Nova School of Business and Economics

The Use of Technology in Portuguese Hospitals – The Case of MRI

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Motivation

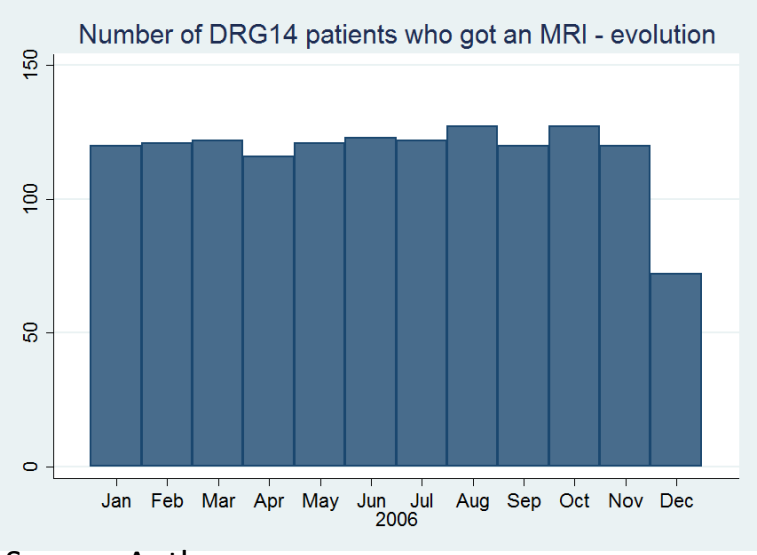
- Technological progress is believed to be the main driver of health spending growth;
- Several authors point that it is not technology *per se* that is driving up expenditure, but the way it is inefficiently adopted and used;
- A better understanding of these dynamics could help containing health expenditure.

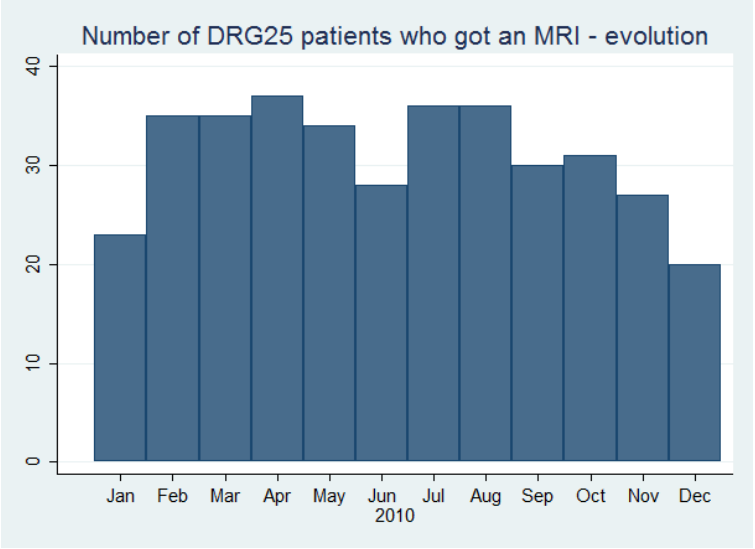
Research Question

- Do funding constraints restrain MRI use in Portuguese NHS hospitals?
  - Focus on patients suffering from specific medical conditions (10 DRGs).
  - Period between 2006 and 2010.

Descriptive Statistics

- How does the number of patients sent for MRI evolve over the year?





Source: Author.

The systematic decline in the figure for December may be reflecting a thightening effect on the hospital's budget constraint

Methodology – Econometric Model

- Dependent variable: binary variable taking value 1 in case the patient was sent for MRI and value 0 otherwise.
  - Probit model
- Regressors: vectors containing individual-, time-, hospital- and region-specific variables.

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

Data

a) ACSS: data on individual NHS hospital admissions from 2006 to 2010.
   - Individual: age, gender, total number of diagnosis and procedures, mortality rate.
   - Hospital: patients admitted over the year, district and level1 hospitals, teaching, EPE, hospital center, contract with Ministry of Health.
   - Time: admission year, eleven binary variables to account for the admission month.

Data

b) INE: regional data on socio-economic characteristics of the population

- Income, education, number of physicians, % of elderly population, population, population density.

Results – Determinants of MRI use

Individual variables

Pr[Mri]	Coefficient
Gender	-0.416***
Age	0.034***
Age squared	-0.001***
Gender * age	0.006***
Total number of procedures	0.104**
Total number of diagnoses	-0.050***
Mortality rate	-3.061***

Source: Author.

- Age exerts a positive impact for patients up to 33yrs old and a negative one from that point on.
- Impact of age varies with gender: if age >33, then its magnitude is lower for women than for men.
- Impact of illness severity is ambiguous.

Results – Determinants of MRI use

Hospital variables

Pr[Mri]	Coefficient
Epe hospital	-0.122***
Hospital center	-0.041**
Contract with Min. of Health	-0.017
Total patients admitted / 1000	0.001**
District hospital	-3.223***
Level1 hospital	-2.683
Teaching hospital	-3.278
Hospital fixed-effects	Yes

Source: Author.

- Hospital fixed-effects are accounted for in the model.
- Hospital size contributes positively to MRI use.
  - Total patients admitted
  - Central hospitals vs. District and Level 1 ones.

Results – Determinants of MRI use

Time variables

Pr[Mri]	Coefficient
Admission year	0.130***
Admitted in January	0.031*
Admitted in February	0.042**
Admitted in March	0.068***
Admitted in April	0.062***
Admitted in May	0.066***
Admitted in June	0.042**
Admitted in July	0.076***
Admitted in August	0.093***
Admitted in September	0.085***
Admitted in October	0.088***
Admitted in November	0.076***

Source: Author.

- Evidence of a possible **tightening effect on the hospitals' budget constraint**: patients admitted in any month from January to November have a higher probability of being sent for MRI than those admitted in December.

Results – Determinants of MRI use

Regional variables

Pr[Mri]	Coefficient
Average Regional income	-0.000
Region population > 65 (%)	-0.021
# physicians per 1000 inhabitants	-0.339***
High school graduates (%)	-0.023***
College graduates (%)	-0.011
Region pop / 100000	-1.259***
Region pop / 100000 squared	0.057***
Population density / 1000	15.798***
Pop density / 1000 squared	-0.010***

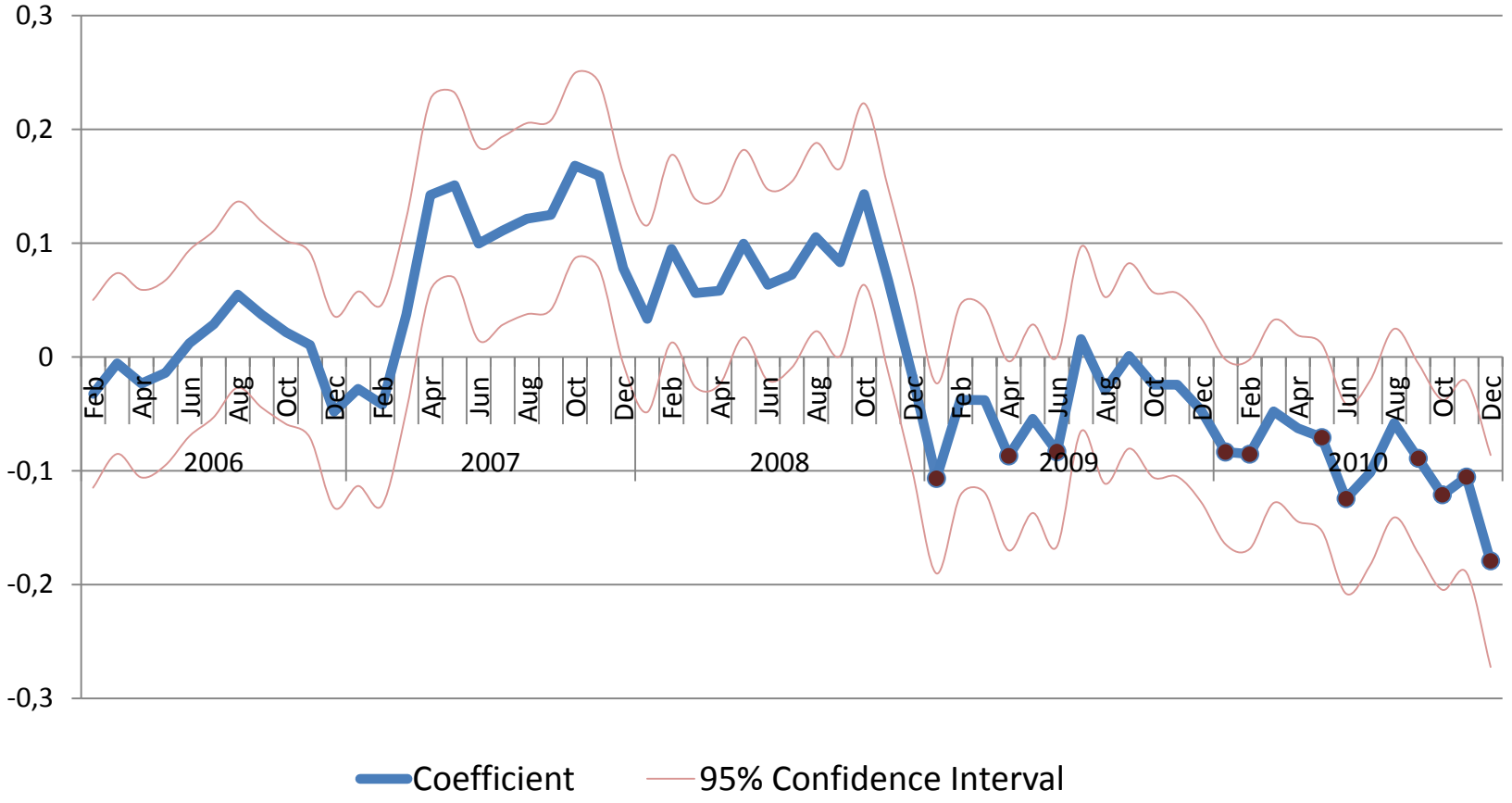
Source: Author.

- Both the number of physicians in the region and the % of high school graduates bear a negative coefficient.
- Urbanization variables exert a negative impact on Pr[MRI] when evaluated at the mean.

Results – Determinants of MRI use

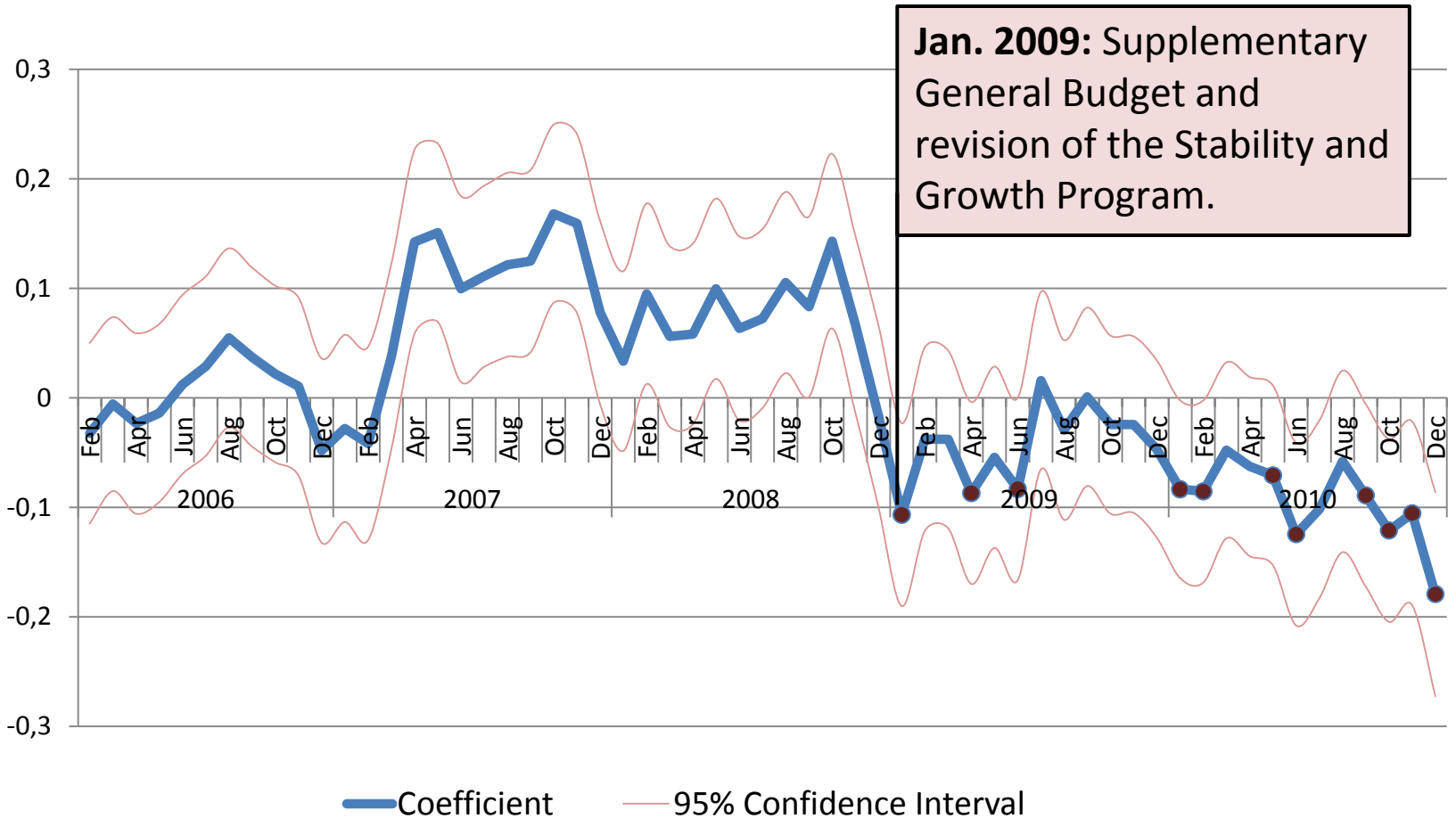
- Replacing the previous time variables by interactions between the admission year and the admission month allows each month to have a different impact on Pr[MRI].
- The negative coefficients can be linked with specific events occurring at the time
  - Hospital fixed effects are disregarded from now on.

Results – Determinants of MRI use



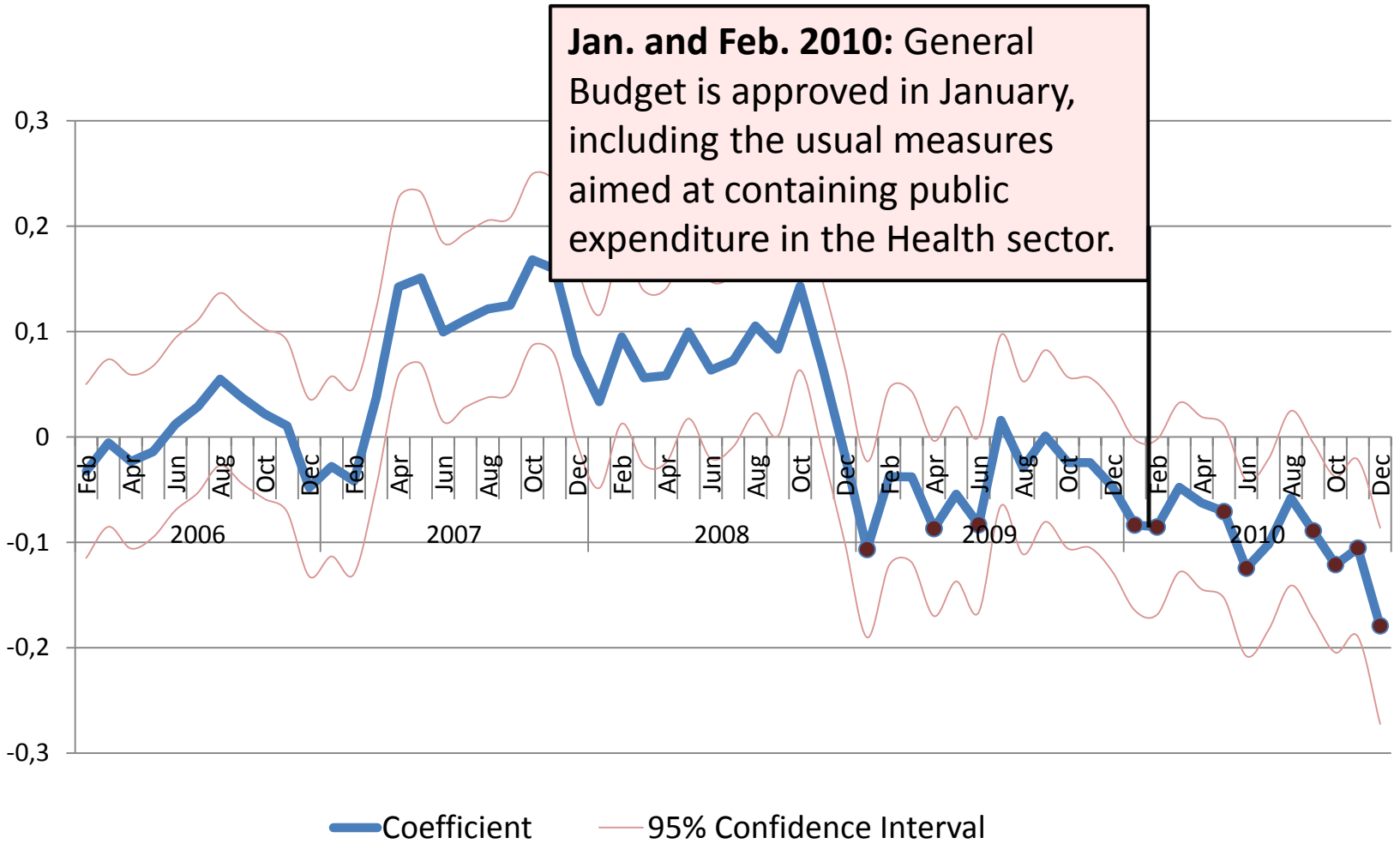
Source: Author.

Results – Determinants of MRI use



Source: Author.

Results – Determinants of MRI use



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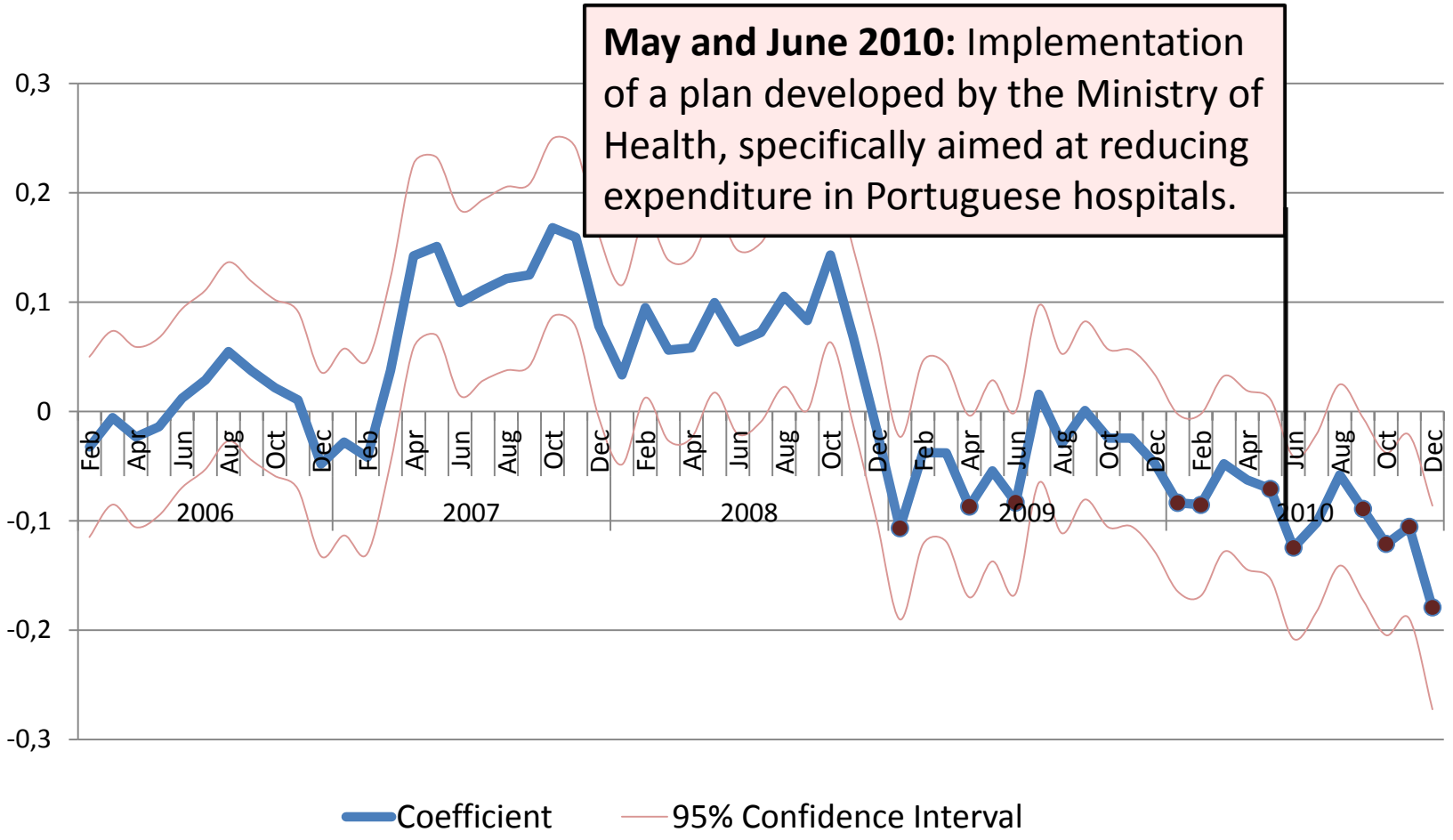
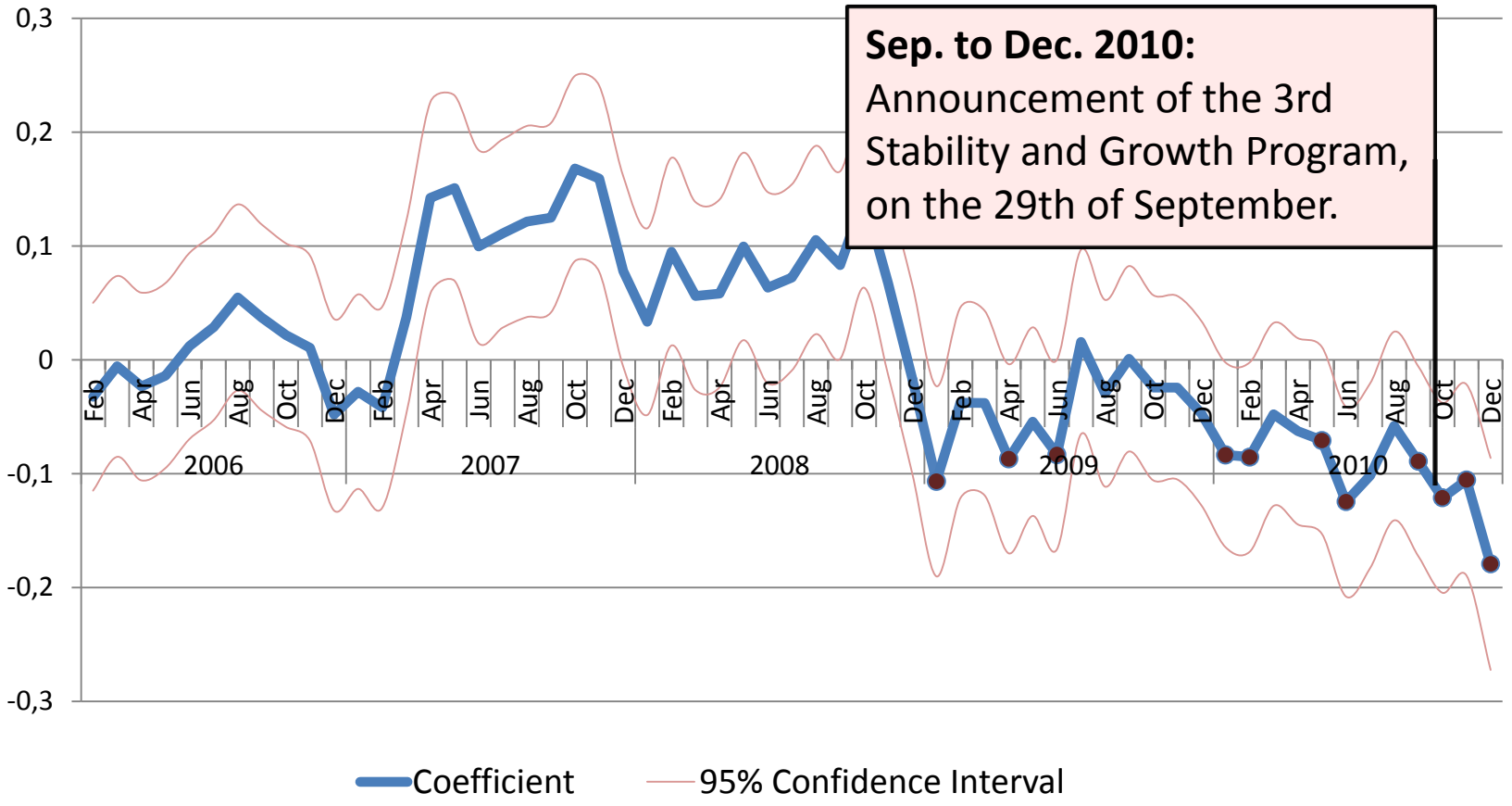
Results – Determinants of MRI use



Source: Author.

Results – Determinants of MRI use



Source: Author.

Conclusions

- Do funding constraints restrain MRI use in Portuguese NHS hospitals?
- Yes, that seems to be the case.
  - Possible tightening effect on the hospitals' budget constraint.
  - Political pressure to reduce expenditure in the last months seems to be producing effects – though they do not last for long.

Thank you.

Extra Slides

Does MRI help patients' survival?

- Dependent variable: dummy taking value 1 if the patient died during his stay at the hospital and 0 otherwise.
- Regressors: vectors containing individual and hospital variables + MRI dummy + interactions between both measures of illness severity and MRI dummy

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

Does MRI help patients' survival?

MRI-related variables

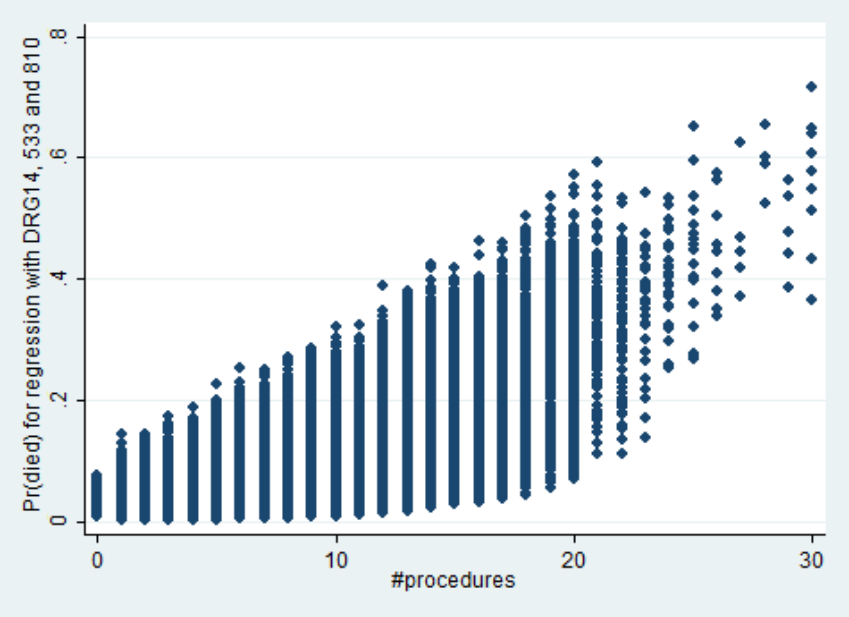
Pr[Death]	Coefficient
MRI	-0.793***
MRI * total number of procedures	-0.002***
MRI * total number of diagnoses	0.027

Source: Author.

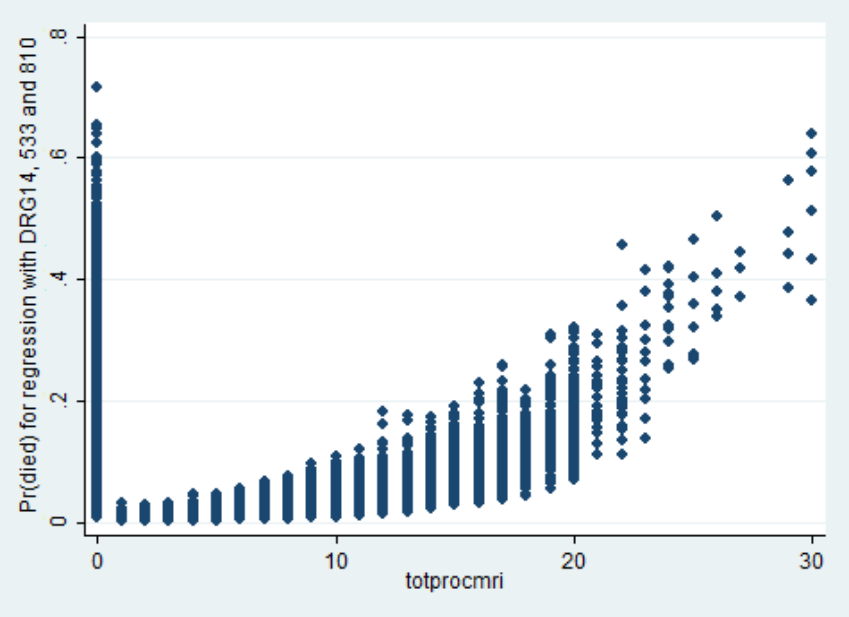
- The effect of an MRI on the probability of death is negative at the mean of both measures of severity.
- MRIs do improve patients' likelihood of survival.

Results – Does MRI help survival?

All patients



Patients who were sent for MRI



Source: Author.

As far as the probability of death is concerned, the gains from an MRI occur mainly for less severe patients.

Results – Does MRI help survival?

- Analytically, the total marginal effect of a change in MRI from 0 to 1 on the probability that the patient dies is:

$$\begin{aligned}\Delta\Pr[\text{death}] &= \beta_1 * MRI + \beta_2 * MRI * TOTPROC + \beta_2 * MRI * TOTDIAG \\ &= \beta_1 + \beta_2 * TOTPROC + \beta_3 * TOTDIAG \\ &= -0{,}0720 - 0{,}0003 * TOTPROC + 0{,}0038 * TOTDIAG\end{aligned}$$

Evaluated at the mean of both measures of severity yields:

$$\begin{aligned}&-0{,}0720 - 0{,}0003 * TOTPROC + 0{,}0038 * TOTDIAG \\ &= -0{,}0720 - 0{,}0003 * 6{,}8977 + 0{,}0038 * 5{,}5432 \\ &= -0{,}0530\end{aligned}$$