend of MRI use as well as a tightening effect on the hospital's budget constraint taking place in December. In this section, I look deeper at this pattern of behavior and check whether it differs with the type of hospital: central, district and level 1.

In fact, for the case of central hospitals, there is still evidence of a tightening effect on the hospital's budget constraint, but the sign of the overtime trend on MRI use is positive. Regarding district hospitals, there is evidence of the tightening effect, though not for all the months as some of them lost their significance. The coefficient that yields the overtime trend also becomes non-significant. Finally, level 1 hospitals exhibit a positive overtime trend on the use of MRI scans and show no evidence of a tightening effect on their budget constraints.

a) For central hospitals:

```
Probit regression                                 Number of obs   =      86103
                                                  LR chi2(34)     =   12630.56
                                                  Prob > chi2     =     0.0000
Log likelihood = -32736.632                       Pseudo R2       =     0.1617

------------------------------------------------------------------------------
         mri |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      gender |  -.3379295   .0393058    -8.60   0.000    -.4149676   -.2608915
         age |   .0347943   .0015299    22.74   0.000     .0317957    .0377928
        age2 |  -.0005017   .0000132   -38.13   0.000    -.0005275   -.0004759
   genderage |   .0045899   .0006076     7.55   0.000     .0033989    .0057809
     totproc |    .091669   .0017896    51.22   0.000     .0881615    .0951765
     totdiag |  -.0457551   .0019531   -23.43   0.000    -.0495831   -.0419272
       mrate |  -4.962903   .2770834   -17.91   0.000    -5.505977    -4.41983
        year |   .0547128   .0182704     2.99   0.003     .0189035     .090522
       adjan |   .0644246   .0242568     2.66   0.008     .0168823     .111967
       adfeb |   .0564946   .0250214     2.26   0.024     .0074535    .1055357
       admar |   .0810758   .0239902     3.38   0.001     .0340558    .1280957
       adapr |   .0682697   .0200929     3.40   0.001     .0288883    .1076512
       admay |   .0771678   .0260557     2.96   0.003     .0260996     .128236
       adjun |   .0516869   .0264561     1.95   0.051    -.0001662      .10354
       adjul |   .0857968    .025738     3.33   0.001     .0353513    .1362422
```

```
       adaug |   .1480573   .0260791     5.68   0.000     .0969433    .1991713
       adsep |   .0884346   .0259006     3.41   0.001     .0376704    .1391988
       adoct |   .0789694   .0257718     3.06   0.002     .0284577    .1294812
       adnov |   .0717858   .0256967     2.79   0.005     .0214212    .1221504
         epe |  -.3521491   .0214407   -16.42   0.000    -.3941722    -.310126
     hcenter |  -.0506056   .0284304    -1.78   0.075    -.1063282    .0051169
    contract |  -.1905186   .0248991    -7.65   0.000      -.23932   -.1417172
  totinterns |    .008565   .0003711    23.08   0.000     .0078376    .0092923
   distrital |  -.7213586   .0626243   -11.52   0.000    -.8441001   -.5986172
      nivel1 |  (omitted)
      ensino |  -.3208708     .03205   -10.01   0.000    -.3836876   -.2580541
      income |   .0009631   .0006078     1.58   0.113    -.0002281    .0021544
     elderly |  -.0577392   .0914599    -0.63   0.528    -.2369974     .121519
  physicians |   .0079909   .0243632     0.33   0.743      -.03976    .0557419
     hschool |  -.0429995   .0110224    -3.90   0.000    -.0646029    -.021396
     college |  -.0544654   .0240155    -2.27   0.023    -.1015348   -.0073959
         pop |   .8209526   .2872198     2.86   0.004     .2580122    1.383893
        pop2 |  -.0214527   .0077149    -2.78   0.005    -.0365737   -.0063317
        dpop |  -4.388516   4.815025    -0.91   0.362    -13.82579    5.048759
       dpop2 |   .0006261   .0020337     0.31   0.758    -.0033598    .0046121
       _cons |  -110.7944   35.62393    -3.11   0.002     -180.616   -40.97274
```

b) For district hospitals:

```
Probit regression                                 Number of obs   =      98150
                                                  LR chi2(33)     =   11418.44
                                                  Prob > chi2     =     0.0000
Log likelihood =  -29893.98                       Pseudo R2       =     0.1604

------------------------------------------------------------------------------
         mri |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      gender |   -.516586   .0453082   -11.40   0.000    -.6053884   -.4277835
         age |   .0317086   .0019238    16.48   0.000      .027938    .0354792
        age2 |  -.0004885   .0000159   -30.69   0.000    -.0005197   -.0004573
   genderage |   .0071496    .000672    10.64   0.000     .0058326    .0084667
     totproc |   .1081159   .0021415    50.48   0.000     .1039186    .1123133
     totdiag |  -.0578624   .0029748   -19.45   0.000    -.0636928    -.052032
       mrate |  -3.112418   .1724115   -18.05   0.000    -3.450338   -2.774498
        year |  -.0071624   .0050189    -1.43   0.154    -.0169993    .0026745
       adjan |  -.0044052   .0252042    -0.17   0.861    -.0538046    .0449942
       adfeb |   .0293076    .025831     1.13   0.257    -.0213203    .0799354
       admar |   .0477923   .0251426     1.90   0.057    -.0014864     .097071
       adapr |   .0519402   .0207675     2.50   0.012     .0112366    .0926438
       admay |   .0594043   .0265083     2.24   0.025     .0074491    .1113596
       adjun |   .0305324   .0270678     1.13   0.259    -.0225196    .0835844
       adjul |   .0674495   .0265822     2.54   0.011     .0153494    .1195497
       adaug |   .0343651   .0269694     1.27   0.203     -.018494    .0872241
       adsep |   .0708732   .0269677     2.63   0.009     .0180174    .1237289
       adoct |   .0925414   .0263104     3.52   0.000      .040974    .1441089
       adnov |    .070316   .0266292     2.64   0.008     .0181238    .1225082
         epe |    .029332   .0180565     1.62   0.104    -.0060582    .0647222
     hcenter |  -.1328612   .0152915    -8.69   0.000     -.162832   -.1028904
    contract |   .0181658   .0255307     0.71   0.477    -.0318734     .068205
  totinterns |   .0128394   .0006179    20.78   0.000     .0116284    .0140505
   distrital |  (omitted)
      nivel1 |  (omitted)
      ensino |   .2555488   .0367752     6.95   0.000     .1834708    .3276268
      income |   .0047318   .0003463    13.66   0.000     .0040531    .0054104
     elderly |  -.0009015   .0056292    -0.16   0.873    -.0119346    .0101316
  physicians |    -.00403   .0058557    -0.69   0.491    -.0155071     .007447
     hschool |   .0211963   .0042638     4.97   0.000     .0128393    .0295532
     college |  -.1108596   .0088367   -12.55   0.000    -.1281791   -.0935401
         pop |  -.0328583   .0147819    -2.22   0.026    -.0618304   -.0038863
        pop2 |  -.0018227   .0004239    -4.30   0.000    -.0026535   -.0009918
        dpop |  -.5832248   .1603842    -3.64   0.000    -.8975721   -.2688775
       dpop2 |   .0006966   .0000967     7.20   0.000     .0005071    .0008862
       _cons |   10.30403   10.07171     1.02   0.306    -9.436161    30.04421
```

c) For level1 hospitals:

```
Probit regression                                 Number of obs   =       9470
                                                  LR chi2(32)     =     543.18
                                                  Prob > chi2     =     0.0000
Log likelihood = -1059.2357                       Pseudo R2       =     0.2041

------------------------------------------------------------------------------
         mri |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      gender |  -1.019932   .2783452    -3.66   0.000    -1.565478   -.4743852
         age |   .0039634    .011871     0.33   0.738    -.0193034    .0272301
        age2 |  -.0003241   .0000937    -3.46   0.001    -.0005077   -.0001404
   genderage |    .014501   .0039685     3.65   0.000     .0067229    .0222791
     totproc |    .141077   .0110814    12.73   0.000     .1193579    .1627962
     totdiag |  -.0730495   .0154794    -4.72   0.000    -.1033885   -.0427104
       mrate |  -.4752486   .3616484    -1.31   0.189    -1.184066    .2335693
        year |   .2834349   .0456386     6.21   0.000     .1939849    .3728849
       adjan |   .0970396   .1224182     0.79   0.428    -.1428956    .3369748
       adfeb |   .1171819   .1272977     0.92   0.357     -.132317    .3666807
       admar |   .1487235   .1230027     1.21   0.227    -.0923574    .3898044
       adapr |   .0886665   .0985699     0.90   0.368    -.1045268    .2818599
       admay |   .0974091   .1348154     0.72   0.470    -.1668242    .3616423
       adjun |   .1514557   .1362668     1.11   0.266    -.1156222    .4185336
       adjul |   .0591196   .1378887     0.43   0.668    -.2111373    .3293764
       adaug |  -.0297607   .1439081    -0.21   0.836    -.3118155     .252294
       adsep |   .0482225   .1422212     0.34   0.735    -.2305261     .326971
       adoct |   .1552915   .1347659     1.15   0.249    -.1088448    .4194279
       adnov |   .1690035   .1356304     1.25   0.213    -.0968271    .4348341
         epe |  -.2822461   .2269928    -1.24   0.214    -.7271439    .1626516
     hcenter |   .0067172   .1103334     0.06   0.951    -.2095323    .2229667
    contract |   .2459139   .4299667     0.57   0.567    -.5968055    1.088633
  totinterns |   .0557567   .0206431     2.70   0.007      .015297    .0962165
   distrital |  (omitted)
      nivel1 |  (omitted)
      ensino |  (omitted)
      income |  -.0089733   .0031958    -2.81   0.005    -.0152369   -.0027097
     elderly |   .2074338   .0513005     4.04   0.000     .1068866    .3079811
  physicians |   .0613139   .0980986     0.63   0.532    -.1309557    .2535836
     hschool |  -.1256668   .0490991    -2.56   0.010    -.2218994   -.0294343
     college |   .0867352   .0616306     1.41   0.159    -.0340586     .207529
         pop |  -.2145631   .1591718    -1.35   0.178    -.5265341    .0974079
        pop2 |   .0919869   .0209822     4.38   0.000     .0508626    .1331113
        dpop |   3.000871   1.702882     1.76   0.078    -.3367161    6.338459
       dpop2 |  -.0067146   .0013389    -5.01   0.000    -.0093389   -.0040903
       _cons |  -566.7172   91.03508    -6.23   0.000    -745.1427   -388.2917
```

3. Transferred patients

I also add a dummy variable equalling one in the case a patient was transferred from another hospital to the current one. The idea is to test whether this fact has a positive impact on the probability of MRI use. Note that this is likely to be the case either for patients suffering from more severe conditions or for those being treated in smaller hospitals, which have access to fewer resources. Information on whether the individual was transferred from another hospital is only available for the 2006 dataset. Therefore, the analysis is restricted to this year and 39.834 observations are included – transferred patients amount to 17, 5% of these observations. The hospital fixed-effects are not accounted for in this model specification. According to the results, we have that

the fact that patient was transferred from another hospital to the current one is associated with a higher probability of being sent for an MRI. These patients come mainly from hospitals with a ratio of MRIs per admitted patients that is lower than the average. Hence, the reason why these patients are transferred is more likely to be linked to the fact that the chances of *having access to an MRI scan* in the hospital of origin were low[1], rather than with more severe medical conditions – one expects patients to be independently and identically distributed across hospitals, so that the probability that a more severe one shows up is the same across hospitals. This variable is disregarded in the main analysis as it implies a large loss of observations.

The regression table relative to this analysis is presented below.

```
Probit regression                                 Number of obs   =      39834
                                                  LR chi2(35)     =    4823.37
                                                  Prob > chi2     =     0.0000
Log likelihood = -12021.942                       Pseudo R2       =     0.1671

------------------------------------------------------------------------------
         mri |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      gender |  -.4456419   .0638884    -6.98   0.000    -.5708608   -.3204229
         age |   .0302136     .00265    11.40   0.000     .0250197    .0354075
        age2 |  -.0004912   .0000235   -20.92   0.000    -.0005372   -.0004452
   genderage |   .0066792   .0010176     6.56   0.000     .0046847    .0086737
     totproc |    .099156   .0031741    31.24   0.000     .0929348    .1053772
     totdiag |  -.0559309   .0041674   -13.42   0.000    -.0640989   -.0477629
       mrate |  -3.372819   .3560723    -9.47   0.000    -4.070708    -2.67493
        year |  (omitted)
       adjan |   .1315498   .0493884     2.66   0.008     .0347504    .2283491
       adfeb |   .0947136    .051102     1.85   0.064    -.0054445    .1948717
       admar |   .1173838   .0497736     2.36   0.018     .0198293    .2149384
       adapr |   .1036135   .0510928     2.03   0.043     .0034735    .2037535
       admay |   .1104024   .0504682     2.19   0.029     .0114865    .2093182
       adjun |   .1413863   .0506874     2.79   0.005     .0420407    .2407318
       adjul |   .1627495    .050729     3.21   0.001     .0633224    .2621765
       adaug |   .1985464   .0506997     3.92   0.000     .0991768     .297916
       adsep |   .1628059   .0507174     3.21   0.001     .0634016    .2622101
       adoct |   .1548554   .0502388     3.08   0.002     .0563892    .2533216
       adnov |   .1262391   .0507543     2.49   0.013     .0267625    .2257158
         epe |  -.2467363   .0254775    -9.68   0.000    -.2966713   -.1968014
     hcenter |   .2945691   .0264213    11.15   0.000     .2427843     .346354
    contract |  -.2809066   .0432739    -6.49   0.000    -.3657219   -.1960914
  totinterns |   .0145707   .0013121    11.11   0.000     .0119991    .0171423
   distrital |  -.1086734   .0314198    -3.46   0.001     -.170255   -.0470918
      nivel1 |  -.6715543     .06978    -9.62   0.000    -.8083206   -.5347881
      ensino |  -.0870849   .0381078    -2.29   0.022    -.1617748   -.0123951
      income |   .0090671   .0012158     7.46   0.000     .0066843      .01145
     elderly |   .0555203   .0121819     4.56   0.000     .0316442    .0793964
  physicians |  -.0286771   .0067171    -4.27   0.000    -.0418423   -.0155118
     hschool |  -.0010876   .0275972    -0.04   0.969    -.0551771     .053002
     college |  -.2326342   .0255964    -9.09   0.000    -.2828023   -.1824662
         pop |  -.0980163   .0340619    -2.88   0.004    -.1647765   -.0312561
        pop2 |   .0014872    .000875     1.70   0.089    -.0002278    .0032021
        dpop |   3.914751   .3902852    10.03   0.000     3.149806    4.679696
       dpop2 |  -.0017519   .0002333    -7.51   0.000    -.0022092   -.0012947
 transferido |   .0510356   .0261801     1.95   0.051    -.0002764    .1023477
```

[1] Note that here what is important is not whether the hospital has MRI equipment or not. Since the MRI scan can be made out of the hospital, what matters is the access that patients have to the examination.

_cons	-6.038064	.4121392	-14.65	0.000	-6.845842	-5.230286

4. Model with the interaction terms between the admission year and the admission month

The eleven regression tables for these regressions are presented below. The coefficients for the interactions between the admission year and the admission month that are statistically significant and bear a negative sign are highlighted in red.

a) For all the DRGs together:

Probit regression — Number of obs = 194516; LR chi2(82) = 25080.54; Prob > chi2 = 0.0000; Log likelihood = -65264.87; Pseudo R2 = 0.1612

mri	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
gender	-.4097973	.0290989	-14.08	0.000	-.4668301	-.3527644
age	.0332915	.0011664	28.54	0.000	.0310053	.0355776
age2	-.0004935	9.85e-06	-50.12	0.000	-.0005128	-.0004742
genderage	.0056364	.0004401	12.81	0.000	.0047738	.0064989
totproc	.0987936	.0013007	75.95	0.000	.0962442	.1013431
totdiag	-.0518816	.0015798	-32.84	0.000	-.054978	-.0487852
mrate	-3.081104	.1238567	-24.88	0.000	-3.323859	-2.838349
epe	-.1862641	.0105369	-17.68	0.000	-.206916	-.1656123
hcenter	-.1011372	.0090074	-11.23	0.000	-.1187913	-.0834831
contract	-.0288216	.0149026	-1.93	0.053	-.0580301	.0003869
totinterns	.0064206	.0002314	27.75	0.000	.0059671	.0068741
distrital	-.1338374	.0123346	-10.85	0.000	-.1580128	-.1096621
nivel1	-.6273726	.0301278	-20.82	0.000	-.686422	-.5683233
ensino	-.2422509	.0150211	-16.13	0.000	-.2716917	-.2128101
income	.0038025	.0002768	13.74	0.000	.00326	.004345
elderly	-.0523967	.0046575	-11.25	0.000	-.0615253	-.0432682
physicians	.0003261	.0023238	0.14	0.888	-.0042286	.0048807
hschool	.0668277	.0040447	16.52	0.000	.0589002	.0747552
college	-.1098329	.007644	-14.37	0.000	-.1248149	-.094851
pop	-.1713288	.0122308	-14.01	0.000	-.1953007	-.1473569
pop2	.0027385	.0003165	8.65	0.000	.0021182	.0033589
dpop	-.5243978	.1458405	-3.60	0.000	-.8102399	-.2385557
dpop2	.0007732	.0000848	9.12	0.000	.0006071	.0009394
feb2006	-.0324288	.0420816	-0.77	0.441	-.1149072	.0500497
mar2006	-.0057479	.0405233	-0.14	0.887	-.0851721	.0736763
apr2006	-.0233798	.0420752	-0.56	0.578	-.1058458	.0590861
may2006	-.0139252	.0414521	-0.34	0.737	-.0951699	.0673195
jun2006	.0121437	.0416953	0.29	0.771	-.0695774	.0938649
jul2006	.0288076	.0417837	0.69	0.491	-.0530869	.110702
aug2006	.0547684	.0416964	1.31	0.189	-.026955	.1364918
sep2006	.0372135	.0416684	0.89	0.372	-.0444549	.118882
oct2006	.0217827	.0411162	0.53	0.596	-.0588037	.102369
nov2006	.0104292	.0414542	0.25	0.801	-.0708196	.091678
dec2006	-.0481604	.0429399	-1.12	0.262	-.132321	.0360003
jan2007	-.0279153	.0435937	-0.64	0.522	-.1133573	.0575267
feb2007	-.0417363	.0450665	-0.93	0.354	-.1300649	.0465924
mar2007	.0372672	.0431769	0.86	0.388	-.0473579	.1218923
apr2007	.1423995	.0428668	3.32	0.001	.0583821	.2264168
may2007	.1509249	.041498	3.64	0.000	.0695904	.2322594
jun2007	.0994797	.0432613	2.30	0.021	.0146892	.1842702
jul2007	.1109816	.0421605	2.63	0.008	.0283486	.1936146
aug2007	.1214955	.0428041	2.84	0.005	.037601	.20539
sep2007	.1247466	.0424205	2.94	0.003	.041604	.2078892
oct2007	.1681618	.0414701	4.06	0.000	.086882	.2494417

nov2007	.1593796	.0416599	3.83	0.000	.0777276	.2410316
dec2007	.0779671	.0426729	1.83	0.068	-.0056702	.1616043
jan2008	.0335409	.0418338	0.80	0.423	-.0484519	.1155336
feb2008	.0950116	.042042	2.26	0.024	.0126107	.1774124
mar2008	.0560532	.0421223	1.33	0.183	-.026505	.1386114
apr2008	.0583151	.0420763	1.39	0.166	-.024153	.1407832
may2008	.0996629	.0419898	2.37	0.018	.0173644	.1819615
jun2008	.063416	.0428379	1.48	0.139	-.0205447	.1473766
jul2008	.0723648	.0416856	1.74	0.083	-.0093374	.1540671
aug2008	.1053245	.0421832	2.50	0.013	.022647	.1880021
sep2008	.0831625	.0419927	1.98	0.048	.0008583	.1654667
oct2008	.1431187	.0406529	3.52	0.000	.0634405	.2227968
nov2008	.0673401	.0412256	1.63	0.102	-.0134607	.1481408
dec2008	-.0170116	.0423676	-0.40	0.688	-.1000507	.0660274
jan2009	**-.1066642**	**.0426394**	**-2.50**	**0.012**	**-.190236**	**-.0230925**
feb2009	-.0375333	.0427529	-0.88	0.380	-.1213273	.0462608
mar2009	-.0379001	.0413885	-0.92	0.360	-.1190201	.0432199
apr2009	**-.0868723**	**.0424057**	**-2.05**	**0.041**	**-.169986**	**-.0037586**
may2009	-.0542474	.042267	-1.28	0.199	-.1370891	.0285944
jun2009	**-.0832538**	**.0425175**	**-1.96**	**0.050**	**-.1665867**	**.000079**
jul2009	.0157551	.041343	0.38	0.703	-.0652757	.0967859
aug2009	-.0293666	.0418559	-0.70	0.483	-.1114027	.0526696
sep2009	.0009829	.0415533	0.02	0.981	-.08046	.0824258
oct2009	-.024499	.0415038	-0.59	0.555	-.105845	.0568469
nov2009	-.0244977	.0411288	-0.60	0.551	-.1051087	.0561132
dec2009	-.046943	.0413121	-1.14	0.256	-.1279133	.0340273
jan2010	**-.0834813**	**.0414037**	**-2.02**	**0.044**	**-.1646311**	**-.0023314**
feb2010	**-.085427**	**.042451**	**-2.01**	**0.044**	**-.1686294**	**-.0022246**
mar2010	-.0478459	.0409935	-1.17	0.243	-.1281916	.0324998
apr2010	-.0627723	.0417501	-1.50	0.133	-.1446009	.0190564
may2010	**-.0708183**	**.0418906**	**-1.69**	**0.091**	**-.1529224**	**.0112858**
jun2010	**-.1246086**	**.0425441**	**-2.93**	**0.003**	**-.2079934**	**-.0412237**
jul2010	**-.1017954**	**.0414213**	**-2.46**	**0.014**	**-.1829798**	**-.0206111**
aug2010	-.0580922	.0422829	-1.37	0.169	-.1409653	.0247808
sep2010	**-.0891431**	**.0425363**	**-2.10**	**0.036**	**-.1725127**	**-.0057735**
oct2010	**-.1211677**	**.0426011**	**-2.84**	**0.004**	**-.2046643**	**-.0376712**
nov2010	**-.1055657**	**.0428386**	**-2.46**	**0.014**	**-.1895278**	**-.0216036**
dec2010	**-.1793033**	**.0475352**	**-3.77**	**0.000**	**-.2724706**	**-.0861359**
_cons	-2.902781	.1388553	-20.91	0.000	-3.174933	-2.63063

b) For DRG533:

```
Probit regression                                 Number of obs   =      27988
                                                  LR chi2(81)     =    2653.89
                                                  Prob > chi2     =     0.0000
Log likelihood = -7568.0824                       Pseudo R2       =     0.1492
```

mri	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
gender	-.4932916	.0848513	-5.81	0.000	-.6595971	-.3269861
age	.0314901	.0027028	11.65	0.000	.0261928	.0367875
age2	-.0004724	.0000229	-20.65	0.000	-.0005173	-.0004276
genderage	.0068508	.001206	5.68	0.000	.004487	.0092146
totproc	.0644743	.002952	21.84	0.000	.0586886	.0702601
totdiag	-.0181275	.0034027	-5.33	0.000	-.0247967	-.0114582
mrate	(omitted)					
epe	-.0636836	.0318648	-2.00	0.046	-.1261374	-.0012299
hcenter	-.0828274	.026851	-3.08	0.002	-.1354545	-.0302004
contract	-.1325432	.0443624	-2.99	0.003	-.2194919	-.0455945
totinterns	.0032102	.0006286	5.11	0.000	.0019782	.0044422
distrital	-.2352605	.0365659	-6.43	0.000	-.3069283	-.1635927
nivel1	-.6611853	.0976382	-6.77	0.000	-.8525526	-.469818
ensino	-.249334	.0424957	-5.87	0.000	-.3326241	-.1660438
income	.0041631	.0008949	4.65	0.000	.0024092	.0059169
elderly	-.0441903	.0145067	-3.05	0.002	-.0726228	-.0157578
physicians	.0111709	.0066574	1.68	0.093	-.0018775	.0242192
hschool	.0087993	.0129161	0.68	0.496	-.0165157	.0341143

college	-.0490717	.024637	-1.99	0.046	-.0973594	-.000784
pop	-.1251985	.0384909	-3.25	0.001	-.2006393	-.0497576
pop2	.0020902	.00098	2.13	0.033	.0001694	.0040109
dpop	-.5490204	.4526783	-1.21	0.225	-1.436254	.3382128
dpop2	.0006281	.0002676	2.35	0.019	.0001035	.0011526
seas~7gdh533	.2726149	.1261269	2.16	0.031	.0254108	.519819
seas~9gdh533	.2040509	.1210335	1.69	0.092	-.0331704	.4412723
feb2006	-.1225732	.1308319	-0.94	0.349	-.378999	.1338526
mar2006	.1011169	.1180841	0.86	0.392	-.1303237	.3325576
apr2006	-.0062772	.1310046	-0.05	0.962	-.2630415	.250487
may2006	-.0301221	.1296189	-0.23	0.816	-.2841704	.2239262
jun2006	-.0526011	.1312995	-0.40	0.689	-.3099435	.2047413
jul2006	.0853125	.1255836	0.68	0.497	-.1608268	.3314518
aug2006	.1509003	.1238544	1.22	0.223	-.0918498	.3936504
sep2006	.1834993	.1250268	1.47	0.142	-.0615486	.4285472
oct2006	-.0463975	.1304695	-0.36	0.722	-.3021129	.209318
nov2006	-.0044948	.1291676	-0.03	0.972	-.2576586	.2486689
dec2006	-.0147539	.1265616	-0.12	0.907	-.2628101	.2333023
jan2007	**-.2115375**	**.1277288**	**-1.66**	**0.098**	**-.4618813**	**.0388063**
feb2007	-.0743122	.1260443	-0.59	0.555	-.3213544	.17273
mar2007	.0051266	.1196831	0.04	0.966	-.2294481	.2397012
apr2007	(omitted)					
may2007	.0676697	.1299794	0.52	0.603	-.1870852	.3224247
jun2007	.1758267	.1287293	1.37	0.172	-.076478	.4281315
jul2007	.2357856	.1244019	1.90	0.058	-.0080375	.4796088
aug2007	.1665893	.1282954	1.30	0.194	-.0848652	.4180437
sep2007	.0910636	.1277308	0.71	0.476	-.1592842	.3414113
oct2007	.1831087	.1267888	1.44	0.149	-.0653927	.4316101
nov2007	.053516	.1315146	0.41	0.684	-.2042478	.3112798
dec2007	.1363815	.1261995	1.08	0.280	-.1109649	.3837279
jan2008	.0373447	.1265605	0.30	0.768	-.2107094	.2853988
feb2008	.0471359	.1289463	0.37	0.715	-.2055942	.299866
mar2008	.0839433	.1252446	0.67	0.503	-.1615315	.3294182
apr2008	-.0578185	.1336105	-0.43	0.665	-.3196903	.2040533
may2008	.1255749	.1281389	0.98	0.327	-.1255727	.3767224
jun2008	.2658113	.1271537	2.09	0.037	.0165946	.5150281
jul2008	.1162336	.1260676	0.92	0.357	-.1308544	.3633216
aug2008	.1702983	.1281864	1.33	0.184	-.0809425	.421539
sep2008	.0266615	.1323875	0.20	0.840	-.2328132	.2861363
oct2008	.1588868	.122813	1.29	0.196	-.0818222	.3995958
nov2008	.1956405	.1245102	1.57	0.116	-.048395	.4396761
dec2008	.0888774	.1232964	0.72	0.471	-.1527792	.3305339
jan2009	.0284294	.1256962	0.23	0.821	-.2179307	.2747895
feb2009	.029615	.1269983	0.23	0.816	-.2192971	.2785271
mar2009	-.0250904	.1256668	-0.20	0.842	-.2713928	.221212
apr2009	-.0668845	.1272925	-0.53	0.599	-.3163733	.1826043
may2009	.0402698	.1258365	0.32	0.749	-.2063652	.2869049
jun2009	.0075084	.1296216	0.06	0.954	-.2465453	.2615621
jul2009	.3428864	.2162051	1.59	0.113	-.0808677	.7666405
aug2009	.0433123	.1249133	0.35	0.729	-.2015131	.2881378
sep2009	(omitted)					
oct2009	.1329915	.1229819	1.08	0.280	-.1080487	.3740316
nov2009	.0404819	.1243992	0.33	0.745	-.2033361	.2842999
dec2009	.0791409	.119465	0.66	0.508	-.1550062	.313288
jan2010	.0803682	.1210575	0.66	0.507	-.1569001	.3176366
feb2010	.1521669	.1209302	1.26	0.208	-.084852	.3891858
mar2010	.2380042	.1195389	1.99	0.046	.0037124	.4722961
apr2010	.3035933	.1236863	2.45	0.014	.0611727	.5460139
may2010	.10316	.1249343	0.83	0.409	-.1417068	.3480268
jun2010	-.0593185	.1301933	-0.46	0.649	-.3144926	.1958556
jul2010	-.1221145	.1268693	-0.96	0.336	-.3707738	.1265447
aug2010	.0392306	.1282361	0.31	0.760	-.2121075	.2905687
sep2010	-.0789369	.1311192	-0.60	0.547	-.3359258	.1780521
oct2010	.1074885	.1215547	0.88	0.377	-.1307543	.3457314
nov2010	.1134939	.1256681	0.90	0.366	-.132811	.3597988
dec2010	-.1662414	.1563773	-1.06	0.288	-.4727353	.1402526
_cons	-2.608681	.4289583	-6.08	0.000	-3.449424	-1.767938

c) For DRG14:

```
Probit regression                                 Number of obs   =      78096
                                                  LR chi2(82)     =   13535.91
                                                  Prob > chi2     =     0.0000
Log likelihood = -20792.456                       Pseudo R2       =     0.2456

------------------------------------------------------------------------------
         mri |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      gender |  -.3280586    .076458    -4.29   0.000    -.4779136   -.1782036
         age |  -.0200815   .0039551    -5.08   0.000    -.0278334   -.0123296
        age2 |  -.0001835   .0000295    -6.22   0.000    -.0002413   -.0001256
   genderage |   .0054331   .0010795     5.03   0.000     .0033173    .007549
     totproc |   .1322414   .0027163    48.68   0.000     .1269175    .1375653
     totdiag |  -.0612466   .0029243   -20.94   0.000    -.0669782    -.055515
       mrate |  -6.427869   .4373613   -14.70   0.000    -7.285081   -5.570656
         epe |  -.2552226   .0188998   -13.50   0.000    -.2922656   -.2181797
     hcenter |  -.2093583   .0158947   -13.17   0.000    -.2405114   -.1782051
    contract |  -.0872566   .0257509    -3.39   0.001    -.1377276   -.0367857
  totinterns |   .0100619   .0004471    22.50   0.000     .0091855    .0109383
   distrital |  -.1552346   .0209856    -7.40   0.000    -.1963656   -.1141036
      nivel1 |  -.6378242   .0454119   -14.05   0.000    -.7268299   -.5488185
      ensino |  -.6025606   .0295494   -20.39   0.000    -.6604764   -.5446449
      income |    .007168   .0005026    14.26   0.000      .006183    .008153
     elderly |  -.0771982   .0077942    -9.90   0.000    -.0924745   -.0619218
  physicians |   .0152896   .0046082     3.32   0.001     .0062578    .0243214
     hschool |   .0819435    .006777    12.09   0.000     .0686608    .0952261
     college |  -.1937054   .0129806   -14.92   0.000     -.219147   -.1682639
         pop |  -.2086699   .0199474   -10.46   0.000     -.247766   -.1695738
        pop2 |   .0031533   .0005229     6.03   0.000     .0021285    .0041781
        dpop |  -1.256389     .23911    -5.25   0.000    -1.725036   -.7877421
       dpop2 |   .0012911   .0001392     9.27   0.000     .0010182     .001564
season2007~4 |    .216089   .0800043     2.70   0.007     .0592834    .3728946
season2008~4 |   .2295198   .0750507     3.06   0.002     .0824232    .3766165
     feb2006 |   .0940866   .0777459     1.21   0.226    -.0582926    .2464658
     mar2006 |   .0310773   .0767097     0.41   0.685     -.119271    .1814255
     apr2006 |  -.0186795    .078423    -0.24   0.812    -.1723857    .1350267
     may2006 |   .0811355   .0778996     1.04   0.298     -.071545     .233816
     jun2006 |   .1372874   .0774346     1.77   0.076    -.0144816    .2890564
     jul2006 |   .1147261   .0780972     1.47   0.142    -.0383415    .2677938
     aug2006 |   .1183502   .0766309     1.54   0.122    -.0318437     .268544
     sep2006 |   .1374203   .0774195     1.78   0.076    -.0143191    .2891598
     oct2006 |   .0941474   .0770837     1.22   0.222    -.0569339    .2452288
     nov2006 |   .0848156   .0775222     1.09   0.274    -.0671252    .2367564
     dec2006 |   .0442803   .0788627     0.56   0.574    -.1102878    .1988484
     jan2007 |  -.0008184   .0796426    -0.01   0.992     -.156915    .1552782
     feb2007 |  -.0036292   .0818959    -0.04   0.965    -.1641422    .1568838
     mar2007 |   .1030308   .0787851     1.31   0.191    -.0513852    .2574468
     apr2007 |  (omitted)
     may2007 |   .3438174   .0759817     4.53   0.000      .194896    .4927389
     jun2007 |   .1431269   .0816465     1.75   0.080    -.0168973    .3031512
     jul2007 |   .1254335   .0796816     1.57   0.115    -.0307395    .2816065
     aug2007 |   .1500382   .0800898     1.87   0.061    -.0069349    .3070112
     sep2007 |   .2011559   .0796195     2.53   0.012     .0451046    .3572072
     oct2007 |   .3026114   .0774006     3.91   0.000      .150909    .4543137
     nov2007 |   .2623216    .077357     3.39   0.001     .1107046    .4139385
     dec2007 |   .1539627   .0780323     1.97   0.048     .0010223    .3069031
     jan2008 |    .070284   .0782673     0.90   0.369    -.0831171    .2236851
     feb2008 |   .1594939   .0775961     2.06   0.040     .0074083    .3115795
     mar2008 |   .0808245   .0788717     1.02   0.305    -.0737611    .2354102
     apr2008 |   .1863593    .076976     2.42   0.015     .0354892    .3372294
     may2008 |   .2119932   .0762665     2.78   0.005     .0625137    .3614728
     jun2008 |   .3574334   .1347403     2.65   0.008     .0933472    .6215196
     jul2008 |   .3522433   .1331476     2.65   0.008     .0912788    .6132078
     aug2008 |  -.0073285   .0713274    -0.10   0.918    -.1471277    .1324706
     sep2008 |   .0066566   .0716748     0.09   0.926    -.1338234    .1471366
     oct2008 |  (omitted)
```

nov2008	.1648504	.0751776	2.19	0.028	.017505	.3121958
dec2008	.1481734	.0746109	1.99	0.047	.0019387	.2944081
jan2009	**-.1472226**	**.0777414**	**-1.89**	**0.058**	**-.299593**	**.0051478**
feb2009	.0554554	.0761714	0.73	0.467	-.0938379	.2047486
mar2009	.0272914	.0746373	0.37	0.715	-.118995	.1735777
apr2009	-.0118572	.0757309	-0.16	0.876	-.160287	.1365726
may2009	-.0533917	.0765024	-0.70	0.485	-.2033337	.0965502
jun2009	-.0970122	.0776887	-1.25	0.212	-.2492793	.0552548
jul2009	.0480615	.0752274	0.64	0.523	-.0993815	.1955044
aug2009	-.0102038	.0746958	-0.14	0.891	-.1566049	.1361974
sep2009	-.0211012	.0762124	-0.28	0.782	-.1704746	.1282723
oct2009	.0278885	.0751933	0.37	0.711	-.1194877	.1752646
nov2009	.026508	.0752705	0.35	0.725	-.1210195	.1740356
dec2009	.0104631	.0737918	0.14	0.887	-.1341661	.1550924
jan2010	.031321	.0736044	0.43	0.670	-.1129409	.175583
feb2010	**-.1507404**	**.0784265**	**-1.92**	**0.055**	**-.3044534**	**.0029727**
mar2010	-.0027363	.0741672	-0.04	0.971	-.1481012	.1426287
apr2010	-.0764526	.0750519	-1.02	0.308	-.2235517	.0706464
may2010	-.0304816	.0751023	-0.41	0.685	-.1776795	.1167163
jun2010	-.0997752	.075759	-1.32	0.188	-.24826	.0487097
jul2010	-.0691264	.0749542	-0.92	0.356	-.2160341	.0777812
aug2010	-.1243765	.0777799	-1.60	0.110	-.2768222	.0280692
sep2010	-.0562411	.0775022	-0.73	0.468	-.2081427	.0956605
oct2010	**-.1369068**	**.0774229**	**-1.77**	**0.077**	**-.2886528**	**.0148392**
nov2010	**-.1422725**	**.0783945**	**-1.81**	**0.070**	**-.2959229**	**.0113779**
dec2010	**-.1429214**	**.0837838**	**-1.71**	**0.088**	**-.3071346**	**.0212918**
_cons	-1.98907	.2714129	-7.33	0.000	-2.52103	-1.457111

d) For DRG810:

Probit regression — Number of obs = 18792; LR chi2(82) = 1744.13; Prob > chi2 = 0.0000; Log likelihood = -4768.4973; Pseudo R2 = 0.1546

mri	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
gender	-.3478877	.129195	-2.69	0.007	-.6011053	-.09467
age	.0025746	.0056376	0.46	0.648	-.0084749	.0136241
age2	-.000202	.0000443	-4.56	0.000	-.0002889	-.0001151
genderage	.0035546	.0018868	1.88	0.060	-.0001435	.0072527
totproc	.0812823	.0054844	14.82	0.000	.070533	.0920315
totdiag	-.0387635	.0062048	-6.25	0.000	-.0509247	-.0266022
mrate	-3.626927	.2079599	-17.44	0.000	-4.034521	-3.219333
epe	-.1356181	.0380037	-3.57	0.000	-.2101039	-.0611323
hcenter	-.0345631	.0330801	-1.04	0.296	-.0993989	.0302727
contract	.0290712	.0535116	0.54	0.587	-.0758095	.133952
totinterns	.0042989	.0008905	4.83	0.000	.0025536	.0060442
distrital	-.2262788	.0456628	-4.96	0.000	-.3157762	-.1367814
nivel1	-.5560409	.0997704	-5.57	0.000	-.7515873	-.3604945
ensino	-.2791103	.0568225	-4.91	0.000	-.3904804	-.1677402
income	.0020322	.0010102	2.01	0.044	.0000523	.004012
elderly	-.0351491	.016993	-2.07	0.039	-.0684548	-.0018434
physicians	-.0224198	.0092848	-2.41	0.016	-.0406177	-.0042219
hschool	.0367427	.0153296	2.40	0.017	.0066972	.0667881
college	-.0704986	.0280733	-2.51	0.012	-.1255213	-.0154759
pop	-.1175722	.0442974	-2.65	0.008	-.2043935	-.030751
pop2	.0028447	.0011515	2.47	0.013	.0005877	.0051016
dpop	-.2801257	.5380316	-0.52	0.603	-1.334648	.7743968
dpop2	.00049	.000315	1.56	0.120	-.0001274	.0011074
season2008~0	.2694016	.1380329	1.95	0.051	-.001138	.5399412
feb2006	-.1577243	.1387148	-1.14	0.256	-.4296004	.1141517
mar2006	-.0653107	.1387761	-0.47	0.638	-.3373069	.2066854
apr2006	-.1627711	.148311	-1.10	0.272	-.4534553	.1279132
may2006	-.0130153	.1438907	-0.09	0.928	-.2950359	.2690053
jun2006	-.0739348	.1465078	-0.50	0.614	-.3610848	.2132152
jul2006	.0977357	.1471393	0.66	0.507	-.190652	.3861234

aug2006	-.1930367	.1562709	-1.24	0.217	-.499322	.1132485
sep2006	-.0884162	.1470884	-0.60	0.548	-.3767041	.1998717
oct2006	-.0107365	.1369628	-0.08	0.938	-.2791787	.2577057
nov2006	.0583102	.1345484	0.43	0.665	-.2053999	.3220202
dec2006	**-.3171989**	**.1492945**	**-2.12**	**0.034**	**-.6098106**	**-.0245871**
jan2007	.1078913	.1401425	0.77	0.441	-.166783	.3825655
feb2007	.0409128	.1510981	0.27	0.787	-.2552341	.3370596
mar2007	-.2494513	.1522321	-1.64	0.101	-.5478207	.0489182
apr2007	.0670867	.1397562	0.48	0.631	-.2068303	.3410038
may2007	.0850754	.1395952	0.61	0.542	-.1885262	.358677
jun2007	.2408855	.1413037	1.70	0.088	-.0360648	.5178357
jul2007	.1767728	.1409267	1.25	0.210	-.0994385	.452984
aug2007	-.1440343	.154903	-0.93	0.352	-.4476387	.15957
sep2007	.2453119	.1404809	1.75	0.081	-.0300257	.5206494
oct2007	.0329363	.1488459	0.22	0.825	-.2587963	.3246689
nov2007	.134034	.1397096	0.96	0.337	-.1397918	.4078598
dec2007	.063216	.1389854	0.45	0.649	-.2091904	.3356224
jan2008	.084483	.1380934	0.61	0.541	-.1861751	.3551411
feb2008	.0051366	.1422637	0.04	0.971	-.2736951	.2839683
mar2008	.0016697	.1417147	0.01	0.991	-.2760859	.2794253
apr2008	.0548636	.1465462	0.37	0.708	-.2323617	.342089
may2008	.0656395	.1463394	0.45	0.654	-.2211804	.3524594
jun2008	.3240228	.2442285	1.33	0.185	-.1546564	.8027019
jul2008	.1636389	.2493614	0.66	0.512	-.3251005	.6523783
aug2008	(omitted)					
sep2008	-.0498167	.1495911	-0.33	0.739	-.3430098	.2433764
oct2008	.03711	.1443011	0.26	0.797	-.2457148	.3199349
nov2008	-.0117543	.1388455	-0.08	0.933	-.2838865	.260378
dec2008	-.1457247	.1415215	-1.03	0.303	-.4231017	.1316522
jan2009	-.0219659	.1377215	-0.16	0.873	-.2918952	.2479633
feb2009	.1159888	.1478245	0.78	0.433	-.1737418	.4057194
mar2009	-.0365565	.1430131	-0.26	0.798	-.316857	.243744
apr2009	-.1074625	.1438009	-0.75	0.455	-.3893071	.1743821
may2009	-.0233584	.1462619	-0.16	0.873	-.3100265	.2633097
jun2009	-.1408986	.1529609	-0.92	0.357	-.4406965	.1588992
jul2009	.0248878	.1474317	0.17	0.866	-.264073	.3138485
aug2009	.117666	.1452414	0.81	0.418	-.1670019	.402334
sep2009	-.1838197	.1539199	-1.19	0.232	-.4854971	.1178576
oct2009	-.1085892	.1520708	-0.71	0.475	-.4066426	.1894641
nov2009	-.0829469	.1430139	-0.58	0.562	-.3632489	.1973552
dec2009	-.0017253	.135917	-0.01	0.990	-.2681178	.2646672
jan2010	-.1716958	.1511297	-1.14	0.256	-.4679045	.1245129
feb2010	.1331648	.139197	0.96	0.339	-.1396563	.4059858
mar2010	-.0570717	.1440319	-0.40	0.692	-.339369	.2252255
apr2010	.1194726	.145518	0.82	0.412	-.1657374	.4046825
may2010	-.2526367	.1619051	-1.56	0.119	-.569965	.0646916
jun2010	**-.3109184**	**.1616382**	**-1.92**	**0.054**	**-.6277235**	**.0058868**
jul2010	**-.295125**	**.165105**	**-1.79**	**0.074**	**-.6187248**	**.0284748**
aug2010	-.0280971	.1535375	-0.18	0.855	-.329025	.2728309
sep2010	.0677747	.1527108	0.44	0.657	-.2315329	.3670823
oct2010	-.2648241	.1636773	-1.62	0.106	-.5856257	.0559776
nov2010	.0260216	.1500654	0.17	0.862	-.2681012	.3201445
dec2010	-.1629488	.1847297	-0.88	0.378	-.5250124	.1991148
_cons	-1.081942	.5187339	-2.09	0.037	-2.098642	-.0652427

e) For DRG832:

```
Probit regression                                 Number of obs   =      17352
                                                  LR chi2(82)     =    3358.71
                                                  Prob > chi2     =     0.0000
Log likelihood = -5138.8255                       Pseudo R2       =     0.2463
```

mri	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
gender	-.4305658	.1414397	-3.04	0.002	-.7077825	-.1533492
age	-.019229	.0072176	-2.66	0.008	-.0333753	-.0050828
age2	-.000196	.000055	-3.57	0.000	-.0003037	-.0000883
genderage	.0070137	.002045	3.43	0.001	.0030056	.0110218

totproc	.1383568	.0058904	23.49	0.000	.1268117	.1499018
totdiag	-.0611125	.0068556	-8.91	0.000	-.0745492	-.0476758
mrate	-1.840098	.7459095	-2.47	0.014	-3.302054	-.3781426
epe	-.3378467	.0387933	-8.71	0.000	-.4138803	-.2618131
hcenter	-.2047434	.0352267	-5.81	0.000	-.2737864	-.1357004
contract	.0649783	.0514897	1.26	0.207	-.0359396	.1658961
totinterns	.0125192	.0009727	12.87	0.000	.0106128	.0144256
distrital	-.1835149	.0449854	-4.08	0.000	-.2716845	-.0953452
nivel1	-.8786608	.1156775	-7.60	0.000	-1.105384	-.6519371
ensino	-.5729834	.0701151	-8.17	0.000	-.7104064	-.4355604
income	.001486	.0007944	1.87	0.061	-.000071	.0030431
elderly	-.01134	.0177257	-0.64	0.522	-.0460818	.0234017
physicians	-.0241934	.0109281	-2.21	0.027	-.0456121	-.0027746
hschool	.1226433	.0135843	9.03	0.000	.0960186	.1492679
college	-.166755	.0260512	-6.40	0.000	-.2178145	-.1156954
pop	-.1002528	.0439357	-2.28	0.023	-.1863652	-.0141404
pop2	.0000504	.0011632	0.04	0.965	-.0022295	.0023303
dpop	.7286455	.5608786	1.30	0.194	-.3706564	1.827947
dpop2	.0000464	.0003237	0.14	0.886	-.000588	.0006809
seas~7gdh832	.4132257	.149804	2.76	0.006	.1196153	.7068361
seas~8gdh832	.4797781	.140776	3.41	0.001	.2038622	.7556941
feb2006	.1537691	.1470714	1.05	0.296	-.1344856	.4420239
mar2006	.1323608	.1426078	0.93	0.353	-.1471453	.4118669
apr2006	.0921151	.1440394	0.64	0.522	-.1901969	.3744271
may2006	-.0486626	.1473513	-0.33	0.741	-.3374658	.2401405
jun2006	-.0634974	.1537057	-0.41	0.680	-.364755	.2377603
jul2006	.1558506	.143394	1.09	0.277	-.1251965	.4368977
aug2006	.2196094	.1388267	1.58	0.114	-.0524859	.4917048
sep2006	.2554334	.1436629	1.78	0.075	-.0261408	.5370075
oct2006	.2532691	.1417268	1.79	0.074	-.0245104	.5310486
nov2006	.0621184	.1499606	0.41	0.679	-.2317989	.3560356
dec2006	-.0280886	.1551701	-0.18	0.856	-.3322165	.2760392
jan2007	-.0563308	.1563034	-0.36	0.719	-.3626799	.2500183
feb2007	.0014218	.1515736	0.01	0.993	-.2956569	.2985005
mar2007	.0619735	.1549076	0.40	0.689	-.2416399	.3655869
apr2007	(omitted)					
may2007	.60911	.1467004	4.15	0.000	.3215824	.8966375
jun2007	.4447415	.1497135	2.97	0.003	.1513084	.7381745
jul2007	.5933717	.1425716	4.16	0.000	.3139364	.8728069
aug2007	.5554442	.1438872	3.86	0.000	.2734305	.8374579
sep2007	.3996984	.1436127	2.78	0.005	.1182226	.6811742
oct2007	.567241	.1446882	3.92	0.000	.2836574	.8508246
nov2007	.5991236	.1427298	4.20	0.000	.3193783	.8788689
dec2007	.4832851	.1506696	3.21	0.001	.1879782	.778592
jan2008	.3590479	.1469101	2.44	0.015	.0711094	.6469864
feb2008	.4497093	.1474807	3.05	0.002	.1606524	.7387663
mar2008	.372802	.1486935	2.51	0.012	.0813681	.6642359
apr2008	.2689788	.1492686	1.80	0.072	-.0235823	.5615398
may2008	.4552579	.1458728	3.12	0.002	.1693524	.7411635
jun2008	.3516892	.1519033	2.32	0.021	.0539642	.6494142
jul2008	.3281955	.1446557	2.27	0.023	.0446756	.6117154
aug2008	.8016896	.2528065	3.17	0.002	.306198	1.297181
sep2008	.7603121	.2537829	3.00	0.003	.2629067	1.257717
oct2008	(omitted)					
nov2008	.2995062	.152424	1.96	0.049	.0007606	.5982517
dec2008	.39331	.1491982	2.64	0.008	.1008869	.6857332
jan2009	.1809447	.161428	1.12	0.262	-.1354485	.4973378
feb2009	-.0623366	.1656527	-0.38	0.707	-.3870099	.2623367
mar2009	-.0117184	.1519787	-0.08	0.939	-.3095911	.2861543
apr2009	.1505446	.1571445	0.96	0.338	-.1574529	.4585422
may2009	.0929284	.1562721	0.59	0.552	-.2133593	.399216
jun2009	.0917918	.1511518	0.61	0.544	-.2044603	.3880438
jul2009	.4264126	.1509667	2.82	0.005	.1305232	.722302
aug2009	.1182344	.1528537	0.77	0.439	-.1813533	.4178221
sep2009	.3719808	.1457743	2.55	0.011	.0862684	.6576933
oct2009	.2446739	.1520416	1.61	0.108	-.053322	.5426699
nov2009	.3639382	.1504794	2.42	0.016	.0690039	.6588724
dec2009	.1742198	.1576146	1.11	0.269	-.1346991	.4831388

```
    jan2010 |   .3413365   .1520988     2.24   0.025     .0432284    .6394446
    feb2010 |   .2703646   .1624357     1.66   0.096    -.0480034    .5887327
    mar2010 |   .1982479   .1503111     1.32   0.187    -.0963564    .4928522
    apr2010 |   .2388114    .146645     1.63   0.103    -.0486074    .5262303
    may2010 |   .0567311   .1598233     0.35   0.723    -.2565168    .3699791
    jun2010 |   .0620995   .1589783     0.39   0.696    -.2494923    .3736912
    jul2010 |   .2239218   .1492646     1.50   0.134    -.0686315    .5164751
    aug2010 |   .0827718   .1554863     0.53   0.594    -.2219757    .3875193
    sep2010 |   .1821081   .1570851     1.16   0.246    -.1257731    .4899893
    oct2010 |   .2365556   .1588333     1.49   0.136     -.074752    .5478631
    nov2010 |  -.0629752    .163283    -0.39   0.700     -.383004    .2570537
    dec2010 |   .1421182   .1661534     0.86   0.392    -.1835365    .4677728
      _cons |  -1.685745   .5239765    -3.22   0.001    -2.712719   -.6587695
```

f) For DRG243:

```
Probit regression                                 Number of obs   =      17358
                                                  LR chi2(82)     =    1451.24
                                                  Prob > chi2     =     0.0000
Log likelihood = -6040.8335                       Pseudo R2       =     0.1072

------------------------------------------------------------------------------
         mri |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      gender |  -.5307926   .0785961    -6.75   0.000    -.6848382   -.3767471
         age |  -.0021256   .0032237    -0.66   0.510    -.0084439    .0041927
        age2 |  -.0000797   .0000295    -2.70   0.007    -.0001376   -.0000218
   genderage |   .0089015   .0013193     6.75   0.000     .0063156    .0114873
     totproc |   .0906242   .0049346    18.36   0.000     .0809524    .1002959
     totdiag |   .0641039   .0073712     8.70   0.000     .0496566    .0785513
       mrate |  -1.497109   2.999018    -0.50   0.618    -7.375075    4.380858
         epe |  -.0397246   .0332825    -1.19   0.233     -.104957    .0255079
     hcenter |  -.0212678   .0294057    -0.72   0.470    -.0789019    .0363662
    contract |   .1568843   .0534283     2.94   0.003     .0521668    .2616018
  totinterns |   .0027928   .0007857     3.55   0.000     .0012529    .0043327
   distrital |   .0027274   .0407688     0.07   0.947     -.077178    .0826327
      nivel1 |  -.0585913   .0876845    -0.67   0.504    -.2304497    .1132672
      ensino |   .1890126   .0466913     4.05   0.000     .0974993    .2805259
      income |    .004197   .0009298     4.51   0.000     .0023746    .0060194
     elderly |    .020249   .0138606     1.46   0.144    -.0069172    .0474153
  physicians |   .0221709   .0071941     3.08   0.002     .0080708    .0362711
     hschool |   .0481012   .0124426     3.87   0.000     .0237141    .0724883
     college |  -.0761059   .0250364    -3.04   0.002    -.1251764   -.0270355
         pop |   -.095922   .0379126    -2.53   0.011    -.1702293   -.0216147
        pop2 |   .0003688   .0009957     0.37   0.711    -.0015828    .0023203
        dpop |   1.544956   .4588038     3.37   0.001     .6457176    2.444195
       dpop2 |  -.0006053   .0002653    -2.28   0.023    -.0011252   -.0000853
     feb2006 |   -.109615   .1394558    -0.79   0.432    -.3829432    .1637133
     mar2006 |  -.0459356    .126476    -0.36   0.716    -.2938239    .2019527
     apr2006 |  -.0036267   .1319767    -0.03   0.978    -.2622962    .2550429
     may2006 |  -.1360462   .1316423    -1.03   0.301    -.3940603     .121968
     jun2006 |  -.1190806   .1350244    -0.88   0.378    -.3837236    .1455625
     jul2006 |  -.1413921   .1330915    -1.06   0.288    -.4022466    .1194625
     aug2006 |  -.0591787   .1362994    -0.43   0.664    -.3263206    .2079631
     sep2006 |  -.1836382   .1360556    -1.35   0.177    -.4503022    .0830258
     oct2006 |  -.2507254   .1357459    -1.85   0.065    -.5167825    .0153317
     nov2006 |  -.1642464   .1358782    -1.21   0.227    -.4305629     .10207
     dec2006 |  -.2216624   .1449594    -1.53   0.126    -.5057777    .0624529
     jan2007 |  -.1354011   .1391688    -0.97   0.331     -.408167    .1373648
     feb2007 |  -.4201452   .1537793    -2.73   0.006     -.721547   -.1187433
     mar2007 |  -.2046443   .1336548    -1.53   0.126    -.4666029    .0573144
     apr2007 |   .1313878   .1323663     0.99   0.321    -.1280454     .390821
     may2007 |  -.1187898   .1343636    -0.88   0.377    -.3821376     .144558
     jun2007 |  -.1881805   .1403189    -1.34   0.180    -.4632005    .0868396
     jul2007 |   -.131793   .1354111    -0.97   0.330    -.3971938    .1336079
     aug2007 |  -.1715201   .1358289    -1.26   0.207    -.4377399    .0946997
     sep2007 |  -.1473743   .1395509    -1.06   0.291    -.4208891    .1261405
     oct2007 |  -.0799034   .1330346    -0.60   0.548    -.3406465    .1808397
```

nov2007	.0146147	.1301095	0.11	0.911	-.2403954	.2696247
dec2007	-.0277325	.1369106	-0.20	0.839	-.2960722	.2406073
jan2008	-.1496346	.1371849	-1.09	0.275	-.418512	.1192428
feb2008	-.2158805	.1410579	-1.53	0.126	-.492349	.0605879
mar2008	-.1293263	.1379608	-0.94	0.349	-.3997245	.1410718
apr2008	-.1735257	.139853	-1.24	0.215	-.4476325	.1005811
may2008	**-.2797504**	**.1444351**	**-1.94**	**0.053**	**-.5628381**	**.0033373**
jun2008	-.1275349	.1305621	-0.98	0.329	-.3834318	.1283621
jul2008	-.1512293	.1346847	-1.12	0.262	-.4152064	.1127479
aug2008	-.1144481	.1381076	-0.83	0.407	-.3851341	.1562378
sep2008	-.2061408	.1342355	-1.54	0.125	-.4692376	.056956
oct2008	.0155841	.1272557	0.12	0.903	-.2338325	.2650006
nov2008	-.102159	.13156	-0.78	0.437	-.3600119	.155694
dec2008	**-.3329672**	**.1443208**	**-2.31**	**0.021**	**-.6158307**	**-.0501037**
jan2009	-.1071632	.1400646	-0.77	0.444	-.3816847	.1673583
feb2009	**-.2777657**	**.1412879**	**-1.97**	**0.049**	**-.5546849**	**-.0008466**
mar2009	-.1817658	.1316	-1.38	0.167	-.4396971	.0761655
apr2009	**-.2458899**	**.1371412**	**-1.79**	**0.073**	**-.5146818**	**.022902**
may2009	-.1890323	.1345937	-1.40	0.160	-.452831	.0747665
jun2009	-.2095667	.1324641	-1.58	0.114	-.4691916	.0500583
jul2009	**-.2945043**	**.1350789**	**-2.18**	**0.029**	**-.5592541**	**-.0297544**
aug2009	**-.2336203**	**.1346648**	**-1.73**	**0.083**	**-.4975585**	**.0303179**
sep2009	-.2119648	.1329738	-1.59	0.111	-.4725886	.048659
oct2009	-.1071159	.1298866	-0.82	0.410	-.361689	.1474571
nov2009	**-.4019499**	**.1343144**	**-2.99**	**0.003**	**-.6652012**	**-.1386986**
dec2009	**-.584047**	**.1446451**	**-4.04**	**0.000**	**-.8675461**	**-.3005479**
jan2010	**-.5148992**	**.1424578**	**-3.61**	**0.000**	**-.7941114**	**-.2356869**
feb2010	**-.3996403**	**.1460649**	**-2.74**	**0.006**	**-.6859222**	**-.1133584**
mar2010	**-.4726872**	**.1376474**	**-3.43**	**0.001**	**-.7424712**	**-.2029033**
apr2010	**-.4912423**	**.1447741**	**-3.39**	**0.001**	**-.7749943**	**-.2074903**
may2010	**-.3705024**	**.1381635**	**-2.68**	**0.007**	**-.641298**	**-.0997069**
jun2010	**-.349688**	**.1360379**	**-2.57**	**0.010**	**-.6163174**	**-.0830586**
jul2010	**-.4127529**	**.1338329**	**-3.08**	**0.002**	**-.6750606**	**-.1504451**
aug2010	**-.3956072**	**.1354349**	**-2.92**	**0.003**	**-.6610547**	**-.1301597**
sep2010	**-.3916175**	**.1328431**	**-2.95**	**0.003**	**-.6519853**	**-.1312498**
oct2010	**-.4184339**	**.1355694**	**-3.09**	**0.002**	**-.684145**	**-.1527229**
nov2010	**-.3293458**	**.1312524**	**-2.51**	**0.012**	**-.5865959**	**-.0720958**
dec2010	**-.5883723**	**.1469699**	**-4.00**	**0.000**	**-.8764281**	**-.3003166**
_cons	-5.002378	.4379259	-11.42	0.000	-5.860697	-4.144059

g) For DRG25:

```
Probit regression                                 Number of obs   =      10015
                                                  LR chi2(81)     =    1707.41
                                                  Prob > chi2     =     0.0000
Log likelihood = -3875.3254                       Pseudo R2       =     0.1805
```

mri	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
gender	-.4594212	.0966023	-4.76	0.000	-.6487584	-.2700841
age	.0282107	.005437	5.19	0.000	.0175544	.038867
age2	-.0004419	.0000506	-8.73	0.000	-.0005412	-.0003427
genderage	.0019314	.0018817	1.03	0.305	-.0017567	.0056194
totproc	.1939966	.007401	26.21	0.000	.179491	.2085022
totdiag	.0057702	.0111332	0.52	0.604	-.0160504	.0275908
mrate	(omitted)					
epe	-.21201	.0484244	-4.38	0.000	-.30692	-.1170999
hcenter	-.0592377	.0383347	-1.55	0.122	-.1343723	.0158968
contract	.0969265	.0583091	1.66	0.096	-.0173573	.2112104
totinterns	.0051792	.0011143	4.65	0.000	.0029952	.0073633
distrital	-.4909835	.0517382	-9.49	0.000	-.5923886	-.3895785
nivel1	-1.218714	.1903615	-6.40	0.000	-1.591815	-.8456118
ensino	-.4940905	.0731319	-6.76	0.000	-.6374264	-.3507546
income	.0015953	.0011496	1.39	0.165	-.0006579	.0038485
elderly	-.1005339	.0218483	-4.60	0.000	-.1433557	-.057712
physicians	-.0210349	.0103201	-2.04	0.042	-.041262	-.0008078
hschool	.1084597	.0172007	6.31	0.000	.0747469	.1421725

college	-.0612201	.0337683	-1.81	0.070	-.1274047	.0049645
pop	-.3566241	.0587268	-6.07	0.000	-.4717266	-.2415216
pop2	.0061821	.0015373	4.02	0.000	.0031691	.009195
dpop	-.479358	.667974	-0.72	0.473	-1.788563	.8298469
dpop2	.0012045	.0003644	3.31	0.001	.0004904	.0019187
feb2006	-.187565	.1671923	-1.12	0.262	-.5152558	.1401258
mar2006	**-.3228412**	**.1715057**	**-1.88**	**0.060**	**-.6589862**	**.0133037**
apr2006	-.2185502	.167662	-1.30	0.192	-.5471616	.1100611
may2006	**-.3109588**	**.1636955**	**-1.90**	**0.057**	**-.631796**	**.0098785**
jun2006	-.0717535	.1657414	-0.43	0.665	-.3966007	.2530937
jul2006	-.1323817	.1676233	-0.79	0.430	-.4609173	.1961539
aug2006	-.2626838	.172334	-1.52	0.127	-.6004523	.0750847
sep2006	-.2238147	.1704071	-1.31	0.189	-.5578066	.1101772
oct2006	-.1756748	.1622026	-1.08	0.279	-.493586	.1422364
nov2006	-.1119442	.1625761	-0.69	0.491	-.4305875	.206699
dec2006	-.274668	.1766453	-1.55	0.120	-.6208864	.0715504
jan2007	.0458516	.1715995	0.27	0.789	-.2904772	.3821804
feb2007	.0773388	.1738917	0.44	0.656	-.2634825	.4181602
mar2007	.0392475	.1701201	0.23	0.818	-.2941818	.3726767
apr2007	-.0102996	.1730351	-0.06	0.953	-.3494421	.3288429
may2007	-.0717909	.1650455	-0.43	0.664	-.395274	.2516923
jun2007	-.2256151	.1706733	-1.32	0.186	-.5601287	.1088985
jul2007	-.0695986	.1716325	-0.41	0.685	-.4059921	.2667949
aug2007	-.1664532	.1829546	-0.91	0.363	-.5250376	.1921313
sep2007	-.0408112	.1714581	-0.24	0.812	-.3768629	.2952405
oct2007	.0781862	.1581708	0.49	0.621	-.2318229	.3881953
nov2007	-.0246812	.169868	-0.15	0.884	-.3576164	.308254
dec2007	-.1356356	.1833911	-0.74	0.460	-.4950755	.2238043
jan2008	-.1160493	.1675799	-0.69	0.489	-.4445	.2124013
feb2008	-.0360089	.1690072	-0.21	0.831	-.367257	.2952392
mar2008	-.0489871	.1637388	-0.30	0.765	-.3699093	.271935
apr2008	-.247757	.1721714	-1.44	0.150	-.5852068	.0896927
may2008	-.2050179	.1750967	-1.17	0.242	-.5482013	.1381654
jun2008	**-.3159266**	**.1813204**	**-1.74**	**0.081**	**-.671308**	**.0394549**
jul2008	-.1318613	.1721488	-0.77	0.444	-.4692669	.2055442
aug2008	-.1571223	.1765001	-0.89	0.373	-.5030561	.1888115
sep2008	-.1283344	.1774551	-0.72	0.470	-.4761399	.2194712
oct2008	.0625788	.1644889	0.38	0.704	-.2598136	.3849712
nov2008	-.1459755	.1605131	-0.91	0.363	-.4605754	.1686244
dec2008	.0107172	.1734851	0.06	0.951	-.3293073	.3507417
jan2009	-.2050252	.1826486	-1.12	0.262	-.5630099	.1529595
feb2009	-.2270045	.1870897	-1.21	0.225	-.5936935	.1396846
mar2009	**-.3174069**	**.1818777**	**-1.75**	**0.081**	**-.6738807**	**.0390669**
apr2009	**-.3054376**	**.1793091**	**-1.70**	**0.088**	**-.656877**	**.0460019**
may2009	-.2233872	.1692506	-1.32	0.187	-.5551123	.1083378
jun2009	**-.3440587**	**.1791503**	**-1.92**	**0.055**	**-.6951869**	**.0070694**
jul2009	-.2186926	.1651615	-1.32	0.185	-.5424032	.105018
aug2009	.0629215	.1724476	0.36	0.715	-.2750696	.4009126
sep2009	-.1615336	.1778485	-0.91	0.364	-.5101103	.1870431
oct2009	**-.3239171**	**.172191**	**-1.88**	**0.060**	**-.6614052**	**.013571**
nov2009	-.1220029	.1678367	-0.73	0.467	-.4509569	.2069511
dec2009	-.0722796	.172244	-0.42	0.675	-.4098716	.2653124
jan2010	**-.5592908**	**.1815134**	**-3.08**	**0.002**	**-.9150505**	**-.203531**
feb2010	**-.4229641**	**.1736174**	**-2.44**	**0.015**	**-.763248**	**-.0826802**
mar2010	**-.3977992**	**.1726704**	**-2.30**	**0.021**	**-.736227**	**-.0593714**
apr2010	**-.4549035**	**.1697894**	**-2.68**	**0.007**	**-.7876846**	**-.1221224**
may2010	-.264245	.1720165	-1.54	0.124	-.6013911	.0729011
jun2010	**-.4612779**	**.1805835**	**-2.55**	**0.011**	**-.8152151**	**-.1073407**
jul2010	**-.3667073**	**.1697821**	**-2.16**	**0.031**	**-.6994741**	**-.0339405**
aug2010	-.2623842	.1713003	-1.53	0.126	-.5981267	.0733583
sep2010	**-.4173396**	**.1765424**	**-2.36**	**0.018**	**-.7633563**	**-.0713228**
oct2010	**-.3755839**	**.1760881**	**-2.13**	**0.033**	**-.7207103**	**-.0304575**
nov2010	**-.3352891**	**.1800803**	**-1.86**	**0.063**	**-.6882401**	**.0176619**
dec2010	**-.4396539**	**.192158**	**-2.29**	**0.022**	**-.8162766**	**-.0630311**
_cons	-1.595365	.6117825	-2.61	0.009	-2.794436	-.3962931

h) For DRG13:

Probit regression Number of obs = 3956

```
                                                LR chi2(82)     =    1599.65
                                                Prob > chi2     =     0.0000
Log likelihood = -1805.5501                     Pseudo R2       =     0.3070

------------------------------------------------------------------------------
         mri |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      gender |  -.1445648   .1597176    -0.91   0.365    -.4576054    .1684759
         age |   .0185069   .0079544     2.33   0.020     .0029165    .0340972
        age2 |  -.0003769   .0000884    -4.26   0.000    -.0005501   -.0002036
   genderage |   .0047899   .0036183     1.32   0.186    -.0023019    .0118817
     totproc |   .3426084   .0115343    29.70   0.000     .3200016    .3652153
     totdiag |  -.0293685   .0170369    -1.72   0.085    -.0627603    .0040232
       mrate |   -11.7013    3.00222    -3.90   0.000    -17.58554   -5.817056
         epe |  -.0140243    .074088    -0.19   0.850    -.1592341    .1311855
     hcenter |  -.1138959   .0589053    -1.93   0.053    -.2293481    .0015563
    contract |   .0572532   .1039093     0.55   0.582    -.1464053    .2609117
  totinterns |   .0013318   .0018899     0.70   0.481    -.0023723     .005036
   distrital |  -.4146677   .0795721    -5.21   0.000     -.570626   -.2587093
       nivel1 |  -1.077979   .5437765    -1.98   0.047    -2.143761   -.0121967
      ensino |  -.6280862   .1060581    -5.92   0.000    -.8359562   -.4202162
      income |    .005302   .0017858     2.97   0.003     .0018018    .0088021
     elderly |  -.0575924   .0326053    -1.77   0.077    -.1214977    .0063129
  physicians |   .0152056   .0136246     1.12   0.264    -.0114981    .0419093
     hschool |   .0749923   .0269785     2.78   0.005     .0221153    .1278693
     college |   -.138355   .0482068    -2.87   0.004    -.2328385   -.0438714
         pop |  -.2981183   .0959828    -3.11   0.002    -.4862412   -.1099954
        pop2 |   .0035957   .0024758     1.45   0.146    -.0012567    .0084481
        dpop |  -.5027667   .9358922    -0.54   0.591    -2.337082    1.331548
       dpop2 |   .0012461   .0005312     2.35   0.019     .0002049    .0022872
seaso~9gdh13 |  -.4966949   .2359067    -2.11   0.035    -.9590636   -.0343262
     feb2006 |  -.3663799   .2195773    -1.67   0.095    -.7967434    .0639837
     mar2006 |  -.5140869    .215139    -2.39   0.017    -.9357517   -.0924221
     apr2006 |  -.1955335   .2218679    -0.88   0.378    -.6303866    .2393196
     may2006 |   -.310229   .2191059    -1.42   0.157    -.7396687    .1192106
     jun2006 |  -.4651007   .2187213    -2.13   0.033    -.8937866   -.0364147
     jul2006 |  -.1964674   .2220439    -0.88   0.376    -.6316655    .2387307
     aug2006 |   -.486949   .2590905    -1.88   0.060     -.994757    .0208589
     sep2006 |  -.3031292   .2295725    -1.32   0.187     -.753083    .1468246
     oct2006 |  -.4101931   .2437002    -1.68   0.092    -.8878367    .0674506
     nov2006 |  -.1804205   .2160025    -0.84   0.404    -.6037775    .2429365
     dec2006 |  -.1768252   .2457108    -0.72   0.472    -.6584095    .3047591
     jan2007 |    .175487   .2920269     0.60   0.548    -.3968752    .7478491
     feb2007 |  -.2215993   .3058359    -0.72   0.469    -.8210265     .377828
     mar2007 |   .4142794   .2958912     1.40   0.161    -.1656566    .9942155
     apr2007 |  -.2924182   .2768205    -1.06   0.291    -.8349765    .2501401
     may2007 |   .0841402   .2150818     0.39   0.696    -.3374124    .5056928
     jun2007 |   .0086605   .2436635     0.04   0.972    -.4689111    .4862322
     jul2007 |   .0057671    .239897     0.02   0.981    -.4644223    .4759565
     aug2007 |  -.0951764   .2435544    -0.39   0.696    -.5725343    .3821816
     sep2007 |   -.209061   .2572799    -0.81   0.416    -.7133203    .2951983
     oct2007 |   .0450183   .2252629     0.20   0.842    -.3964889    .4865255
     nov2007 |  -.4733423   .2582415    -1.83   0.067    -.9794863    .0328018
     dec2007 |  -.0626946   .2546672    -0.25   0.806    -.5618331    .4364439
     jan2008 |  -.4910175   .2356028    -2.08   0.037    -.9527904   -.0292445
     feb2008 |  -.3715276   .2536515    -1.46   0.143    -.8686754    .1256201
     mar2008 |  -.3477254   .2649071    -1.31   0.189    -.8669338    .1714831
     apr2008 |  -.1380067   .2270664    -0.61   0.543    -.5830487    .3070354
     may2008 |  -.1553064    .219786    -0.71   0.480     -.586079    .2754662
     jun2008 |  -.3554709   .2274618    -1.56   0.118    -.8012877     .090346
     jul2008 |  -.0688524   .2351594    -0.29   0.770    -.5297562    .3920515
     aug2008 |  -.2340069   .2461149    -0.95   0.342    -.7163833    .2483694
     sep2008 |  -.3225064   .2389634    -1.35   0.177    -.7908661    .1458532
     oct2008 |   -.269863    .218441    -1.24   0.217    -.6979995    .1582736
     nov2008 |  -.1320313    .242959    -0.54   0.587    -.6082222    .3441596
     dec2008 |  -1.020582   .3379751    -3.02   0.003    -1.683001   -.3581628
     jan2009 |  -.3254733   .2502451    -1.30   0.193    -.8159448    .1649981
     feb2009 |  -.6347727   .2593696    -2.45   0.014    -1.143128   -.1264177
```

mar2009	-.0456893	.249281	-0.18	0.855	-.534271	.4428924
apr2009	-.2579209	.2511205	-1.03	0.304	-.7501079	.2342662
may2009	-.3859151	.2476774	-1.56	0.119	-.8713539	.0995238
jun2009	**-.4697525**	**.234178**	**-2.01**	**0.045**	**-.9287329**	**-.0107721**
jul2009	**-1.116496**	**.4176996**	**-2.67**	**0.008**	**-1.935172**	**-.2978195**
aug2009	**-.9692809**	**.4164805**	**-2.33**	**0.020**	**-1.785568**	**-.1529941**
sep2009	.1412464	.2553508	0.55	0.580	-.359232	.6417248
oct2009	.1067292	.2443179	0.44	0.662	-.3721251	.5855835
nov2009	(omitted)					
dec2009	**-.4915719**	**.2644926**	**-1.86**	**0.063**	**-1.009968**	**.0268241**
jan2010	**-.5602965**	**.2603181**	**-2.15**	**0.031**	**-1.070511**	**-.0500824**
feb2010	**-.5004283**	**.2579492**	**-1.94**	**0.052**	**-1.005999**	**.0051428**
mar2010	**-.5378988**	**.249776**	**-2.15**	**0.031**	**-1.027451**	**-.0483468**
apr2010	-.3163736	.2409666	-1.31	0.189	-.7886594	.1559123
may2010	-.2255673	.2280653	-0.99	0.323	-.6725671	.2214325
jun2010	**-.5086797**	**.2534947**	**-2.01**	**0.045**	**-1.00552**	**-.0118392**
jul2010	-.0350293	.2367891	-0.15	0.882	-.4991274	.4290687
aug2010	-.0097155	.2472592	-0.04	0.969	-.4943346	.4749036
sep2010	-.0653366	.2448653	-0.27	0.790	-.5452639	.4145906
oct2010	**-.5294343**	**.2524474**	**-2.10**	**0.036**	**-1.024222**	**-.0346465**
nov2010	-.1558515	.2525298	-0.62	0.537	-.6508008	.3390978
dec2010	**-.4658432**	**.2706319**	**-1.72**	**0.085**	**-.9962719**	**.0645856**
_cons	-3.164969	.9122904	-3.47	0.001	-4.953026	-1.376913

i) For DRG12:

Probit regression — Number of obs = 6102; LR chi2(82) = 940.74; Prob > chi2 = 0.0000; Log likelihood = -2832.9787; Pseudo R2 = 0.1424

mri	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
gender	-.0337192	.1230383	-0.27	0.784	-.2748698	.2074315
age	.0331137	.0040246	8.23	0.000	.0252256	.0410018
age2	-.000426	.0000385	-11.07	0.000	-.0005014	-.0003505
genderage	.0005359	.0019069	0.28	0.779	-.0032015	.0042733
totproc	.1468435	.0074322	19.76	0.000	.1322767	.1614103
totdiag	-.0223713	.0088799	-2.52	0.012	-.0397757	-.004967
mrate	-3.445677	.7629791	-4.52	0.000	-4.941089	-1.950265
epe	-.2457404	.0534359	-4.60	0.000	-.3504729	-.1410079
hcenter	-.0021309	.0463804	-0.05	0.963	-.0930348	.0887729
contract	-.1130808	.0787371	-1.44	0.151	-.2674027	.0412411
totinterns	.0040416	.0011128	3.63	0.000	.0018606	.0062225
distrital	-.217975	.0679979	-3.21	0.001	-.3512484	-.0847016
nivel1	-.7814569	.2173844	-3.59	0.000	-1.207523	-.3553912
ensino	-.2319139	.0736184	-3.15	0.002	-.3762032	-.0876245
income	.0016047	.0015147	1.06	0.289	-.0013641	.0045734
elderly	-.0881592	.0262227	-3.36	0.001	-.1395547	-.0367636
physicians	-.0061146	.0113731	-0.54	0.591	-.0284055	.0161763
hschool	.0580514	.0220963	2.63	0.009	.0147433	.1013594
college	-.0363687	.0427879	-0.85	0.395	-.1202314	.047494
pop	-.1898921	.0700807	-2.71	0.007	-.3272478	-.0525363
pop2	.0021056	.0017773	1.18	0.236	-.0013778	.005589
dpop	-.4702602	.841889	-0.56	0.576	-2.120332	1.179812
dpop2	.0008798	.0004798	1.83	0.067	-.0000606	.0018202
feb2006	-.2441927	.2007145	-1.22	0.224	-.6375859	.1492006
mar2006	.012066	.1800031	0.07	0.947	-.3407337	.3648657
apr2006	.0537078	.1957834	0.27	0.784	-.3300207	.4374362
may2006	-.1793782	.1809587	-0.99	0.322	-.5340508	.1752944
jun2006	-.0454838	.17635	-0.26	0.796	-.3911234	.3001557
jul2006	**-.3593404**	**.1940932**	**-1.85**	**0.064**	**-.7397562**	**.0210753**
aug2006	-.1487017	.1939879	-0.77	0.443	-.528911	.2315075
sep2006	-.1871879	.1808432	-1.04	0.301	-.5416341	.1672583
oct2006	-.0348816	.182287	-0.19	0.848	-.3921576	.3223944
nov2006	.041283	.1781343	0.23	0.817	-.3078538	.3904198
dec2006	-.0994544	.2107967	-0.47	0.637	-.5126084	.3136995
jan2007	.3219024	.2109878	1.53	0.127	-.091626	.7354309

feb2007	.0652761	.2231283	0.29	0.770	-.3720474	.5025996
mar2007	.4949932	.2112501	2.34	0.019	.0809506	.9090358
apr2007	-.2460752	.2050432	-1.20	0.230	-.6479525	.1558021
may2007	-.2556312	.2078923	-1.23	0.219	-.6630926	.1518301
jun2007	.2874548	.1918113	1.50	0.134	-.0884884	.663398
jul2007	-.1984098	.1872807	-1.06	0.289	-.5654732	.1686536
aug2007	.0237677	.2128761	0.11	0.911	-.3934619	.4409972
sep2007	.0437761	.1955238	0.22	0.823	-.3394435	.4269957
oct2007	.1517934	.1852758	0.82	0.413	-.2113406	.5149273
nov2007	.1038332	.1908538	0.54	0.586	-.2702333	.4778997
dec2007	-.1945062	.2134325	-0.91	0.362	-.6128262	.2238137
jan2008	-.1726827	.2004498	-0.86	0.389	-.5655571	.2201918
feb2008	.13692	.1979789	0.69	0.489	-.2511115	.5249514
mar2008	.221967	.1936545	1.15	0.252	-.1575888	.6015229
apr2008	-.2782541	.1966184	-1.42	0.157	-.6636192	.1071109
may2008	-.2605799	.2057623	-1.27	0.205	-.6638667	.1427069
jun2008	-.2258829	.2017519	-1.12	0.263	-.6213094	.1695436
jul2008	.0780389	.1901112	0.41	0.681	-.2945723	.4506501
aug2008	-.3043017	.2058863	-1.48	0.139	-.7078314	.0992279
sep2008	-.1736034	.1913561	-0.91	0.364	-.5486544	.2014476
oct2008	-.1039623	.1907768	-0.54	0.586	-.4778781	.2699534
nov2008	-.2023054	.1972543	-1.03	0.305	-.5889168	.184306
dec2008	**-.4001492**	**.2299475**	**-1.74**	**0.082**	**-.8508379**	**.0505396**
jan2009	**-.547257**	**.2211822**	**-2.47**	**0.013**	**-.9807663**	**-.1137478**
feb2009	-.0434068	.1992744	-0.22	0.828	-.4339775	.3471639
mar2009	.083803	.1839327	0.46	0.649	-.2766986	.4443046
apr2009	-.1773166	.209655	-0.85	0.398	-.5882329	.2335996
may2009	-.0755929	.1904942	-0.40	0.691	-.4489547	.2977689
jun2009	**-.5524109**	**.2137461**	**-2.58**	**0.010**	**-.9713456**	**-.1334762**
jul2009	-.1515774	.1917466	-0.79	0.429	-.5273939	.2242391
aug2009	**-.4015397**	**.2120683**	**-1.89**	**0.058**	**-.8171859**	**.0141064**
sep2009	-.0801682	.1855234	-0.43	0.666	-.4437874	.283451
oct2009	**-.3945806**	**.2017696**	**-1.96**	**0.051**	**-.7900417**	**.0008805**
nov2009	**-.3700945**	**.197549**	**-1.87**	**0.061**	**-.7572834**	**.0170945**
dec2009	**-.4856297**	**.2298732**	**-2.11**	**0.035**	**-.9361729**	**-.0350865**
jan2010	-.1843717	.1935519	-0.95	0.341	-.5637265	.194983
feb2010	-.3037462	.1926352	-1.58	0.115	-.6813042	.0738118
mar2010	-.1166414	.1889697	-0.62	0.537	-.4870152	.2537323
apr2010	-.2297761	.1906923	-1.20	0.228	-.6035261	.1439739
may2010	**-.3436291**	**.2018907**	**-1.70**	**0.089**	**-.7393275**	**.0520693**
jun2010	**-.6645195**	**.2321946**	**-2.86**	**0.004**	**-1.119612**	**-.2094265**
jul2010	**-.3811618**	**.2003205**	**-1.90**	**0.057**	**-.7737827**	**.0114591**
aug2010	-.03717	.1975609	-0.19	0.851	-.4243822	.3500422
sep2010	**-.3637194**	**.1998138**	**-1.82**	**0.069**	**-.7553472**	**.0279085**
oct2010	-.3007466	.202895	-1.48	0.138	-.6984135	.0969204
nov2010	-.0211073	.20497	-0.10	0.918	-.4228411	.3806265
dec2010	-.1612477	.2405949	-0.67	0.503	-.6328051	.3103097
_cons	-1.145534	.7402261	-1.55	0.122	-2.596351	.305282

j) For DRG11:

```
Probit regression                                 Number of obs   =       4870
                                                  LR chi2(82)     =     854.22
                                                  Prob > chi2     =     0.0000
Log likelihood = -2897.7425                       Pseudo R2       =     0.1285
```

mri	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
gender	-.0266928	.1307357	-0.20	0.838	-.28293	.2295444
age	.0050282	.0046842	1.07	0.283	-.0041527	.014209
age2	-.0000713	.0000412	-1.73	0.083	-.0001519	9.37e-06
genderage	.0004164	.0020471	0.20	0.839	-.0035958	.0044287
totproc	.1239339	.0074784	16.57	0.000	.1092765	.1385913
totdiag	-.0236603	.0114984	-2.06	0.040	-.0461968	-.0011238
mrate	-2.37909	.2148597	-11.07	0.000	-2.800207	-1.957973
epe	-.3236541	.0534836	-6.05	0.000	-.42848	-.2188281
hcenter	.1552636	.0427239	3.63	0.000	.0715263	.2390009
contract	-.0056704	.0803079	-0.07	0.944	-.163071	.1517301

totinterns	.0039986	.0009142	4.37	0.000	.0022067	.0057904
distrital	.2132774	.0707307	3.02	0.003	.0746478	.351907
nivel1	-.5395074	.1808889	-2.98	0.003	-.8940432	-.1849716
ensino	.1193926	.0616155	1.94	0.053	-.0013716	.2401568
income	-.0017532	.0014855	-1.18	0.238	-.0046647	.0011583
elderly	.0065305	.0236955	0.28	0.783	-.0399117	.0529728
physicians	-.0522536	.0112311	-4.65	0.000	-.0742662	-.0302411
hschool	.0155169	.0208624	0.74	0.457	-.0253726	.0564065
college	.0415467	.0407309	1.02	0.308	-.0382843	.1213777
pop	.0628397	.0620604	1.01	0.311	-.0587963	.1844758
pop2	-.0018915	.0015688	-1.21	0.228	-.0049662	.0011832
dpop	.4640011	.7789127	0.60	0.551	-1.06264	1.990642
dpop2	-.0004786	.000454	-1.05	0.292	-.0013685	.0004112
season2006~1	.3538071	.2046302	1.73	0.084	-.0472607	.7548748
feb2006	.2298708	.2090678	1.10	0.272	-.1798946	.6396362
mar2006	.0666006	.2059169	0.32	0.746	-.336989	.4701902
apr2006	-.0044863	.2062319	-0.02	0.983	-.4086934	.3997208
may2006	.002135	.2139495	0.01	0.992	-.4171982	.4214682
jun2006	-.1346501	.2021135	-0.67	0.505	-.5307853	.2614852
jul2006	-.0491998	.2078375	-0.24	0.813	-.4565537	.3581542
aug2006	-.1329764	.2029328	-0.66	0.512	-.5307174	.2647645
sep2006	-.2139836	.2031058	-1.05	0.292	-.6120638	.1840965
oct2006	(omitted)					
nov2006	.0081469	.2031066	0.04	0.968	-.3899348	.4062285
dec2006	.3921191	.2194102	1.79	0.074	-.037917	.8221552
jan2007	-.2847403	.201872	-1.41	0.158	-.6804021	.1109216
feb2007	-.0657351	.215766	-0.30	0.761	-.4886287	.3571585
mar2007	-.0406299	.2057735	-0.20	0.843	-.4439385	.3626786
apr2007	.1936262	.2059356	0.94	0.347	-.2100002	.5972527
may2007	.0366904	.2015159	0.18	0.856	-.3582734	.4316543
jun2007	.146983	.2111891	0.70	0.486	-.26694	.5609061
jul2007	-.1105976	.2192423	-0.50	0.614	-.5403047	.3191095
aug2007	.4052585	.2083854	1.94	0.052	-.0031694	.8136864
sep2007	.3321921	.2025062	1.64	0.101	-.0647127	.7290969
oct2007	.0140876	.2056062	0.07	0.945	-.3888931	.4170684
nov2007	.2310941	.2042564	1.13	0.258	-.1692412	.6314293
dec2007	.0771072	.2092305	0.37	0.712	-.3329771	.4871915
jan2008	.2268234	.1975475	1.15	0.251	-.1603627	.6140095
feb2008	.312325	.206288	1.51	0.130	-.0919921	.7166421
mar2008	.0800913	.2063514	0.39	0.698	-.3243501	.4845327
apr2008	.1437	.1974334	0.73	0.467	-.2432624	.5306623
may2008	-.0295615	.1997851	-0.15	0.882	-.4211331	.3620102
jun2008	-.1174598	.2075221	-0.57	0.571	-.5241957	.289276
jul2008	.1899211	.2037505	0.93	0.351	-.2094226	.5892647
aug2008	-.0781457	.210107	-0.37	0.710	-.4899478	.3336564
sep2008	-.02467	.2027569	-0.12	0.903	-.4220662	.3727262
oct2008	.3131794	.2060796	1.52	0.129	-.0907292	.717088
nov2008	.1322268	.2067753	0.64	0.523	-.2730454	.537499
dec2008	-.1672278	.2347792	-0.71	0.476	-.6273865	.2929309
jan2009	.0559166	.2029649	0.28	0.783	-.3418872	.4537204
feb2009	.1040702	.2037217	0.51	0.609	-.295217	.5033574
mar2009	-.2841341	.2116062	-1.34	0.179	-.6988746	.1306064
apr2009	-.045141	.2101581	-0.21	0.830	-.4570433	.3667612
may2009	.1368101	.2240311	0.61	0.541	-.3022829	.575903
jun2009	.4363508	.2058923	2.12	0.034	.0328092	.8398923
jul2009	.2367303	.2046625	1.16	0.247	-.1644009	.6378615
aug2009	.2939158	.2200034	1.34	0.182	-.1372829	.7251146
sep2009	.3573957	.2192963	1.63	0.103	-.0724173	.7872086
oct2009	.2503002	.2078556	1.20	0.229	-.1570893	.6576897
nov2009	.3552012	.1984544	1.79	0.073	-.0337622	.7441646
dec2009	.0715123	.2052598	0.35	0.728	-.3307895	.4738142
jan2010	-.2291061	.2238192	-1.02	0.306	-.6677836	.2095714
feb2010	.1511973	.2259156	0.67	0.503	-.2915891	.5939837
mar2010	.0619478	.2116945	0.29	0.770	-.3529658	.4768614
apr2010	-.1553477	.2272167	-0.68	0.494	-.6006842	.2899888
may2010	.3601132	.2100283	1.71	0.086	-.0515347	.7717612
jun2010	.3442503	.2053142	1.68	0.094	-.058158	.7466587
jul2010	.3644954	.205531	1.77	0.076	-.0383379	.7673286

```
     aug2010 |   .4800737   .2107553     2.28   0.023      .067001    .8931465
     sep2010 |   .2969054    .220725     1.35   0.179    -.1357076    .7295184
     oct2010 |   .3340616   .2362286     1.41   0.157    -.1289379    .7970611
     nov2010 |   .2688103   .2225933     1.21   0.227    -.1674644    .7050851
     dec2010 |   .1576978   .2383061     0.66   0.508    -.3093736    .6247691
       _cons |  -.8005415   .7285539    -1.10   0.272    -2.228481    .6273979
```

k) For DRG2:

```
Probit regression                                 Number of obs   =       9985
                                                  LR chi2(81)     =    1851.93
                                                  Prob > chi2     =     0.0000
Log likelihood = -4239.0258                       Pseudo R2       =     0.1793

------------------------------------------------------------------------------
         mri |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      gender |  -.1285009   .1160712    -1.11   0.268    -.3559963    .0989945
         age |   .0559476   .0060041     9.32   0.000     .0441798    .0677153
        age2 |  -.0005688   .0000513   -11.09   0.000    -.0006693   -.0004682
   genderage |  -.0005004   .0019114    -0.26   0.793    -.0042467    .0032459
     totproc |   .1403908   .0051174    27.43   0.000     .1303608    .1504208
     totdiag |   .0093382   .0086759     1.08   0.282    -.0076663    .0263426
       mrate |   -2.91992   .8506075    -3.43   0.001     -4.58708   -1.25276
         epe |  -.3463269   .0542996    -6.38   0.000     -.452752   -.2399017
     hcenter |  -.3273506   .0677824    -4.83   0.000    -.4602016   -.1944996
    contract |  -.1828422   .0712781    -2.57   0.010    -.3225447   -.0431398
  totinterns |   .0105655    .000844    12.52   0.000     .0089112    .0122198
   distrital |   .7050474   .1109827     6.35   0.000     .4875254    .9225694
      nivel1 |  (omitted)
      ensino |  -.0259811   .0668529    -0.39   0.698    -.1570103     .105048
      income |  -.0021664   .0016757    -1.29   0.196    -.0054506    .0011179
     elderly |   .3417156   .0604929     5.65   0.000     .2231516    .4602795
  physicians |  -.1142985   .0223721    -5.11   0.000    -.1581471     -.07045
     hschool |  -.0572373   .0408347    -1.40   0.161    -.1372717    .0227972
     college |  -.0583266   .0628594    -0.93   0.353    -.1815287    .0648755
         pop |    .037408   .2037911     0.18   0.854    -.3620152    .4368312
        pop2 |   .0012337   .0048389     0.25   0.799    -.0082503    .0107177
        dpop |   11.84508   2.058979     5.75   0.000      7.80956    15.88061
       dpop2 |  -.0066239   .0011358    -5.83   0.000      -.00885   -.0043978
     feb2006 |   -.052354   .1625601    -0.32   0.747    -.3709659     .266258
     mar2006 |   .2500024   .1544925     1.62   0.106    -.0527973    .5528021
     apr2006 |    .041329   .1703806     0.24   0.808    -.2926108    .3752689
     may2006 |   .0138409   .1596946     0.09   0.931    -.2991547    .3268366
     jun2006 |   .0665311   .1584447     0.42   0.675    -.2440148    .3770769
     jul2006 |   .1447718   .1558893     0.93   0.353    -.1607656    .4503093
     aug2006 |    .387597   .1653652     2.34   0.019     .0634871    .7117069
     sep2006 |  -.0466777   .1675802    -0.28   0.781    -.3751288    .2817735
     oct2006 |  -.0279815    .154037    -0.18   0.856    -.3298885    .2739255
     nov2006 |   -.126586   .1696292    -0.75   0.456    -.4590531    .2058812
     dec2006 |   .1632155   .1731478     0.94   0.346     -.176148     .502579
     jan2007 |   .1222562   .1804999     0.68   0.498    -.2315171    .4760296
     feb2007 |   .1659569    .192267     0.86   0.388    -.2108795    .5427932
     mar2007 |   .0593356   .1871387     0.32   0.751    -.3074495    .4261207
     apr2007 |  -.0770649     .18305    -0.42   0.674    -.4358363    .2817064
     may2007 |   .0113425   .1661807     0.07   0.946    -.3143657    .3370507
     jun2007 |  -.0038473   .1791733    -0.02   0.983    -.3550205     .347326
     jul2007 |   .1346179   .1639737     0.82   0.412    -.1867647    .4560005
     aug2007 |   .4981595   .1658812     3.00   0.003     .1730383    .8232807
     sep2007 |   .1059082   .1703285     0.62   0.534    -.2279295    .4397459
     oct2007 |  -.0106087   .1613289    -0.07   0.948    -.3268076    .3055902
     nov2007 |   .0581293   .1635615     0.36   0.722    -.2624454     .378704
     dec2007 |  -.2131185   .1799519    -1.18   0.236    -.5658177    .1395806
     jan2008 |  -.0179188   .1653325    -0.11   0.914    -.3419645     .306127
     feb2008 |  -.0306346    .166188    -0.18   0.854    -.3563572    .2950879
     mar2008 |  -.0546251   .1722866    -0.32   0.751    -.3923005    .2830503
     apr2008 |   .0392088   .1645321     0.24   0.812    -.2832681    .3616858
     may2008 |  -.1387176   .1756405    -0.79   0.430    -.4829667    .2055315
     jun2008 |    .008708   .1703077     0.05   0.959     -.325089     .342505
```

```
    jul2008 |  -.1843151    .166895    -1.10   0.269    -.5114232    .1427931
    aug2008 |  -.1077746   .1801399    -0.60   0.550    -.4608423     .245293
    sep2008 |   .0439415   .1683332     0.26   0.794    -.2859856    .3738685
    oct2008 |  -.1012515   .1660067    -0.61   0.542    -.4266187    .2241157
    nov2008 |  -.1246736   .1668219    -0.75   0.455    -.4516384    .2022913
    dec2008 |  -.1157722   .1793274    -0.65   0.519    -.4672475    .2357031
    jan2009 |  -.1837589   .1777063    -1.03   0.301    -.5320567     .164539
    feb2009 |  -.2171163   .1783091    -1.22   0.223    -.5665957    .1323631
    mar2009 |   .0043462   .1752745     0.02   0.980    -.3391855    .3478779
    apr2009 |  -.0690548   .1809845    -0.38   0.703    -.4237778    .2856682
    may2009 |  -.2442574   .1848602    -1.32   0.186    -.6065768     .118062
    jun2009 |  -.0343894   .1864377    -0.18   0.854    -.3998007    .3310218
    jul2009 |  -.0208533   .1696384    -0.12   0.902    -.3533384    .3116318
    aug2009 |  -.0975957   .1777006    -0.55   0.583    -.4458823     .250691
    sep2009 |  -.2035361   .1795487    -1.13   0.257    -.5554451     .148373
    oct2009 |  -.2040075   .1790732    -1.14   0.255    -.5549845    .1469694
    nov2009 |      .0135    .172613     0.08   0.938    -.3248152    .3518152
    dec2009 |   .2201661   .1808578     1.22   0.223    -.1343087     .574641
    jan2010 |   .2196814   .1943676     1.13   0.258    -.1612722    .6006349
    feb2010 |   .3328024    .195355     1.70   0.088    -.0500863    .7156912
    mar2010 |   .1685019    .194579     0.87   0.387     -.212866    .5498698
    apr2010 |  -.1287632   .2042649    -0.63   0.528     -.529115    .2715886
    may2010 |   .0756538   .1985585     0.38   0.703    -.3135137    .4648213
    jun2010 |   .1709619   .2046853     0.84   0.404     -.230214    .5721377
    jul2010 |   .0571808   .1982122     0.29   0.773    -.3313079    .4456695
    aug2010 |   .0510688   .2035396     0.25   0.802    -.3478615    .4499992
    sep2010 |   .0294493   .1966113     0.15   0.881    -.3559017    .4148002
    oct2010 |   .1580807    .196191     0.81   0.420    -.2264467    .5426081
    nov2010 |   .0049018   .2033513     0.02   0.981    -.3936595     .403463
    dec2010 |  -.2815989    .242977    -1.16   0.246    -.7578252    .1946273
      _cons |  -6.881909    1.11287    -6.18   0.000    -9.063094   -4.700724
```

5. Does MRI help patients' survival?

The tables referring to the regressions mentioned in section 8 of the main document are presented below.

a) For DRGs 14, 533 and 810:

```
Probit regression                                 Number of obs   =     114524
                                                  LR chi2(16)     =    4584.41
                                                  Prob > chi2     =     0.0000
Log likelihood = -31801.575                       Pseudo R2       =     0.0672

------------------------------------------------------------------------------
        died |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         mri |  -.7927725   .0580261   -13.66   0.000    -.9065015   -.6790434
         age |  -.0270229   .0020094   -13.45   0.000    -.0309612   -.0230846
        age2 |   .0002682   .0000144    18.63   0.000       .00024    .0002964
      gender |   .0201973   .0628457     0.32   0.748     -.102978    .1433725
   genderage |   .0010169   .0008063     1.26   0.207    -.0005634    .0025972
       mrate |  (omitted)
     totdiag |  -.0030214   .0019383    -1.56   0.119    -.0068205    .0007777
     totproc |    .078177   .0017783    43.96   0.000     .0746916    .0816624
  totdiagmri |   .0270087   .0064542     4.18   0.000     .0143588    .0396587
  totprocmri |   -.001987   .0064665    -0.31   0.759    -.0146611    .0106872
         epe |  -.0424265   .0134889    -3.15   0.002    -.0688642   -.0159888
    contract |  -.0136787   .0217824    -0.63   0.530    -.0563715    .0290141
     hcenter |  -.1082073   .0117288    -9.23   0.000    -.1311954   -.0852192
   distrital |  -.0687282   .0146566    -4.69   0.000    -.0974547   -.0400017
      nivel1 |  -.1214706    .027914    -4.35   0.000    -.1761811   -.0667601
      ensino |  -.1928111   .0186082   -10.36   0.000    -.2292826   -.1563397
  totinterns |   .0022001   .0002933     7.50   0.000     .0016252     .002775
       _cons |  -1.362519   .0810212   -16.82   0.000    -1.521318    -1.20372
```

b) For DRG 14:

```
Probit regression                                 Number of obs   =      72293
                                                  LR chi2(16)     =     275.21
                                                  Prob > chi2     =     0.0000
Log likelihood = -2261.9374                       Pseudo R2       =     0.0573

------------------------------------------------------------------------------
        died |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         mri |   -.786987   .3604192    -2.18   0.029    -1.493396   -.0805784
         age |   .0108748   .0182942     0.59   0.552    -.0249812    .0467307
        age2 |   .0000217   .0001168     0.19   0.852    -.0002072    .0002507
      gender |   .1182593   .3149835     0.38   0.707    -.4990971    .7356156
   genderage |  -.0024084   .0039589    -0.61   0.543    -.0101677    .0053509
       mrate |  (omitted)
     totdiag |  -.0330853   .0085979    -3.85   0.000    -.0499368   -.0162338
     totproc |    .026813   .0069942     3.83   0.000     .0131045    .0405214
  totdiagmri |   .0925713   .0378027     2.45   0.014     .0184794    .1666633
  totprocmri |  -.0314622    .045947    -0.68   0.494    -.1215166    .0585922
         epe |    .065243    .044664     1.46   0.144    -.0222968    .1527829
    contract |  -.2543676   .0631668    -4.03   0.000    -.3781723   -.1305629
     hcenter |  -.1530306   .0381988    -4.01   0.000    -.2278989   -.0781623
   distrital |   .0431638   .0533218     0.81   0.418     -.061345    .1476726
      nivel1 |  -.0096666   .0842646    -0.11   0.909    -.1748221     .155489
      ensino |   .2566091   .0636297     4.03   0.000     .1318972    .3813211
  totinterns |  -.0088893   .0014231    -6.25   0.000    -.0116785      -.0061
       _cons |  -3.027616   .7281119    -4.16   0.000     -4.45469   -1.600543
```

c) For DRG 533:

```
Probit regression                                 Number of obs   =      27995
                                                  LR chi2(16)     =    1509.60
                                                  Prob > chi2     =     0.0000
Log likelihood = -17130.441                       Pseudo R2       =     0.0422

------------------------------------------------------------------------------
        died |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         mri |  -1.013013   .0785745   -12.89   0.000    -1.167016   -.8590095
         age |   .0179643   .0024182     7.43   0.000     .0132247    .0227039
        age2 |  -.0000635    .000018    -3.53   0.000    -.0000989   -.0000282
      gender |  -.0216942   .0795719    -0.27   0.785    -.1776523     .134264
   genderage |   .0011169    .001023     1.09   0.275    -.0008881     .003122
       mrate |  (omitted)
     totdiag |  -.0510722   .0026131   -19.54   0.000    -.0561939   -.0459505
     totproc |   .0266908   .0022848    11.68   0.000     .0222126    .0311689
  totdiagmri |   .0379082   .0080345     4.72   0.000     .0221609    .0536555
  totprocmri |   .0097836   .0075277     1.30   0.194    -.0049705    .0245377
         epe |    -.04532   .0195171    -2.32   0.020    -.0835728   -.0070673
    contract |  -.0340688   .0325623    -1.05   0.295    -.0978898    .0297521
     hcenter |  -.0970627   .0169675    -5.72   0.000    -.1303183    -.063807
   distrital |  -.0268619   .0213056    -1.26   0.207    -.0686202    .0148963
      nivel1 |   .0233016   .0433854     0.54   0.591    -.0617323    .1083354
      ensino |  -.2008732   .0254887    -7.88   0.000    -.2508301   -.1509163
  totinterns |   .0031641   .0003984     7.94   0.000     .0023832     .003945
       _cons |  -1.202747   .0974452   -12.34   0.000    -1.393736   -1.011758
```

d) For DRG 810:

```
Probit regression                                 Number of obs   =      14236
                                                  LR chi2(16)     =     222.67
                                                  Prob > chi2     =     0.0000
Log likelihood = -1171.0483                       Pseudo R2       =     0.0868

------------------------------------------------------------------------------
        died |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         mri |  -1.450829   .6468301    -2.24   0.025    -2.718592   -.1830649
```

age	-.0054481	.012968	-0.42	0.674	-.0308649	.0199687
age2	.0000763	.0000941	0.81	0.417	-.000108	.0002607
gender	-.110118	.2914059	-0.38	0.706	-.681263	.461027
genderage	.0009485	.0039052	0.24	0.808	-.0067055	.0086025
mrate	(omitted)					
totdiag	-.1011017	.0146782	-6.89	0.000	-.1298704	-.072333
totproc	.0400395	.010277	3.90	0.000	.019897	.0601821
totdiagmri	.0214564	.1128557	0.19	0.849	-.1997367	.2426494
totprocmri	.0474633	.0807191	0.59	0.557	-.1107431	.2056698
epe	.1069758	.063229	1.69	0.091	-.0169507	.2309022
contract	-.155541	.0930533	-1.67	0.095	-.337922	.02684
hcenter	-.2212954	.0572103	-3.87	0.000	-.3334256	-.1091653
distrital	-.2684686	.0737714	-3.64	0.000	-.4130578	-.1238794
nivel1	-.4756076	.1420236	-3.35	0.001	-.7539688	-.1972464
ensino	.2143132	.0875683	2.45	0.014	.0426826	.3859439
totinterns	-.0144035	.0021901	-6.58	0.000	-.018696	-.0101111
_cons	-1.132793	.4677317	-2.42	0.015	-2.04953	-.2160556