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The Effect of Inpatient User Charges on Inpatient Care

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Abstract:
The essay assesses the infuence of inpatient user charges in the Czech Republic on the amount of inpatient hospital care provided, namely the number of patient days. We apply the difference-indifferences approach on a panel of 76 general hospitals in 2008-2009. The introduction and subsequent partial reimbursement of user fees charged on an inpatient day in the Czech Republic satisfies the criteria of a natural experiment - the decision to reimburse patients for user charges applied to hospitals under the control of the Social Democratic (ČSSD) regional governments in the year 2009, and was unrelated to other hospital characteristic. Our treatment group comprises hospitals where patients could ask for reimbursement, i.e. user charges were effectively abolished. The control group covers hospitals where it was not possible to get reimbursement. The base year is 2008 when user charges were introduced. The observed effect of user-charge abolition was small and marginally significant (between 2.7 % and 4.1 %) having controlled for exogenous hospital and regional characteristics.

JEL: I12, I18
Keywords: Cost-sharing, inpatient care, difference-in-difference, Czech Republic

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1 Introduction

Cost–sharing of any form in health care has been a controversial and vivid issue in all developed countries over the last two decades. Within the last 20 years cost-sharing arrangements have been changing rapidly. The definition of user charges differs across countries.[1] Within the EU, the reliance on patient cost-sharing has been increasing both in terms of scope and amount (Tambor *et al.*, 2010). A strong justification for user charges comes from fiscal pressures. Given aging population which results in increasing demand for healthcare services and escalating costs, co-payments should bring additional revenues to the system and curb the avoidable demand for healthcare services at the macroeconomic level.

However, at microeconomic level, there is a tradeoff of cost-sharing. On one hand, cost-sharing motivates the individuals to consume care efficiently. The patients forgo unnecessary care that would be consumed if they did not bear some portion of medical costs. On the other hand, some individuals - particularly the old, seriously ill and the poor - may avoid medical care that is necessary too. To avoid adverse effect on these most vulnerable groups, there is a broad equity protection in place, including ceilings or exemptions.

We may observe a correlation between patient cost–sharing arrangements and specific characteristics of the health–care and political systems (Tambor *et al.*, 2010). These include cultural values deeply rooted in the societies which cause some nations to view free healthcare as their utmost right which results in the lack of public acceptance of user charges which either restrains policy-makers from introducing user charges or results in their abolition. In countries with strong public opposition to user charges in healthcare, the attempts to introduce them depends on political representation. Their introduction is often temporary and serves the purposes of a political cycle.

Being a matter of a controversial political debate, co-payments in the Czech Republic were introduced in January 2008. Co-payments were charged for an outpatient visit during which a clinical examination was carried out (CZK 30/1.2 EUR), for a drug on a prescription (CZK 30/1.2 EUR)[2], for an inpatient day (CZK 60/2.4 EUR)[3] and for an emergency visit (CZK 90/3.6 EUR). Despite the low level of co-payments which was comparable to the price of a pack of cigarettes at the time, in February 2009, regions under the control of the Social Democratic Party (CSSD) started to reimburse patients for co-payments for care in hospitals owned by the region. It was a political decision unrelated to hospital characteristics. These benefits ceased in the middle of 2010, the exact date of cessation differed by regions.

The effect of varying levels of cost-sharing was first tested in the U.S.A. in the 1970s in the RAND Health Insurance Experiment (RAND HIE). Thousands of families were randomly assigned varying levels of cost-sharing. The resulting rich dataset has been employed for empirical analyses of cost-sharing over years (Manning, 1987; Newhouse & Group, 1993; Gruber & Kaiser, 2006) as well as for estimations of price elasticity for healthcare per se (see for example Keeler & Rolph (1988)). The RAND HIE gives even now relevant lessons for

[1] An overview of the latest developments and a cross-country comparison is available from the HSPM Network (https://www.hspm.org/mainpage.aspx).

[2] In January 2012, a single co-payment for a prescription regardless of the number of items was introduced.

[3] In December 2011, the fee increased to CZK 100/4 EUR.

policy discussions.

Results of the RAND HIE show that cost-sharing indeed curbs demand which is in line with its primary purpose. The results are constant across healthcare services (Manning, 1987; Newhouse & Group, 1993; Gruber & Kaiser, 2006). Other studies endorse this effect analyzing different datasets. In Germany, co–payments reduced the number of doctor visits by about 10% on average (Winkelmann, 2003). An experiment conducted in the U.S.A. by Cherkin *et al.* (1990) showed that co–payments of approximately 5 USD decrease physical examinations by 14 %. According to Scitovsky & McCall (1977) the introduction of a 25 % co-insurance provision lead to approximately 24 % fewer physician visits one year later.

For a person of average health and income, the RAND HIE shows that a reasonable level of cost-sharing does not exert a negative effect on health status. Due to income-related cost-sharing and copayment ceilings, the effect on the sick and the poor was only marginally different (Gruber & Kaiser, 2006). However, other studies suggest that cost-sharing does decrease demand for healthcare of the most vulnerable groups. When estimating the effect of increased cost-sharing for ambulatory care among the elderly enrolled in Medicare plans, Trivedi *et al.* (2010) found that people in low–income and low–educated areas forgone outpatient visits most. Beck & Horne (1980) point to a similar effect for the elderly and low–income individuals in Canada. In Sweden, Elofsson *et al.* (1998) indicate that costs appeared to be the main reason to forgo a doctor's visit for 22 % of the respondents in a random sample of 17–year–olds and older. The authors link this fact to their poor economic conditions since they found the probability of forgoing care to be 10 times higher among those who assessed their financial situation as poor than among those who considered it fairly good. It suggests that the demand for healthcare of these groups is very price–elastic. Zweifel & Manning (2000) explain that consumer incentives while seeking healthcare are different from a demand for consumer goods, thus the amount cost-sharing in healthcare and an appropriate exemption and ceiling plan is crucial not to worsen the health status of the most vulnerable groups.

Some studies found only a temporary effect of cost-sharing, which was sometimes offset by an increase in the level of other types of treatment, thus suggesting that there is some substitution effect at play. Roemer *et al.* (1975) showed that user charges of USD 1 for the first two doctor visits in the U.S.A. initially reduced demand for physician services, but then lead to more visits over the long–term, even more than in the control group, thus no savings resulted. Although Gruber & Kaiser (2006) found a stable effect of cost-sharing over short- and long-run in the RAND HIE, Manning (1987) showed on the RAND HIE data that a reduction in the physician services can be accompanied by increased treatment intensity in the form of longer and more expensive treatment episodes.

Saltman & Figueras (1997) and Tambor *et al.* (2010) argue that the effect of cost-sharing may depend on institutional setting and thus varies by country and the type of cost-sharing. A good example of the effect of user charges in one country is hardly replicable in another country. Some studies thus did not find any effect of cost-sharing at all, such as Schreyögg & Grabka (2008), Augurzky *et al.* (2006) or Votápková & Žílová (2016a), all of whom estimated the effect of co-payments for ambulatory services.

Most studies assess the effect of drug co-payments. A nice overview can be found in

Gemmill *et al.* (2008). The effect of user charges for outpatient care was estimated for example by Farbmacher (2009) and Schreyögg & Grabka (2008). Inpatient care was assessed, for instance, in Helms *et al.* (1978).

In order to assess the effect of the mechanism, many studies exploit the fact that there are usually some exceptions to cost-sharing. Early studies, such as O'Brien (1989), employed a system of equations, taking advantage of Seemingly Unrelated Regressions. One of his equations estimated chargeable prescriptions as the dependent variable; exempt prescriptions was the dependent variable in the second regression. Some of the later studies use the difference–in–differences methodology (DiD). Examples include Winkelmann (2003), or Schreyögg & Grabka (2008) for Germany, Helms *et al.* (1978) for the U.S.A. or Zhang (2007) in Hangzhou city, China.

Czech studies analyzing the effect of user charges include Zápal (2010), who estimated the effect of user charges on children's physician visits. Physician visits are proxied by the number of drug prescriptions under the assumption that there is a fixed probability of issuing a prescription during a visit. Zápal (2010) finds a desired effect of user charges only if a one-month-period prior to the abolition of user charges (reform) is used as a pre-reform period. The results suggest a timing effect, i.e. postponement of care for the period after the reform. Kalousová (2014) estimates the effect of user charges on health service consumption among the elderly taking advantage of the SHARE database. Kalousová (2014) discovered a significant decrease in the use of outpatient care but the effect on inpatient care was insignificant. Using EU-SILC survey data, Votápková & Žílová (2016a) estimated the effect of user charges on outpatient visits finding no significant effect. A natural experiment was used in which the abolition of user charges for children represented the reform. Finally, Hromádková (2016) dealt with the effect of co-payments on prescriptions. Hromádková (2016) finds that the number of prescriptions filled decreased by 29% with the introduction of user charges. However, the effect was only temporary. The total expenditure on prescription drugs dropped only in the first quarter of the post-introduction period and then returned to the same level. A significant role was played also by a subsequent reform which allowed more packages and a different composition of drugs to be filled out on a single prescription, i.e. for a single co-payment. Finally, Hromádková (2016) analyzed behavioral responses of individuals to the partial reversal of the co-payment policy, under which patients were offered reimbursement for co-payments for drug prescription but only in region-owned pharmacies. Hromádková (2016) finds a significant preference for reimbursing pharmacies identifying also the main drivers of the preference, which include monetary costs, type of physician and distance as a proxy for opportunity costs.

The essay contributes to this stream of research and will use the difference-in-differences approach (DiD) to assess the effect of co-payments charged for an inpatient day on the amount of hospital care provided, i.e. the number of inpatient days. The advantage of the DiD is that it removes biases that could result from either permanent differences between the treatment and control groups, or shared trends.

The essay exploits the fact that the decision to reimburse user charges in 2009 was purely political and unrelated to hospital characteristics. Besides, not all hospitals within the Czech

Republic are controlled by regional governments, therefore, user charge reimbursement did not apply to all hospitals within the region. There is no doubt that the patients were aware of the possibility to receive reimbursement for care in some hospitals since it was such a vivid political issue. Moreover, the hospitals were instructed to offer the possibility of reimbursement to the patients based on donation contracts or another form of agreement, thus the patients did not need to bring any money to the hospital at all, with a few exceptions in which user-charges were reimbursed with a two-months delay.

Given the socio-economic situation and political decisions at the time, we can assume that there was no confounding effect on the number of patient days other than the reform of user-charge reimbursement that would cause an expected gain bias in the DiD model for the hospitals in the treatment group (Ryan *et al.*, 2015). At the same time, the nature of the reform does not allow a "spill-over" effect from treatment to comparison group (Ryan *et al.*, 2015).

In the analysis, we are interested in the effect of user-charges on the total amount of inpatient care provided, as measured through inpatient days. Given the Czech institutional setting, Czech hospitals satisfy the demand from the community rather than they would themselves decide how much care they provide. As opposed to any other analysis of co-payments carried out in the Czech Republic which used patient-level data, a hospital will be the unit of observation in our analysis. The problem will thus be analyzed from the supply side perspective.

Similar to Hromádková (2016), the essay takes advantage of the partial reimbursement of co-payments. Regional hospitals where patients could be reimbursed for user charges in 2009 represent the treatment group, hospitals without the possibility of reimbursement constitute the control group. We control for other explanatory variables, which includes characteristics of the hospital, characteristics of the region where the hospital is situated, as well as a dummy variable acknowledging that the hospital is situated in a region where there is at least one hospital where patients could get reimbursement to account for a substitution effect.

We will answer the following questions:

1. Did the abolition of user charges for an inpatient day increase consumption of inpatient hospital care?

2. What other exogenous variables play a role in determining the number of patient days?

If the dependent variable, i.e. the number of patient days, increases after the reform which introduced user-charge reimbursement, we can conclude that the introduction of co-payments had the desired effect of reducing excess demand. Our results correspond with the mixed results of other studies carried out in the Czech Republic finding a small effect of cost-sharing. Specifically, after co-payments were reimbursed in regional hospitals, the number of inpatient days in these hospitals increased between 2.7 % and 4.1 % having controlled for exogenous hospital and regional characteristics.

The essay is organized as follows: Section 2 theoretically explains the methodology used, Section 3 introduces the dataset, Section 4 reports empirical results and Section 5 discusses the results and concludes the essay.

2 Methodology

We will estimate whether the reimbursement of co-payments charged on an inpatient day had an effect on the number of patient days hospitals report using a difference–in–differences (DiD) approach.

In economics, the difference–in–differences approach was fist applied in the 1980s. Ashenfelter & Card (1985) is considered a pioneering work. The simplest difference–in–differences setup is explained in Figure 1. The outcomes are observed for two groups of observations for two periods. One group (treatment group) is subject to the treatment in the second period, but not in the first one. The other group is not exposed to any treatment during any period. The average increase in y in the control group is then subtracted from the average increase in y in the treatment group. This reduces bias that would otherwise result from intrinsic differences if treatment and control groups were compared in the second period only, or that would result from common trends if outcomes of the treatment group were compared in isolation over time.

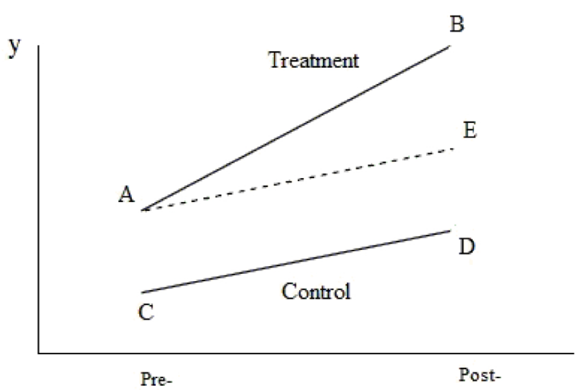


Figure 1. Difference–in–differences

The Difference–in–Difference model will take the following form (Blundell & Dias, 2008; Wooldridge, 2002):

$$y_{it} = \beta_0 + \beta_1 \mathbf{w}_i + \beta_2 \mathbf{z}_t + \beta_3 (\mathbf{w}_i \times \mathbf{z}_t) + \beta_4 \mathbf{X}_{it} + \epsilon_{it} \tag{1}$$

where y_{it} is the outcome variable, $\mathbf{w}_i$ is the treatment vector indicating whether patients of the hospital i may be reimbursed for co-payments in 2009, taking the value of 1 where reimbursement was possible; $\mathbf{z}_t$ is a vector denoting the co-payment period, thus it takes value of 1 for 2009. The interaction term $(\mathbf{w}_i \times \mathbf{z}_t)$ denotes utilization in hospitals in which patients could seek reimbursement in 2009. $\mathbf{X}_{it}$ represents a matrix of exogenous characteristics of the hospital and region that we control for.

That is, a vector of dummies, $\mathbf{w_i}$, captures the possible difference between the treatment and control groups before the possibility of reimbursement in regional hospitals. A vector of dummies $\mathbf{z}_t$ captures the aggregate factors that would cause changes in y even without a policy change. The coefficient of interest is β_3 which measures the multiplicative effect. If patients in a hospital could ask for reimbursement and the year of observation is 2009, then $(\mathbf{w}_i \times \mathbf{z}_t) = 1$.

The conditional difference–in-differences estimate, which will be obtained using OLS is then:

$$\hat{\beta}_3 = (\bar{y}_{T2} - \bar{y}_{T1}) - (\bar{y}_{C2} - \bar{y}_{C1}) \tag{2}$$

where C denotes control group, i.e. hospitals where patients had no choice but to pay the co-payments; and T denotes treatment group, i.e. regional hospitals where reimbursement was available.

If $\hat{\beta}_3$ is positive and significant, the reimbursement of user charges caused an increase of patient days in these hospitals. Put inversely, a positive coefficient suggests that an introduction of user charges decreases the number of inpatient days in hospitals, i.e. it reduces moral hazard and demand for inpatient hospital care. If insignificant, the introduction of user charges on inpatient day had a purely funding effect as found for example in Schreyögg & Grabka (2008) or Beck & Horne (1980).

In a significant $\hat{\beta}_3$, there may however be two effects at play. (1) user charges reduce the length of stay per patient and (2) user charges incentivize patients to move away from hospitals which effectively impose them to hospitals which reimburse user charges. That is, with a sufficiently high price elasticity, one will take advantage of care offered by regional hospitals where one receives reimbursement. In 2009, regional hospitals thus represented an outside option for patients who would otherwise consume care in hospitals that effectively imposed user charges.

However, we assume mechanism (2) to be nearly non-existent in the Czech Republic, given a low value of user charge which equals approximately the price of a lower-priced meal in a pub or a pack of cigarettes in 2009 (CZK 60). Mechanism (2) would have to be considered under a much larger user fee. Under the current set-up, the transaction costs (monetary and time) of traveling to a different hospital due to user-charge reimbursement overweight the benefits of the reimbursement itself. For instance, a train ticket from Ceske Budejovice to Plzen, which are 140 km apart, costs 140 CZK (EUR 5). The substitution effect is thus not expected to play a role given a user charge of CZK 60 (EUR 2.4), even for longer hospitalizations. In addition, when a hospitalization is longer, a patient appreciates visits and emotional support from family members whose travel costs are not imperceptible either. Travelling to a distant hospital is thus expected only for diversified treatment, which is however not a substitute to treatment in the nearest hospital.

Without the loss of generality, we assume that $\hat{\beta}_3$ estimates the national effect, user charges would have under a comprehensive reform.[4]

[4] Under the existence of mechanism (2) $\hat{\beta}_3$ would form the upper bound of the national effect.

3 Data

The essay analyzes a two year panel of 76 Czech general hospitals observed for the period 2008-2009.[5]

The data comes from the Institute of Health Information and Statistics of the Czech Republic,[6] Národní referenční centrum, thereafter NRC, Czech Statistical Office, thereafter CZSO, and the Registry of Companies in the Czech Republic Additional data is publicly available information of individual hospitals.

Since the Zlin region offered reimbursement for certain population groups (under 18 and above 70), and thus could not be used among the control group in the main analysis, we excluded these hospitals from the sample and used them for a robustness check only. In the robustness check of the results, we include 51 % of patient days of the Zlinsky region hospitals[7], i.e. the non-reimbursed share of patient days, as additional members of the control group. The share of 49 % of care which was potentially reimbursed was excluded fully from the analysis.

Total inpatient *days* constitute the dependent variable and are obtained by multiplying the number of patients by the average length of stay in the particular hospital.

In addition to the set of dummies introduced above to account for the treatment effect, a set of exogenous variables which are expected to affect the number of patient days of a hospital is employed. The *DRG* case–mix index accounts for the fact that people with more demanding diagnoses aim at centres which deal with more complicated cases even if outside their catchment area. The DRG case-mix index is expected to increase the number of patient days reported.

Teaching status is a dummy variable taking the value of 1 for a university hospital. University hospitals are very specific in nature. Besides treatment, their teaching and research mission is expected to increase the number of patient days they report.

Not_profit characterizes a hospital in terms of ownership status. During the process of corporatization which started in 2004, many Czech hospitals were transformed from nonprofit institutions into joint–stock companies in order to increase their efficiency. However, even the corporatized joint–stock companies are effectively under the control of districts, regions or municipalities which are their major shareholders. Only a minority of Czech hospitals is in purely private hands thus we cannot control for private vs. public ownership. The variable *not_profit* takes the value 1 when a hospital is public nonprofit and 0 otherwise, i.e. publicly controlled joint–stock company or a privately owned hospital.[8]

[5] Year 2010 was initially considered, but it was excluded due to methodological reasons. Specifically, since reimbursement stopped in June 2010, we cannot infer much about the effect of co-payments in that year.

[6] Specifically from the following set of publications: 'Healthcare - Regions and the Czech Republic' ('Zdravotnictví kraje + ČR') for individual years

[7] The overall patient days in the Zlin region was be divided according to the shares of healthcare provided to groups 0-18 and 70+ as of UZIS (2008–2009), Table 2.13.3, *Inpatients treated in the Zlin region by age structure*.

[8] In preliminary analysis, we initially included also a dummy for the presence of a specialized centre as defined by the Ministry of Health and a dummy reflecting whether a hospital is situated in Prague. Neither of these variables significantly increased the explanatory power of the model and both of them correlated with

Table 1. Descriptive statistics

	TREAT	POST	presence	days	DRG	teaching	population	not_profit	unc_eff2019	c_eff2019
mean	0.413	0.507	0.753	130310	1.014	0.147	71606	0.567	0.929	0.944
median	0	1	1	92503	0.875	0	24864	1	1	1
minimum	0	0	0	26785	0.650	0	3604	0	0.449	0.500
maximum	1	1	1	544025	4.220	1	371399	1	1.262	1.011
st.dev.	0.492	0.500	0.431	111000	0.400	0.354	99779	0.496	0.151	0.103

Efficiency scores of individual hospitals obtained in Mastromarco *et al.* (2019) were applied in alternative model specifications. The variable *unc_eff2019* represents unconditional efficiency scores and *c_eff2019* are efficiency scores with efficiency conditioned on determinants. These variables are employed as robustness checks replacing the variable *DRG*. If patients perceive and value efficiency of individual hospitals, the number of patient days will increase with efficiency. Otherwise, inefficient hospitals are expected to report more patient days.

Population in the municipality where the hospital is situated characterizes the area. Besides, it is correlated with the size of the hospital since bigger hospitals are often situated in bigger cities. The population of Prague was divided into core catchment areas of individual hospitals not to bias the results. Since hospitals situated in bigger cities serve more people, the number of patient days provided is expected to increase with population.[9]

The variable *Presence* takes the value 1 if there is at least one hospital in the region where patients could ask for reimbursement of the user charge. It represents competitive pressures in the region. If price elasticity is sufficiently high, the patients will choose to travel to a hospital where reimbursement is offered. The variable would thus be negative and significant. An insignificant effect would support the initial assumption of high transaction costs outweighing benefits received from user-charge reimbursement.

Of course, the patient may travel to a hospital situated in a different region. However, in some regions the possibility of reimbursement was restricted only to the patients living in that region, thus if there was an it should be strengthened for reimbursing hospitals within regional boundaries.

All variables, including the dependent variable, except for dummies, were logarithmized due to distributional properties. Descriptive stastistics of the variables is provided in Table 1 and a correlation matrix is in Table B1.

4 Empirical results

The main results of the analysis of the effect of co-payments on inpatient care are provided in Table 2. Results of the models where DRG scores are replaced with efficiency scores are

the variable *DRG*. Another hospital characteristics tested was the share of doctors striking in the protest “Dekujeme, odchazime“ for a wage increase in spring 2010. The variable was insignificant causing a strong heteroscedasticity of the errors.

[9]The share of the elderly in a municipality was also analyzed with no significant improvement of the model.

provided in Table 3. Robustness checks are provided in Table B3 and Table B4.

All models were tested for normality (graphically, Jarque Bera test), the presence of homoscedasticity (Breush-Pagan test) and absence of autocorrelation of residuals (Durbin-Watson test). The test results are provided in Table B2. All models reveal autocorrelation of residuals. The main analyses with efficiency scores further report heteroscedastic errors. In addition to OLS standard errors, cluster-robust standard errors which overcome these ills are therefore reported.

The results of model 1 in Table 2 suggest that the interaction term is marginally significant, i.e. at 10 % significance level when heteroscedasticity and autocorrelation of residuals are addressed. The coefficient suggests that the reimbursement of co-payments increased the number of patient days in these hospitals by 2.7% after accounting for differences between treatment and control hospitals, treatment and control periods and exogenous hospital and regional characteristics. The model explains as much as 76.7 % of the variation in patient days.

Teaching and non-profit hospitals report more patient days and so do hospitals in bigger cities. The presence of another hospital in the region which offers reimbursement does not play a role when heteroscedasticity and autocorrelation are controlled for, even though the coefficient sign is as expected. Given the results of Hromádková (2016) who found that distance is a significant determinant of pharmacy choice if reimbursement is offered, we assume that the costs connected to the distance to the nearest hospital where user charges are reimbursed probably outweigh the benefits of reimbursement. This result support our assumption that the estimated effect of user charges was the true effect if user charges were applied nationally. Price elasticity at such low amount of user-charges is non-existent.

When *log(DRG)* is added into model 2 in Table 2, the explanatory power of the model increases and so does the effect of reimbursement. Hospitals with more complicated cases report significantly more patient days than hospitals with less complicated cases. The signs and significance of other of hospital and regional characteristics are consistent with model 1.

Table 2. Main results

Model 1		P-value				**Model 2**	P-value			
	Coefficient	Cluster–robust SE		OLS		Coefficient	Cluster–robust SE		OLS	
Intercept	8.8687	0.00E+00	***	1.52E-52	***	9.1464	0.00E+00	***	1.61E-51	***
INTERACTION	0.0272	8.84E-02	*	8.13E-01		0.0395	4.16E-02	*	7.28E-01	
TREAT	0.6425	1.69E-12	***	4.14E-11	***	0.6360	2.53E-13	***	3.93E-11	***
POST	-0.0224	1.93E+00		7.62E-01		-0.0212	1.82E+00		7.71E-01	
teaching	1.0690	1.83E-05	***	1.45E-18	***	0.9809	5.41E-06	***	4.79E-15	***
log(population)	0.2137	9.79E-04	***	3.55E-09	***	0.1875	2.39E-03	**	5.31E-07	***
presence	-0.2780	1.98E+00		6.04E-04	***	-0.2452	1.95E+00		2.52E-03	***
log(DRG)						0.3111	9.83E-02	*	3.31E-02	**
not_profit	0.3416	4.76E-03	***	8.33E-07	***	0.3327	6.17E-03	**	1.21E-06	***
adjusted R^2	0.7676					0.7734				
F-Statistics	< 2.2e-16					< 2.2e-16				
	142 DF					141 DF				

Note: Significance codes: 0.01 ***, 0.05 **, 0.1*

In models 3 and 4 in Table 3, *log(DRG)* was replaced with *log(unc_eff2019)* and *log(c_eff2019)*, respectively. The explanatory power of the models is unchanged, but none of these variables were significant. The marginal significance of the reform from models 1 and 2 in Table 2 disappeared. The effects of exogenous characteristics stayed consistent with the main results. The results suggest that people do not consider efficiency to be a determining factor when choosing a hospital.

Table 3. Results with efficiency scores

Model 3		P-value				**Model 4**	P-value			
	Coefficient	Cluster–robust SE		OLS		Coefficient	Cluster–robust SE		OLS	
Intercept	8.8292	0.00E+00	***	4.20E-51	***	8.8576	0.00E+00	***	1.52E-51	***
INTERACTION	0.0350	1.32E-01		7.64E-01		0.0452	1.30E-01		7.00E-01	
TREAT	0.6381	1.62E-10	***	1.39E-10	***	0.6283	5.85E-11	***	2.79E-10	***
POST	-0.0127	1.39E+00		8.66E-01		-0.0210	1.819		7.79E-01	
teaching	1.0563	1.57E-05	***	1.02E-17	***	1.0613	3.11E-05	***	5.93E-18	***
log(population)	0.2180	1.76E-03	***	3.13E-09	***	0.2163	2.20E-03	***	3.51E-09	***
presence	-0.2705	1.96E+00		1.04E-03	***	-0.2719	1.96E+00		9.73E-04	***
not_profit	0.3388	1.18E-02	**	1.59E-06	***	0.3314	1.48E-02	***	2.66E-06	***
log(unc_eff2019)	0.1486	5.54E-01		3.47E-01						
log(c_eff2019)						0.2041	5.98E-01		3.83E-01	
adjusted R^2	0.7669					0.7667				
F-Statistics	< 2.2e-16					< 2.2e-16				
	139 DF					139 DF				

Significance codes: 0.01 ***, 0.05 **, 0.1*

Robustness checks of the results with non-reimbursed shares of patient days of Zlin hospitals which enrich the control group are provided in Table B3 and Table B4. The effect of the reform was significant in all models except for model 1 where it turned insignificant. In other words, even though the efficiency scores stay insignificant in models 3 and 4, the effect of co-payments turned marginally significant even when efficiency scores were included (at 10 % significance level). In model 3, *log(DRG)* turned insignificant from being previously significant at 10 % level.

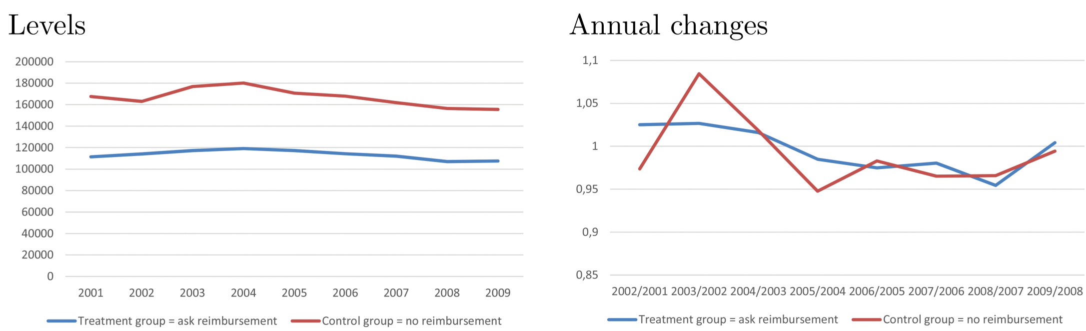
Results of an additional robustness check in Table B5 and Table B6 for which the sample was stratified by the presence of at least one reimbursing hospital in the region support the main results. However, the interaction term is insignificant in all model specifications. The effect of the reform is thus even weaker for a stratified sample than for the main analysis in which the interaction term was significant at least for some specifications. Should a substitution effect take place, the interaction term would be significant at least in the sample of hospitals with an outside option close by. This robustness check therefore points to the absence of outside options and non-existence of a substitution effect in the given set-up.

The comparison of results of the main analysis and robustness checks suggests that the effect of co-payments is very small and statistically unstable. The point estimate remains in the tight range of 2.7-4.5 % across different model specifications. Under the absence of outside options which was supported by a robustness check with a stratified sample, the observed effect is the true effect that would take place if user charges were reimbursed in all hospitals in the country.

4.1 Validity tests of the DiD methodology

The validity of the DiD methodology was tested. The parallel trend assumption was visually inspected. Figure 2 suggests that the parallel trend assumption between the treatment and control groups is satisfied. Both treatment and control groups reveal a similar trend of development prior to the examined period, i.e. 2005–2007. A slight difference occurs in the period 2003–2005 in which the number of patient days in the control group rose more relative to the treatment group. Such a development is most probably attributable to the process of corporatization of Czech hospitals and is unrelated to our purposes.

Figure 2. Parallel trend assumption - patient days



The parallel trend assumption was parametrically supported by a leads and lags model in Table 4. In order for the parallel trend assumption to hold, the effect of the lags should be insignificant in the model (Wing *et al.*, 2018). As a lead, the treatment year, i.e. 2009 was used. As lags we define dumies for years in which a parallel trend is assumed. Thus, dummies for year 2007 and 2010 were chosen as lags, even though year 2010 does not preceed the treatment. However, in 2010, the trend in the control and treatment groups should be parallel again since during the first months of 2010, regions phased out all reimbursement mechanisms, i.e. user charges were abolished for all. The fact that the entire year 2010 was not fully free from treatment may pose a minor bias that must be kept in mind when interpreting the results of the leads and lags model. The period considered for the leads and lags model was 2006–2010.[10]

The results reveal that the parallel trend assumption holds since significance of both aforementioned dummies and their cross-terms with the treatment group dummy was rejected. Even the interaction of year_2010 $\times$ TREAT was strongly insignificant despite a minor bias that may overestimate it. The explanatory variables revealed the same results both in terms

[10] Dummy for year 2006 was omitted due to a dummy trap.

of significance and the direction of the effect as the baseline model.

Table 4. Leads and lags model

	Coefficient	P-value Cluster-robust SE		OLS	
(Intercept)	8.628	0.000	***	0.000	***
INTERACTION	0.034	0.405		0.746	
INTERACTION_2010	0.011	0.786		0.915	
INTERACTION_2007	0.033	0.392		0.756	
TREAT	0.618	0.000	***	0.000	***
POST	-0.059	1.964		0.389	
year_2010	-0.069	1.986		0.314	
year_2007	-0.001	1.028		0.990	
presence	-0.343	1.954		0.000	***
teaching	1.093	0.001	***	0.000	***
log(population)	0.265	0.003	***	0.000	***
adjusted R^2	0.724				
F-Statistics	< 2.2e-16				
	383 DF				

Significance codes: 0.01 ***, 0.05 **, 0.1*

Assuming random or exogenous assignment to treatment and control groups, the estimate of the treatment effect is more efficient with additional exogenous controls because these controls reduce the error variance. However, if the assignment is random, then including additional covariates should have a negligible effect on the estimated treatment effect. Thus, results for the treatment effect were compared for a model with additional controls and without them. The results are provided in Table 5. Comparing the results of the main analysis for the treatment effect, the assumption of randomness is supported since the effect on the interaction term when observables are dropped is not very much different from the main analysis when observables are included.

Table 5. Random assignment test

	Coefficient	P-values Cluster-robust SE		OLS	
Intercept	11.5358	0.00E+00	***	4.80E-139	***
INTERACTION	0.0473	1.81E-01		8.44E-01	
TREAT	-0.0621	1.30E+00		7.17E-01	
POST	-0.0365	1.75E+00		8.14E-01	
Adjusted R^2	-0.0194				
F statistics				0.9838	
				146 DF	

Significance codes: 0.01 ***, 0.05 **, 0.1*

Since the groups differ along observables, there is a chance that they also differ along unobservables (Constatinides *et al.*, 2012), a regression of the treatment indicator on observables (a binomial logit regression) was carried out. All observables (in all models) report insignificant effect on treatment. Results are upon request from the author.

Finally a falsification test was carried out (Constatinides *et al.*, 2012). It was falsely assumed that the treatment occurred in 2006, i.e. the observed period was 2005–2006. The falsification test was carried out for model 1 (see Table 2) due to data availability and the fact that the treatment effect was marginally significant only in models 1 and 2 in Table 2. Since the variable *presence* has no meaning in the falsification test and was insignificant in Table 2, it was excluded for the falsification test. The results of the falsification test are provided in Table 6. The estimated treatment effect is statistically indistinguishable from zero, thus the observed change in 2009 likely happened due to the treatment rather than other alternative forces, even though at small levels. The size and direction of the effect of observables in the falsification test resembles the results of Model 1 in Table 2.

Table 6. Falsification test - Difference-in-differences

		P-value			
	Coefficient	Cluster-robust SE		OLS	
Intercept	8.2005	0.00E+00	***	3.42E-46	***
INTERACTION	0.0687	5.16E-01		5.77E-01	
TREAT	0.4539	6.67E-07	***	1.66E-06	***
POST	0.0112	1.10E+00		8.87E-01	
teaching	1.0102	4.74E-12	***	7.39E-16	***
log(population)	0.2706	4.60E-08	***	1.86E-11	***
not_profit	0.3312	4.84E-07	***	1.52E-05	***
Adjusted R^2	0.7652				
F-statistics				¡ 2.2e-16 131 DF	

Significance codes: 0.01 ***, 0.05 **, 0.1*

5 Conclusion

The essay estimated the effect of the reimbursement of inpatient user charges on the amount of inpatient care provided. The number of inpatient days represented the dependent variable. The analysis was carried out from the supply side perspective, assuming that hospitals respond to the demand from the community rather than themselves deciding on the amount of care they provide to the population.

The difference-in-differences methodology was applied. The decision of the social democratic regional governments of 2009 under which they decided to reimburse user charges in all hospitals under their control was unrelated to any hospital characteristics. Such a decision thus allowed a natural experiment. There was no other influence in the economy either, that would affect the number of patient days in hospitals, thus the effect of the reform was most probably plausibly exogenous bearing no expected gain bias (Ryan *et al.*, 2015). The design of the reform does not allow any 'spill-over' from the treatment to comparison groups either (Ryan *et al.*, 2015) The assumptions of the DiD, including the parallel trend assumption and random assignment, were tested in subsection 4.1.

As many as 76 general hospitals were observed in the period 2008-2009. The year 2008 represented the period prior to the reform, ie. control period, when all patients had to pay co-payments, and the year 2009 represented the period after the reform, i.e. treatment period in which some of the patients could be exempted from user charge payments. Hospitals under the control of the social democratic regional government which offered user-charge reimbuserment represented the treatment group.

It was assumed that if the number of patient days increases after the governmental decision to reimburse user charges, i.e. the coefficient of the interaction term denoting the treatment group in the treatment period is positive, the opposite may be inferred about the introduction of user charges. In other words, if people increase their consumption of inpatient care once user charges are abolished, they should decrease their consumption when user charges are introduced. In addition, it is believed, in given the context of very low private participation in healthcare expenses in the Czech Republic, that there is some over-consumption of healthcare present. Private participation on healthcare in the Czech Republic reached 14.3% in 2014 which is far below the European area average (WHO, 2003–2012). The number of inpatient discharges was over 21 cases per 100 inhabitants in 2016 which exceeded the Visegrad and any EU average. The number of doctor consultations exceeded 11 consultations per capita in 2013 which again significantly exceeds the EU average (OECD, 2000–2012). A reduction of the consumption due to user-charges is thus not deemed harmful, but rather as a decrease of over-consumption.

A number of specifications of the model were tested. In addition to the set of treatment dummies, we controlled for exogenous characteristics of the hospital and the region where the hospital is situated. Alternative specifications with the DRG case mix index and efficiency scores obtained in Mastromarco *et al.* (2019) were tested. A robustness check with an enhanced control group was carried out.

The alternative results are consistent as to the effect of most exogenous variables on the number of inpatient days. Teaching hospitals, non-profit hospitals and hospitals in larger cities report more inpatient days. The effect of the DRG case-mix index is marginally positive being significant at 10 % level in the main analysis but turning insignificant in the robustness check.

Having tested different model specifications, the effect of co-payments is not statistically robust. The statistical significance of the effect varies with model specification. The direction of the effect stays consistent across models. The magnitude of the effect when significant ranges from 2.7% to 4.1%.

We assumed that in the Czech set-up under a very low value of the user-charge which cost the same as a meal in a restaurant or a pack of cigarettes in 2009, the patients are unlikely to choose a hospital based on the possibility to receive user-charge reimbursement. The transaction costs to travel to a different hospital would outweigh the benefits received by user-charge reimbursement. Regional hospitals thus did not represent an outside option for patients which was also supported by the insignificant dummy variable capturing the effect of a nearby reimbursing hospital and the results of a robustness check in which hospitals were stratified by the presence of a reimbursing hospital in the region. Thus, if significant at all, user charges influenced only the length of stay per patient. The estimated effect from the natural experiment thus represents the true effect that would take place if the reform applied nationally without exceptions.

The results are consistent with existing empirical Czech literature which finds mixed evidence regarding the significance of the effect of co-payments. On the one hand, Hromádková (2016) discovered a desired effect of reimbursement in regional hospitals, but dealing with prescriptions, on the other hand Kalousová (2014) did not find any significant effect of co-payments on inpatient care using individual SILC data. Neither Votápková & Žílová (2016a) find any significance of copayments (across age cohorts) when assessing the effect of user charges on ambulatory doctor visits. However, the level of user charge for ambulatory visits was even smaller than the user charge for an inpatient day.

Czech general hospitals analyzed in this essay treat a wide spectrum of patients. The patients are of different age, sex, income, etc. Due to universal coverage and the third-party-payer system, the structure of patients treated is, however, homogeneous across hospitals both in treatment and control groups.

Other Czech research however suggests that the effect of cost-sharing may differ for different age cohorts and type of care. Specifically, analyzing price-elasticity of different age cohorts through generic substitution, Votápková & Žílová (2016b) find out that the elderly are more price sensitive and prefer cheaper generics. When being prescribed a drug against acute illness, the patient, regardless of age, does not opt for a cheaper generic but in case of drugs against chronic illnesses, the longer the generics is available, the more the probability increases that the patient chooses the generics, although at the beginning the patients rather chose the original. It suggests that transactions costs are too high for occasional drug users, but a regular drug user recognizes benefits of saving overtime and opts for generics. It is assumed that we may observe similar results for different types of inpatient care, however for a sufficiently large amount of cost-sharing. A heterogeneity analysis of inpatient user-charges for a different structure of patients and types of care serves as motivation for further research since the present dataset does not allow for it.

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Appendix

Table B1. Correlation matrix

	TREAT	POST	PRESENCE	DAYS	DRG	teaching	population	not_profit	unc_eff2019	c_eff2019
TREAT	1									
POST	-0.011	1								
PRESENCE	0.480	-0.008	1							
DAYS	-0.185	-0.009	-0.282	1						
DRG	-0.307	0.007	-0.375	0.534	1					
teaching	-0.348	-0.006	-0.287	0.856	0.530	1				
population	-0.396	0.000	-0.283	0.629	0.445	0.634	1			
not_profit	-0.359	-0.002	-0.376	0.429	0.329	0.363	0.392	1		
unc_eff2019	-0.132	-0.178	-0.129	0.113	0.134	0.112	0.003	0.017	1	
c_eff2019	-0.085	-0.115	-0.160	0.166	0.158	0.133	0.041	0.129	0.761	1

Note: Significance codes: 0.01 ***, 0.05 **, 0.1*

Table B2. Model tests

Main analysis				
Model		Normality	Homoscedasticity	No autocorrelation
	graphically	Jacque Bera test	Breush-Pagan test	Durbin–Watson test
model 1	accept	accept ** P= 0.082	accept * P = 0.015	reject P = 2.99e-09
model 2	accept	accept * P = 0.047	accept * P = 0.016	reject P = 1.624e-09
model 3	accept	accept*** P = 0.114	reject P = 0.004	reject P = 4.447e-09
model 4	accept	accept *** P = 0.134	reject P = 0.001	reject P = 4.353e-09
Robustness check				
Model		Normality	Homoscedasticity	No autocorrelation
	graphically	Jacque Bera test	Breush-Pagan test	Durbin–Watson test
model 1	accept	accept ** P = 0.073	accept * P= 0.02478	reject P = 2.272e-10
model 2	accept	accept * P = 0.03602	accept * P = 0.023	reject P = 1.313e-10
model 3	accept	accept *** P = 0.100	accept * P = 0.020	reject P = 2.926e-10
model 4	accept	accept ***P = 0.1115	accept at * P = 0.012	reject P = 3.17e-10

Table B3. Robustness results - enhanced sample: Model 1 & Model 2

Model 1		P-value				**Model 2**	P-value			
	Coefficient	Cluster–robust SE		OLS			Cluster–robust SE		OLS	
(Intercept)	8.9043	0.00E+00	***	1.73E-53	***	9.1696	0.00E+00	***	7.45E-52	***
INTERACTION	0.0277	1.06E-01		8.08E-01		0.0389	4.10E-02	**	7.32E-01	
TREAT	0.6128	8.46E-13	***	2.49E-10	***	0.6061	2.46E-13	***	2.81E-10	***
POST	-0.0221	1.91E+00		7.72E-01		-0.0210	1.82E+00		7.81E-01	
teaching	1.0693	9.73E-06	***	4.41E-18	***	0.9908	3.15E-06	***	7.97E-15	***
log(population)	0.2084	1.12E-03	**	9.10E-09	***	0.1832	3.49E-03	**	1.34E-06	***
presence	-0.2740	1.97E+00		1.00E-03	**	-0.2445	1.95E+00		3.49E-03	**
log(DRG)						0.2836	1.31E-01		5.69E-02	*
not_profit	0.3693	1.63E-03	**	1.44E-07	***	0.3623	2.21E-03	**	1.98E-07	***
adjusted R^2	0.7487					0.7531				
F-Statistics	< 2.2e-16					< 2.2e-16				
	150 DF					149 DF				

Note: Significance codes: 0.01 ***, 0.05 **, 0.1*

Table B4. Robustness results - enhanced sample: Model 3 & Model 4

Model 3	Coefficient	P-value Cluster–robust SE		OLS		**Model 4** Coefficient	P-value Cluster–robust SE		OLS	
(Intercept)	8.8836	0.00E+00	***	3.45E-52	***	8.9010	0.00E+00	***	1.56E-52	***
INTERACTION	0.0348	8.06E-02	*	7.64E-01		0.0416	9.70E-02	*	7.22E-01	
TREAT	0.6064	2.00E-11	***	8.73E-10	***	0.6000	9.50E-11	***	1.43E-09	***
POST	-0.0158	1.49E+00		8.39E-01		-0.0212	1.84E+00		7.84E-01	
teaching	1.0622	5.55E-06	***	2.22E-17	***	1.0648	2.83E-05	***	1.46E-17	***
log(population)	0.2108	8.68E-04	***	9.93E-09	***	0.2098	1.90E-03	***	1.02E-08	***
presence	-0.2697	1.98E+00		1.49E-03	***	-0.2701	1.96E+00		1.44E-03	***
not_profit	0.3660	2.37E-03	**	3.30E-07	***	0.3608	5.76E-03	***	4.59E-07	***
log(unc_eff2019)	0.0968	6.98E-01		5.48E-01						
log(c_eff2019)						0.1446	6.91E-01		5.43E-01	
adjusted R^2	0.747					0.747				
F-Statistics	$<$ 2.2e-16					$<$ 2.2e-16				
	147 df					147 DF				

Note: Significance codes: 0.01 ***, 0.05 **, 0.1*

Table B5. Robustness results - stratified by presence of reimbursement in region: Model 1 & Model 2

Model 1	Coefficient	P-value Cluster-robust SE		OLS		model 2 Coefficient	P-value Cluster-robust SE		OLS	
Intercept	8.8763	0.00E+00	***	2.79E-44	***	9.3110	0.00E+00	***	4.04E-41	***
INTERACTION	0.0337	1.26E-01		7.94E-01		0.0337	1.74E-01		7.91E-01	
TREAT	0.6881	8.62E-12	***	8.44E-11	***	0.6674	3.33E-11	***	1.81E-10	***
POST	-0.0280	1.83E+00		7.70E-01		-0.0028	1.09E+00		9.76E-01	
teaching	1.5082	5.17E-11	***	5.65E-18	***	1.1876	4.12E-03	***	1.35E-07	***
log(DRG)						0.5926	2.21E-01		4.03E-02	**
log(population)	0.1836	3.33E-03	***	2.38E-06	***	0.1501	2.15E-02	**	2.58E-04	***
not_profit	0.2504	4.37E-02	**	4.98E-04	***	0.2374	5.59E-02	*	8.21E-04	***
Adjusted R^2	0.7494					0.757				
F Statistics	$<$ 2.2e-16					$<$ 2.2e-16				
	106 DF					105 DF				

Note: Significance codes: 0.01 ***, 0.05 **, 0.1*

Table B6. Robustness results - stratified by presence of reimbursement in region: Model 3 & Model 4

Model 3		P-value				Model 4	P-value			
	Coefficient	Cluster-robust SE		OLS		Coefficient	Cluster-robust SE		OLS	
INTERCEPT	8.8523	0.00E+00	***	7.89E-43	***	8.8648	0.00E+00	***	3.60E-43	***
INTERACTION	0.0348	2.80E-01		7.92E-01		0.0421	2.14E-01		7.49E-01	
TREAT	0.6863	1.05E-10	***	3.02E-10	***	0.6800	3.59E-11	***	4.02E-10	***
POST	0.0146	1.28E+00		8.83E-01		0.0180	1.46E+00		8.54E-01	
teaching	1.5068	3.73E-11	***	3.16E-17	***	1.5080	3.20E-10	***	1.91E-17	***
log(population)	0.1862	4.93E-03	***	2.76E-06	***	0.1859	7.27E-03	***	2.46E-06	***
not_profit	0.2407	5.25E-02	*	1.06E-03	***	0.2351	6.72E-02	*	1.40E-03	***
log(unc_eff2019)	0.0715	8.13E-01		6.66E-01						
log(c_eff2019)						0.1509	0.7828		0.5431	
Adjusted R^2	0.7473					0.7478				
F Statistics	$< 2.2e-16$					$< 2.2e-16$				
	103 DF					103 DF				

Note: Significance codes: 0.01 ***, 0.05 **, 0.1*

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