Implications of global budget payment system on nursing home costs

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Abstract

Pressure on health care systems due to the increasing expenditures of the elderly population is pushing policy makers to adopt new regulation and payment schemes for nursing home services. We sketch a simple theoretical model to predict the behavior of nursing homes under different payment schemes. We then investigate the implications of prospective payments on nursing home costs using a panel of 41 homes in Southern Switzerland observed over a 12-years period (1999-2010). To evaluate the impact of the recent policy change - from retrospective to prospective payment - we employ a fixed effects model with a time trend that is allowed to change after the policy reform. We find evidence that the new payment system reduces costs for nursing home care, *ceteris paribus*. This result is in line with the theoretical expectations.

Keywords: nursing homes, prospective payment, quality of care, policy change

JEL classification: I18, C23, J33.

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1 Introduction

Increasing health care expenditures for the elderly population is a major concern for society and policymakers. In Europe, the percentage of people over 64 rose rapidly in the past decades and is expected to increase between two and six times by 2060, ranging from 22-25% in Belgium, Denmark, Ireland, and the United Kingdom, to 33-36% in Bulgaria, Germany, Latvia, Poland, Romania, and Slovakia. The share of very elderly people (80 and over) in the EU15 experienced the highest increase among all age classes, from 1.2% in 1950 to 4.2% in 2010, and is projected to almost triple (12%) by 2060 in the EU27 (Eurostat, 2012; European Union, 2012). Accordingly, the demand of nursing home care is expected to increase rapidly raising the burden on public resources generally used to cover nursing home costs or to subsidize prices of nursing home services (Karlsson et al., 2006).

In the past 30 years hopes have been pinned on the possibility to control healthcare expenditures by replacing Retrospective (RPS) with Prospective Payment Systems (PPS), mainly in the hospital sector. Under PPS, a predetermined, fixed amount of resources is paid for the service. The rationale is that reimbursement based on ex-ante costs prevents health care providers from giving unnecessary care (Jegers et al., 2002). In the U.S., the use of PPS has been extended from hospitals to the nursing home sector in 1997 through the Balanced Budget Act. Similarly, many European countries have recently incorporated more incentivizing payment systems into their existing funding systems.

Although the health economics literature is rich of studies on the impact of PPS in the U.S. nursing home sector (e.g. Chen and Shea, 2002; Norton, 1992; Zhang et al., 2008), there is little empirical evidence in Europe. A number of studies have been published on the impact of PPS in the hospital sector in different European countries, for instance Finland (Linna, 2000), Norway (Biorn et al., 2006), and Portugal (Dismuke and Sena, 1999). To our knowledge, the only study on the impact of PPS to finance nursing home services is the recent analysis by Dormont and Martin (2012) based on a hypothetical scenario. The authors investigate the costs-efficiency trade-off in French nursing homes (NHs) to predict possible implications of a switch in the payment system.

In this paper, we provide evidence on the impact of PPS on the costs of a sample of NHs operating in one Swiss canton (Ticino) by exploiting data before and after the introduction of PPS. Switzerland is a federal state in which the provision and regulation of nursing home care for elderly people is organized at the regional level (cantons). As consequence, 26 very different nursing home sectors exist. In 2006, the cantonal authority substituted the previously-in-force payment system based on acknowledged financial needs (RPS) with an ex-ante determined budget (PPS). To evaluate the impact of this policy change we use: i) an econometric model with fixed-effects (FE) and a time trend that is allowed to change after the policy reform; and ii) a counterfactual approach (CF) where a fixed-effects model is used to predict costs for the years after the reform, and the impact of the reform is calculated as the difference between observed- and predicted costs in each year. We will provide evidence that the new payment system reduced costs growth for NH care, after controlling for the quality of services.

The remainder of the paper is organized as follows. Section 2 provides an overview of recent studies analyzing the impact of PPS on costs, quality and access to health care services. Section 3 describes the regulatory reform and proposes a simple theoretical model to infer the behavior of NHs under the old RPS and the new PPS. Data and the identification strategy for the policy change are discussed in section 4. The econometric estimations are presented in section 5, and section 6 concludes the paper.

2 Previous research on the impact of PPS in nursing home care

The empirical evidence regarding the impact of PPS on costs, quality and access in NHs care is not conclusive. The literature mostly relies on studies conducted during the 90s in the U.S. where PPS were firstly introduced. Some of these studies focus on the financial consequences of PPS by looking at changes in costs (e.g. Ohsfeldt et al., 1991; Sexton et al., 1989). More recently, attention has been devoted to the understanding of cost reduction achievements. Improved methods to control for changes in quality and to cope with the potential endogeneity of output and/or quality in cost functions have been proposed (Gertler and Waldman, 1992; Chen and Shea, 2002). Also, direct assessment of the impact of PPS on quality (Konetzka et al., 2004; Konetzka et al., 2006) and access to nursing care (Coburn et al., 1993) have been carried out.

Regarding the effects on costs, Sexton et al. (1989) use a two steps strategy to regress efficiency scores calculated using Data Envelopment Analysis on changes in the payment system occurred in the State of Maine in 1982. They find a decrease in technical efficiency. Quality variations are assumed to be negligible. Ohsfeldt et al. (1991) exploit variations in the payment systems of 47 U.S. states over a 12-years period using a random effects model. After correcting for endogeneity in the reimbursement system by means of instrumental variables, the authors find a reduction of 20 per cent in per diem costs due to PPS.

Coburn et al. (1993) extend the traditional cost analysis by looking at the consequences of PPS on quality and access for Medicaid patients in the State of Maine. The analysis shows that PPS reduces growth in per-patient variable costs. During the first three years after the introduction of PPS, the average savings and losses per patient day decreased substantially. Afterward, the authors observed a remarkable increase in the number of NHs experiencing losses. Only the percentage of room and board costs relative to the total variable costs decreased over time, suggesting that cost savings were not achieved through reductions in quality. Finally, the percentage of Medicaid patients decreased, which can be interpreted as a negative impact on access for most severe patients.

Concerns about the evidence obtained during the 90s are raised by Chen and Shea (2002), who question the methodology used. In particular, they point at the inadequate measures of quality and output/quality endogeneity in cost functions. To cope with the endogeneity issue, the authors construct instrumental variables for both output and quality, and investigate the impact of PPS on short-term operating costs. The analysis is performed on a one-year data set of different U.S. states grouped into three different payment systems. The authors show that NHs with PPS are no longer significantly cheaper than facilities subject to cost-based retrospective payments, after controlling for quality differences.

More recently Zhang et al. (2008) assessed the impact of PPS on the cost efficiency of 8361 NHs in the U.S. over the period 1997-2003. During this period, three major policy changes occurred. In 1997, the Balance Budget Act (BBA) ratified the introduction of PPS. Afterward, the Balanced Budget Refinement Act (BBRA, 2000) and the Benefit Improvement and Protection Act (BIPA, 2001) increased the baseline payments in consequence of the financial difficulties reported by NHs. DEA calculated efficiency scores are regressed on policy change variables identified with time markers and a truncated random effect model is applied. The results show a negative relationship of all policy change variables with efficiency scores. The authors capture quality differences by weighting the output with a score calculated using the number of deficiency citations.

A growing strand of literature investigates the impact of PPS on quality aspects of nursing home care. Using data on U.S. NHs over the period 1996-2000, Konetzka et al. (2004) study the impact of PPS on quality by applying a difference-in-difference approach and a negative binomial model. The authors use changes in the professional staffing and the number of regulatory deficiencies as proxies for quality. As expected, PPS is found to significantly reduce the professional staff. The negative impact of PPS is partially corrected by the introduction of the Balanced Budget Refinement Act. As with respect to regulatory deficiencies, only weak evidence is reported. Also, no differences between for-profit and nonprofit NHs are found.

Finally, Konetzka et al. (2006) investigate the spillover effects of introducing PPS in Medicare residents on quality for Medicaid patients. Since facilities cross-subsidize part of the costs of Medicaid residents with the higher margins of Medicare and high private-pay residents, the cuts in revenue due to the introduction of PPS may also have affected quality of long-stay residents. Using a quasi-experimental approach in four U.S. states over the period 1995-2000, the authors show that PPS has an adverse effect on urinary tract infections and pressure scores.

To conclude, the literature remains inconclusive as with respect to the impact of PPS in nursing home care. Also, it is worth pointing out that most of the studies mentioned are conducted in the U.S. where private for-profit facilities represent a large share of total NHs and the environment is increasingly competitive. It is not clear whether this leads to different behavioral responses as compared to nonprofit institutions which are largely present in Europe. In competitive environments, the expected negative impact of cost reductions on quality may be mitigated by the need to maintain a high reputation. As suggested by Grabowski and Town (2011), NHs facing greater competition are more responsive to quality improving projects. However, competition can also have a negative effect on quality if it pushes prices down (Forder and Allan, 2012). Conversely, in a non-competitive, nonprofit environment with highly regulated prices and quality, such as the Swiss NH sector, the possible negative impact of cost reductions on quality is expected to be limited.

3 The regulatory reform

3.1 Background

In Ticino, nursing home care is provided primarily by regulated public and private nonprofit organizations. The provision of nursing care is further decentralized at local level (municipalities) and elderly people are commonly assigned to the NH in the community of residence. Therefore, NHs operate as local monopolies with virtually no competition. Price and quality are regulated by the cantonal authority, i.e. the Regional Department of Public Health (RDPH). Prices are subsidized and defined by the RDPH as a function of residents' income (pension's rent) and wealth, and do not vary across NHs. Quality is regulated in many aspects, in particular structural and procedural. Because of tight regulation the production process is highly homogeneous (Crivelli et al., 2002).

In 2006, the cantonal authority in Ticino introduced global budgets for nursing home care.[1] Prior to the introduction of global budgets, subsidies to providers of long term care were allocated by the cantonal authority based on acknowledged financial needs; a form of soft budget constraint. The payment system consisted of two parts: a prospectively defined component and a retrospective, upward adjustment based on actual costs at the end of the year. The prospective part was an estimation of the costs for the following operative year based on a combination of historical costs and benchmarking parameters at the sector level. At the end

[1] Two other cantons recently introduced PPS in nursing home care: Vallis and Geneva.

of the year, more financial resources were paid if the NH was able to justify additional expenses. Conversely, service providers with year-end costs below the initially estimated financial need were not allowed to retain the "savings". The cantonal authority viewed this system as inflationary and poorly incentivizing. The low flexibility of the system due to the detailed control over all cost items made it almost impossible for the management to make decisions on the cost structure, and led to low responsibility as with respect to budget decisions and financial performance. The funding system had the adverse incentive to spend the whole amount of resources provided.

In the early 2000s, to respond to the need of improving transparency and efficiency in long term care, the RDPH modified the payment system. To develop a new funding system based on prospectively defined payment rates, a pilot phase was lunched in January 2003. Five NHs were selected to partecipate to the pilot phase over a three-years period. Information collected during these years were used to define the list of services provided, an analytical accounting system, and a package of modern managerial tools. Since January 2006, the system has been applied to all NHs.

The current payment system (global budget) is composed of two elements: an individual component and a standardized part. The individual component mainly covers fixed costs such as rents and expenses for education trainings. The standard component includes four main categories of costs: residential, animation, care and therapies. Global budgets are calculated by the multiplying standard prices (also called *prospective rates* in the literature) with quantities. Standard prices stem from the analytical accounting register and reflect median costs in the nursing home industry classified into nine categories according to size. Also, standard prices are calculated to implicitly define the level of efficiency and quality desired by the cantonal authority. Quantities are given by the number of beds times the level of occupancy and yearly-days. For nursing care services, the number of resident-days is weighted by the NH-specific case-mix index calculated by the RDPH.

The starting prospective rate was determined for the year 2005, while the prospective payment rates for the following years were adjusted for inflationary changes of some cost items only (e.g. wages). An adjustment based on savings achieved in the previous years is planned to occur on a medium-term perspective depending on the financial stability of the NHs and has not been applied yet.

The final budget does not depend on the actual costs generated by the residents. NHs with end-year costs lower than the global budget are entitled to retain a share (25%) of the savings. The main part (75%) are saved as mandatory reserves to cover previous or future deficits. This system is expected to ensure financial stability of nursing care providers in the medium-term.

A discussed possible consequence of the new payment system is the negative impact on quality levels of nursing home services. This risk may be higher with excess of demand since incentives to compete are lower. However, the existing regulation of structural and procedural aspects of the production and provision of nursing home care is expected to strongly limit this possibility. For example, the RDPH defines the number of care givers in each NH as well as their education level. To further reduce this potential negative effect, new systems of quality promotion and control in terms of outcome have been integrated.

3.2 A simple model

Before assessing the impact of the new payment system empirically, we sketch a simple theoretical model to illustrate differences in the behaviour of NHs under the old and the new payment schemes, respectively the soft budget constraint (RPS) and the prospective payment (PPS) introduced recently. The demand of nursing home care is independent of prices because fees are established by the RDPH and are homogenous across the canton. Moreover, similarly to Chalkley and Malcomson (1998), the demand of nursing home care does not reflect quality.[2] Building on Di Giorgio et al. (2012) we define NH total costs as:

$$C = \widetilde{\theta} - e \tag{1}$$

[2] The typical arguments supporting this assumption are two. First, patients may not be able to assess the multidimensional nature of quality. Second, quality is partially an experience good and is observable only after receiving care. These aspects are particularly relevant in the case of nursing care due to the type of patients and the nature of the service. Also, in the Swiss context, individuals do not have free choice of the NHs and the allocation occurs according to the place of residence. Finally, the regulator sets quality standards which are equal for all NHs included in the sample, resulting in a very homogenous sector of nursing care.

where $\widetilde{\theta}\epsilon \left[\overline{\theta}, \underline{\theta}\right]$ is an exogenous cost component with $\overline{\theta} > \underline{\theta}$ and probability distribution $\Pr(\theta = \underline{\theta}) = q$ and $\Pr(\theta = \overline{\theta}) = 1 - q$, and only partially observable by the regulator.[3] The last term (e) in the equation (1) is cost-reducing effort. We normalize the population of patients to one, so that eq. (1) is also the average cost function. The prospective budget is a function $P(\theta, q)$ of costs the NH is expected to incur during the operating year:

$$P(\theta, q) = q\underline{\theta} + (1 - q)\overline{\theta}. \tag{2}$$

The NH maximizes the following objective function:

$$U = W - \lambda_i^{\theta}(B - C)^2 - \phi(e) \tag{3}$$

where W represents exogenous benefits from the production of nursing home services, and $\lambda_i^{\theta}\epsilon(\lambda_i^{\underline{\theta}}, \lambda^{\overline{\theta}})$ captures the marginal impact of an unbalanced budget from the i^{th} payment scheme ($i\ \epsilon\ [RPS, PPS]$) where:

$$\lambda_{PPS}^{\underline{\theta}} = \lambda^{\overline{\theta}}(\alpha - 1) \qquad\qquad 0 < \alpha \leq 1,\ \lambda^{\overline{\theta}} > 0 \tag{4}$$

and

$$\lambda_{RPS}^{\underline{\theta}} = -\lambda_{PPS}^{\underline{\theta}}. \tag{5}$$

Note that two scenarios are possible: over financing $(\theta = \underline{\theta})$ and under financing $\left(\theta = \overline{\theta}\right)$. Remember that the budget is defined by the RDPH as a weighted average of the structural cost parameter (eq. 2). Using (1) and (2), we then observe that for $\theta = \underline{\theta}$ we have $B - C > 0$ for any level of effort e. Conversely, for $\theta = \overline{\theta}$, we have $B - C \leq 0$ for any $e \in [0, e_{bal}]$.[4] Consequently, eq. (3) assumes that underfinancing reduces NH utility under both payment regimes, RPS and PPS, since$\lambda^{\overline{\theta}} > 0$. Conversely, incentives for the two regimes differ in the case of overfinancing since $\lambda_{RPS}^{\underline{\theta}} \neq \lambda_{PPS}^{\underline{\theta}}$. Under the old payment regime (RPS), NHs

[3] This reflects, for instance, the number of days spent by NH residents. While the number of residents per year is known in advance due to an excess of demand, uncertainty remains about the type and intensity of care needed by residents. Also, uncertainty is related to structural costs for standard daily activities, such as eating and other physical activities, or costs related to the geographical location of the NH.

[4] Note that the equilibrium level of effort for $\theta = \overline{\theta}$ is always lower that e_{bal}. See Table 1 for details.

were not allowed to retain resources in excess at the end of the year. Substituting (4) in to (5) and then (5) into the utility function defined by (3), we see that profits decrease. Moreover, the marginal impact of profits is generally lower than the marginal impact of losses ($\alpha - 1 \leq 1$). Under the new PPS system, NHs are entitled to retain resources in excess. Since $\lambda^{\underline{\theta}}_{RPS} = -\lambda^{\underline{\theta}}_{PPS}$, we allow surpluses to increase utility under the PPS regime only. Finally, $\phi(e)$ is the disutility of effort to reduce costs, which is increasing in the level of effort, with $d\phi/de > 0$ and $d^2\phi/de^2 > 0$. We specify the disutility of effort as $\phi(e) = \frac{\eta}{2}e^2$, with $\eta > 2\lambda^{\overline{\theta}}$. The marginal impact of effort on NH's utility is then captured by the parameter η.

To calculate the optimal level of effort, we first substitute (1), (2) and $\phi(e)$ into (3) and derive the following first-order condition:

$$\frac{dU}{de} = -2\lambda^{\theta}_{i}\left[(\overline{\theta} - \widetilde{\theta}) - q(\overline{\theta} - \underline{\theta}) + e^*\right] - \eta e^* = 0. \tag{6}$$

We then solve (6) for the equilibrium level of effort under the two financing regimes (RPS and PPS) and scenarios (underfinancing and overfinancing). The results are summarized in Table (1) where $\beta = 2\lambda^{\overline{\theta}}$ for simplicity.

	RPS	PPS
$\theta = \overline{\theta}$	$e^{\overline{\theta}*}_{SBC} = \frac{\beta q(\overline{\theta}-\underline{\theta})}{\eta+\beta}$	$e^{\overline{\theta}*}_{PPS} = \frac{\beta q(\overline{\theta}-\underline{\theta})}{\eta+\beta}$
$\theta = \underline{\theta}$	$e^{\underline{\theta}*}_{SBC} = 0$	$e^{\underline{\theta}*}_{PPS} = \frac{\beta(1-\alpha)(1-q)(\overline{\theta}-\underline{\theta})}{\eta-\beta(1-\alpha)}$

Table 1: Equilibrium level of cost reducing efforts under different payment systems and structural costs.

As expected, no differences in incentives arise between the two regimes in the case of underfinancing ($\theta = \overline{\theta}$). However, the new regime (PPS) provides more incentives to cost containment in the case of overfinancing if $\alpha < 1$ and $\beta > 0$.Therefore, the ability of the new payment system to control costs is related to the importance that NHs attach to additional resources, which is captured by $\beta(\alpha - 1)/2$ or $\lambda^{\overline{\theta}}(\alpha - 1)$ as defined by (4). This weight may be relatively weak since NHs operating in our context are generally nonprofit firms. One last consideration arises from the impact of the parameter η. Since NHs are nonprofit firms, η may represent not only the marginal cost of effort to reorganize the production process and save costs but also the disutility caused by reducing working time per employee or the number of employees. If those costs are very high (e.g. $\eta \to \infty$), then cost reducing effort tends to zero under both regimes, and incentives are invariant.

4 Empirical specification

4.1 The cost function

To empirically investigate the impact of global budget payments in nursing home care, we exploit data from a natural experiment in Switzerland where the payment system recently changed from RPS to PPS. Similarly to Di Giorgio et al (2012), we assume that NHs transform two inputs, capital and labor, into a single output, measured by the number of patient-days of nursing home care.[5] Since the production process is highly homogenous among NHs, the number of resident-days can represent a good indicator of the level of production. Consequently, we specify a total costs function[6] which depends on output (Y), price of capital and labor (P_k and P_l), two output characteristics (Q_1 and Q_2),[7] and a general time trend (τ).

$$C = f(Y, P_k, P_l, Q_1, Q_2, \tau). \tag{7}$$

The price of labor is calculated as the weighted average wage of different professional categories employed in the NH (doctors, nurses, administrative and technical staff), while the price of capital is derived from the residual approach, i.e. labor costs are subtracted from total costs and the residual is divided by the capital stock approximated by the number of beds. Q_1 is an index which measures the average patients assistance by means of normal daily activities such as eating, personal care or physiological activities. This is calculated on a yearly basis by the cantonal authority. Patients are classified in one out of five categories according

[5] In this study we employ a similar model specification to explore a different research question based on an updated dataset.

[6] In a non-competitive environment such as the Swiss one, there is no reason to assume that NHs minimize costs. In this case, the cost function is a *behavioral cost function* (Evans, 1971) and can still be used to make a comparison among firms. Moreover, by estimating a total cost function instead of a variable cost function we avoid the risk related to a high correlation between capital stock and output, which leads to a positive relationship between variable costs and capital stock. A similar approach is used, for instance, by Farsi and Filippini (2004).

[7] In order to estimate a cost function, either the output is assumed to be homogenous or we need to control for service intensity and patients' characteristics (Birnbaum et al., 1981).

to their severity level. A value between 0 and 4 is assigned where higher values indicate more severe cases. Q_2 is the nursing staff ratio, that is the ratio between the number of nurses employed in a NH and the number of nurses that should be employed according to the guidelines of the cantonal authority.

Because nursing home care is a labor-intensive service, the nursing staff ratio can be considered as a good indicator of quality (see for example Johnson-Pawlson and Infeld, 1996; Schnelle et al., 2004). Labor costs represent the main costs of a NH and make about 85 per cent of total costs. Consequently, a small change in the nursing staff ratio may affect total costs considerably. The nursing staff ratio is, therefore, a key variable in our analysis since NHs with relatively high costs may decide to decrease the proportion or the "quality" of workers to save money. If this is the case, then the estimates could suffer from endogeneity bias. To test the endogeneity of this regressor, we perform the robust Durbin-Wu-Hausman test.[8]

In order to impose as few restrictions as possible to (7), we adopt a flexible translog functional form approximated at the median value. Input prices and total costs are divided by the price of capital in order to satisfy the homogeneity condition in input prices.[9] The translog approximation to (7) can be written as:

$$\begin{aligned}
\ln\left(\frac{C}{P_k}\right) = {} & \delta_Y \ln Y + \delta_{Q_1} \ln Q_1 + \delta_{Q_2} \ln Q_2 + \delta_{P_l} \ln \frac{P_l}{P_k} \\
& + \frac{1}{2}\delta_{YY}(\ln Y)^2 + \frac{1}{2}\delta_{Q_1Q_1}(\ln Q_1)^2 + \frac{1}{2}\delta_{Q_2Q_2}(\ln Q_2)^2 \\
& + \frac{1}{2}\delta_{P_lP_l}\left(\ln \frac{P_l}{P_k}\right)^2 + \delta_{YQ_1} \ln Y \ln Q_1 + \delta_{YQ_2} \ln Y \ln Q_2 \\
& + \delta_{YP_l} \ln Y \ln \frac{P_l}{P_k} + \delta_{Q_1P_l} \ln Q_1 \ln \frac{P_l}{P_k} + \delta_{Q_1Q_2} \ln Q_1 \ln Q_2 \\
& + \delta_{P_lQ_2} \ln \frac{P_l}{P_k} \ln Q_2 + \delta_t \tau + \varepsilon
\end{aligned} \tag{8}$$

where ε is the error term. We check for the concavity condition in input prices

[8] The test is robust to arbitraily violations of conditional homoskedasticity and clustering, and consists in estimating the model by a Generalized Method of Moments (GMM) estimator and applying the Sargan statistic. We perform this test using the lagged value of Q_2 as an instrumental variable. The test statistic is χ^2 distributed with a robust score $\chi^2(1) = 0.49$ or $F(1, 234) = 0.395$. The null hypothesis of exogenous Q_2 cannot be rejected at any standard level of significance.

[9] The cost function is linear homogenous of degree 1 in input prices when a 10% increase in all input prices leads to a 10% increase in total costs.

after the estimation.

4.2 Data and descriptive statistics

Our study builds on data extracted from annual reports delivered to the cantonal authority by all regulated NHs scattered in canton Ticino, Switzerland. The initial data set contains 50 NHs observed over a 12-years period ($1999 - 2010$). This period includes the 7-year period before and the 5-year period after implementation of global budgets. From this initial sample, we exclude 5 NHs either because a considerable share of the output (patient-days) is produced in foyers[10] or because they show unreasonable values for some variables of interest and are therefore dropped.[11] Finally, we exclude the NHs selected for the pilot phase of global budget adoption, for three main reasons: first, the pilot phase was mainly intended to set down the rules of the new payment system and to understand its functioning. The new payment system was introduced stepwise and adjusted over time. Second, pilot NHs are few and are observed for a too short period (3 years) to be used as control group. Third, these NHs were not randomly selected.[12]

The final sample consists of an unbalanced panel of 41 NHs observed for 12 years (471 observations). The minimum number of observations per cluster is 7, while on average information are available over almost the whole period (11.5 years). In Table 2 we report some descriptive statistics of the characteristics of NHs, which include the mean, the standard deviation, and the first and third quartiles.

On average, NHs have 67 beds and provides services for 23450 resident days yearly, each of which costs about CHF 240. The nursing staff ratio is 0.96 indicating that, on average, the personnel employed by NHs is close to the amount

[10]Foyers are external residential apartments where the healthiest patients get nursing care. Therefore, the production process of these NHs might differ a lot as compared to the others.

[11]These are private for-profit institutions that have been placed under the cantonal authority and largely subsidized. This implied a change in the production process and hardly comparable data.

[12]In Table 7 (attached) we show that pilot NHs are relatively cheaper than non pilot NHs. Also, in Tabel 8 (attached) we show that also the cost evolution over time differs between the two groups: pilot NHs experience a more important cost increase before the pilot phase, while from the extended introduction of the new payment system their costs increase relatively less than non pilot NHs.

Variables	Description	Mean	Std. Dev.	1^{st} q.	3^{rd} q.
AC	Average cost per resident day	239.50	27.40	219.25	257.45
Y	Total resident days per year	23450	8523	17373	27664
Q_1	Average dependency index	3.10	0.35	2.87	3.36
Q_2	Nursing staff ratio	0.96	0.09	0.91	1.00
P_l	Average labor price per employee per year	81102	4963	77893	84522
P_k	Average capital price per bed	14419	3466	12084	16057
K	Number of beds	67	24	49	80

Notes: All monetary values are in 2005 Swiss francs (CHF) adjusted by the national Consumer Price Index.

Table 2: Descriptive statistics of costs, inputs and output characteristics over the whole period.

suggested by the cantonal authority. The average price of labor is about CHF 80000 per year, while the price of capital is CHF 14419 per bed.

A considerable variation is observed across NHs in almost all variables. The average cost per resident day of the first quartile is around CHF 220, and increases to almost CHF 260 in the third quartile. The size of NHs also varies remarkably: three quarter of NHs provide less than 80 beds, and the biggest NH has 145 beds (value not shown). This sizable variation can be read also in the number of resident days.

As with respect to input prices, we recognize that variation in average costs per employee is relatively small (around CHF 6500 per year), whereas average price of capital in the third quartile is 25% higher than in the first quartile. This heterogeneity in the price of capital is mainly due to differences in depreciation policies, donations and/or capital structure. In addition, NHs vary in output characteristics, i.e. the dependency index and the nursing staff ratio. Note, however, that 50% of NHs have a nursing staff ratio between 0.91 and 1. This is because the cantonal authority allows NHs to deviate from the value of reference by 10% only. Beyond this threshold, the RDPH intervenes to ask for an adjustment in the number of employees.

In Table 3 we provide some descriptive statistics for the variables of interest, calculated separately for the period before the change in the payment system (PRE) and the following period (POST). The fourth column specifies whether the variable mean has increased (+) or decreased (−). Finally, we report the results of a t-test on the probability of equal means across the two periods. Since cost savings can be achieved through a reduction in the number of staff, for the nursing staff ratio (Q_2) we test whether the mean value has decreased (one-sided t-test).

Variables	PRE (266 obs.)	POST (205 obs.)	Variation	H_0	p-value
AC	229.621	252.380	+	$\mu_{PRE} = \mu_{POST}$	0.000
Y	22804	24288	+	$\mu_{PRE} = \mu_{POST}$	0.061
Q_1	3.061	3.158	+	$\mu_{PRE} = \mu_{POST}$	0.003
Q_2	0.983	0.933	−	$\mu_{PRE} > \mu_{POST}$	0.000
P_l	79425	83278	+	$\mu_{PRE} = \mu_{POST}$	0.000
P_k	13338	15820	+	$\mu_{PRE} = \mu_{POST}$	0.000
K	65.278	68.941	+	$\mu_{PRE} = \mu_{POST}$	0.010

Notes: all monetary values are in 2005 Swiss francs (CHF) adjusted by the national Consumer Price Index.

Table 3: Comparison of means (pre and post reform) for the main variables of interest.

The pre-post analysis shows a statistically significant increase in average costs (AC), from about CHF 230 per resident day to more than CHF 250. However, since costs have generally increased, these figures do not allow any inference about the impact of the new payment system. The number of beds and the number of resident days remained pretty constant. As for output characteristics, the analysis shows that the dependency index has slightly increased while the nursing staff ratio decreased by 5% points. The increase in the dependency index may be due to the increasing demand of nursing home care over time and the shift of less severe residents to home care services. Also, it shows that, as expected, NHs did not respond to the change in the payment system by selecting healthier patients. Conversely, NHs may have responded to the change in the payment system by reducing the number of nurses per resident. The issue is discussed in more detail in section 5.3.

4.3 Identification strategy

At the bottom of any policy evaluation lays a missing data problem. In fact, an individual or a firm can always be observed only in one state: either in the program or not. The challenge of any evaluation analysis consists, therefore, in constructing an appropriate counterfactual. When the policy change occurs for only a few subjects under investigation or it is implemented gradually at different points in time, a battery of evaluation methods can be considered (Blundell and Dias, 2000; 2009; Nichols, 2007). Among the methods available for panel data, we find the difference-in-difference approach (DID), the matching estimator, the regression discontinuity designs (RD), selection models (also called control functions), structural models, the regression approach, and the counterfactual analysis. All these methods are motivated by the omitted-variable bias since correlation of policy identifying variables with other unobservable variables might lead to an incorrect assessment of the policy. As for panel data, the underlying idea is to use information on different points in time for the same individual as own group of control (individual effects). The standard DID approach, also called natural experiment approach, is typically used when a policy shift occurs for one group but not the other, creating a form of randomization in the treatment assignment. The policy impact is then measured by comparing the average outcome change (before and after the treatment) between the two groups, assuming a common time effect and removing unobservable individual effects. The matching estimator consists in pairing observations of any two individuals (treated and non-treated) according to some observable factors, so that the only relevant difference is participation in the program. The treatment group is basically reproduced among the untreated. If an appropriate excluded instrument can be found, a way to solve the endogeneity issue is to use the IV approach. However, IV estimators are justified only in large samples. The RD approach comes into play when the probability of being treated changes discontinuously with some continuous variable, which is an observable instrument. In this neighborhood, the treatment assignment can be interpreted as being random. The selection model developed by Heckman (1979) requires the existence of an excludable regressor affecting participation to the program but not the outcome. The correlation of the participation variable with the error term (or the unobservables) is directly taken into account in the estimation procedure. Finally, structural models assume that agents behave according to some maximization rule of an objective function under a defined constraint. The main advantage of this approach is that it simulates ex-ante the impact of a policy change and isolates this from changes in preferences.

As pointed out by Blundell and Dias (2009), the choice of the most appropriate evaluation method relies on the nature of the policy change, as well as the research question and data availability. In our study, the policy change concerns all NHs in the sample at the same time. For this reason we can just observe the treated group before and after the policy change. Therefore, to measure the impact of global budget payment we exploit the panel properties of the dataset. We propose two different approaches. The first approach (*Approach 1*) uses a panel data model that controls for unobserved heterogenity and includes a temporal dummy variable to capture the impact of the policy change. This strategy assumes that no other major event occured over the period considered which affected the production costs of NHs. We are confident that, in our case, this assumption is not too restrictive. First, because the NH sector is highly regulated and no other policy reforms have occurred during the same period. Second, the resulting homogenous production process makes it relatively easy to compare NHs and reduce the unobserved heterogeneity to negligible levels.[13] Consequently, time varying unobserved factors are not expected to have remarkable effects on the results. Finally, input prices and costs have been deflated with the CPI. Hence, reduction in costs due to the recent economic recession should not be counfounded with cost savings generated by the new payment system.

We capture the impact of PPS on costs with a dummy variable equal to 1 for the years $2006-2010$, the period where the PPS was in force, in addition to a general time trend capturing the impact of technical change on costs throughout the whole period. This is the approach adopted in many policy evaluation studies when the policy change affects all firms/individuals at the same time (e.g. Hatton, 2005; Nakahara et al., 2010; Narayana and Pengb, 2006; Rotte and Vogler, 1999).[14]

When adopting this identification strategy, particular attention needs to be devoted to the specification of the time trend. In fact, a mispecified time trend

[13] That unobserved heterogeneity is negligible is proved also by the similarity of the fixed effects and random effects estimates.

[14] Remind that the pilot group cannot be used to apply a DID approach for three main reasons. First, treatment was not randomly assigned. Second, the treated group (pilot NHs) includes only few observations. Finally, the pilot phase was used to set up the new payment system and some rules changed afterwards.

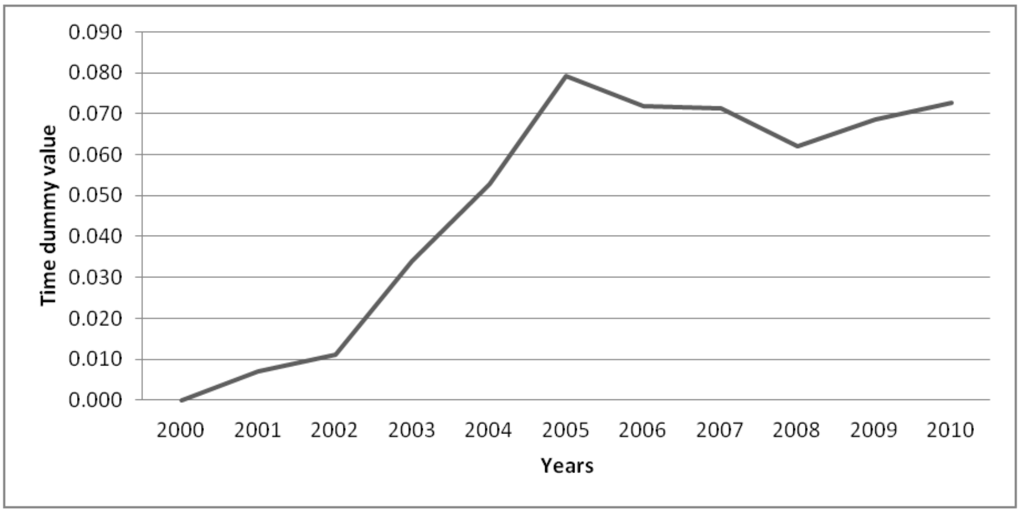

Figure 1: Estimated coefficients for time dummies as percentage of total costs.

may partially capture the impact of the policy change. Hence, to explore the pattern of nursing care costs over time, we estimate a cost model where we replace the time trend with time dummies and drop the policy change dummy. The base year is 1999. We observe that the estimated coefficients for time dummies are statistically significant, with the exception of year 2000. In Figure (1) we report the estimated coefficients for time dummies as percentage change of total costs. From 2001 to 2005 total costs increase linearly. Afterward, i.e. during the the introduction of PPS, total costs remain pretty constant. This pattern suggests modeling the time trend with a linear function. A different specification of the time trend shows that the inclusion of a squared term leads to overspecification and does not allow us to identify the impact of the policy change.

Assume the following general specification of the dummy variable in the total costs function in (8):

$$\ln\left(\frac{C_{it}}{P_{kit}}\right) = \delta_i + X_{it}^T\ \delta_T + \delta_d D + \delta_t t + \delta_{td} tD + v_{it}, \tag{9}$$

where X_{it}^T is the vector of explanatory variables, D is the dummy that assumes value equal to 1 in the period of policy implementation $(2006 - 2010)$, and 0 otherwise, and the error component ε has been splitted into an individual effect δ_i and a stochastic error term v_{it}.

The impact of the policy reform can now be measured in two ways, depending on how the dummy variable is allowed to enter the cost function. By imposing $\delta_{td} = 0$, we restrict the attention to policy changes that affect only the constant term of the total cost function. In this case, dummy variable shifts are interpreted as the average impact of PPS on costs during the whole period $2006 - 2010$. Alternatively, if we allow $\delta_{td} \neq 0$, the impact of PPS can change over time, and additional information can be provided on the rate of costs increase. We refer to these two time trend specifications as the *restricted fixed-effects model* and the *unrestricted model.*[15] These will be estimated and compared in the following section. Since the cost model is in log-log form, the estimated coefficient of the policy dummy variable is interpreted as percentage change in total costs for small values of the coefficients, and semi-elasticity for higher values.

By identifying the policy change with a time dummy, we implicitly assume that in the absence of reform, total costs in the period 2006-2010 would have increased at the same rate as in the period $1999-2005$. Since economic growth may have an impact on the evolution of prices, for example wages, and therefore costs. Indeed, the Consumers Price Index (CPI) decreased in the last years considered in the analysis. To control for changes in costs related to variations in the economic cycle, we then adjust cost and input prices for the CPI.[16]

The second approach (*Approach 2*) uses a panel model estimated over the years prior the policy change to predict the costs of each NH in the following years, hadn't they been treated. The counterfactual is built by making predictions. In a

[15] A battery of specification tests was also performed. First, we checked whether the reform affected other coefficients by building interaction terms of each explanatory variable with the policy dummy (D) and did not find significant evidence. An alternative approach would consist of estimating two different models, one before the reform and one after the reform, and compare the estimated coefficients. However, this strategy allows individual effects to differ between the two periods, which is not desirable. Finally, we used a stochastic frontier approach to estimate several models, such as the pooled frontier with Mundlak correction (Farsi at al., 2005) and the true random effect model. The impact of the reform was analyzed in two ways: first, we introduced the policy dummy into the deterministic part of the frontier, and second, we compared the calculated mean inefficiencies using the non parameteric Kruskal-Wallis test. All the model specifications and approaches used confirm the evidence that the new payment system reduced total costs.

[16] According to the cantonal law (RL 2.5.4.5), salaries and indemnities for public employees are adjusted using the national Consumer Price Index. Since labor costs represent the largest proportion of total costs (up to 85%), to deflate total costs and input prices seems an appropriate choice.

recent study Horowitz (2007) makes use of predictions in the context of an energy saving program in the U.S. to apply a DID approach and investigate changes occurred in the electricity demand. The counterfactual is required to make the two groups comparable and purge the control group from different proneness to react to the policy change. This can be done by inserting the covariate means of the treatment group into the estimated model of the untreated. We then estimate the cost function for the period prior the introduction of PPS ($t < 2006$) and use the coefficients ($\hat{\delta}_i$, $\hat{\delta}_T$ and $\hat{\delta}_t$) to predict costs of each NH i in each year t (nonlinear predictions) as follows:

$$\ln\left(\frac{\widehat{C}_{it}}{P_{kit}}\right) = \hat{\delta}_i + X_{it}^T\hat{\delta}_T + \hat{\delta}_t t \qquad \text{for } t \geq 2006. \tag{10}$$

The impact of the reform is computed as the difference between mean observed costs and mean predicted costs ($\overline{C}_{it} - \overline{\widehat{C}}_{it}$) in each year separately. The results of this approach are directly comparable with those of the *unrestricted model* of the first approach (*Approach 1*).

5 Econometric estimation and results

5.1 Estimation approach

In order to choose the most adequate panel data model, we perform a series of tests on our NHs dataset. Since the likelihood ratio test rejects the null hypothesis of homoskedasticity ($\chi^2(40) = 175.68$, p-value $= 0.000$), heteroskedasticity-robust tests and estimation methods are considered. We examine the fixed-effect model (FE), the random effect model (RE), and the first difference model (FD) discussed in Nichols (2007) to create the counterfactual using observations on the same unit over time. These methods remove the bias due to unobserved characteristics that remain constant over time by adding individual-specific effects. Nevertheless, it is still necessary to control for the panel structure of the dataset, namely for errors correlated within groups (Cameron and Miller, 2010). If part of the bias is due to unobservable time-varying factors, our results may still be biased.

The difference between the FE estimator and the FD estimator consists mainly in the underlying assumption about the speed at which the policy reform affects the outcome. The FE estimates compare the mean outcome before the policy reform with the mean outcome in the period after the reform. Instead, the FD model assumes that the reform has a one-shot effect at the moment of its introduction. Therefore, the impact is fully captured by a jump in outcome in the year 2006. We rule out the FD model for two reasons. First, from a policy point of view the relevant question is what are the implications of the new payment system in the medium term. Second, the introduction of PPS involves a series of changes that need time to be understood, implemented and optimized.

Both the FE and the RE models include individual-specific effects that allow to control for any constant unobserved heterogeneity, but they differ in the way they consider these effects. The FE model treats the individual-effects as fixed parameters and allows them to be partially correlated with regressors, accommodating a limited form of endogeneity (Cameron and Trivedi, 2010). In a policy evaluation study this property is of particular relevance. The sufficient condition for consistency of the FE model is $E[X_{it}^T(\varepsilon_{it} - \overline{\varepsilon}_i)] = 0$, i.e. the policy variable is allowed to be correlated with the persistent component of the error term, the unobserved heterogeity , but not with deviations from the mean, $(\varepsilon_{it} - \overline{\varepsilon}_i)$ (Wooldridge, 2002). Three main requirements need to be satisfied when a FE model is applied. First, to avoid the so called incidental parameters problem, the panel has to be long enough relative to the number of firms. Second, the main variable of interest has to vary over time since the FE precludes the estimation of time-invariant regressors. Third, the percentage within variation of the variables of interest as with respect to the overall variation should be large enough to avoid unprecise estimates (Cameron and Trivedi, 2005). Instead, the RE model instead assumes that the unobservable individual effects are random variables distributed independently of the regressors, that is: $\delta_i \sim (\delta, \sigma_{\delta^2})$ and $v_{it} \sim (0, \sigma_{v^2})$, and the coefficients are estimated with the Generalized Least Square (GLS) method. Therefore, no correlation between the individual effects and the error term is permitted. The main disadvantage of the RE model is that the estimates are affected by the heterogeneity bias when the exogeneity assumption is not satisfied, and are, therefore, inconsistent.

To choose between the FE and the RE models we perform the robust version of the Hausman test using the artificial regression approach originally described in Arellano (1993).[17] This approach consists in re-estimating the RE model augmented with the original regressors transformed into deviations from the mean. In this way we test the orthogonality condition of regressors uncorrelated with the group specific effects. The null hypothesis is rejected at the 99% level ($F(14, 484) = 8.27$, p-value = 0.000). Also, the analysis of the within variation of each variable of the cost function presented in Table 4 shows that the percentage within variation over total variation is satisfactory for all variables of interest.

Variables	% within variation	Variables	% within variation
lnC	0.328	$lnY\ lnQ_1$	0.769
lnY	0.309	$lnY\ lnQ_2$	0.856
lnQ_1	0.650	$lnY\ lnP_l$	0.563
lnQ_2	0.869	$lnQ_1\ lnP_l$	0.861
lnP_l	0.595	$lnQ_1\ lnQ_2$	0.917
$(lnY)^2$	0.376	$lnQ_2\ lnP_l$	0.904
$(lnQ_1)^2$	0.900	t	0.986
$(lnQ_2)^2$	0.893	D	0.992
$(lnP_l)^2$	0.678		

Table 4: Within variation over the overall variation for the covatiates of the total costs function.

From literature on forecasting with panel data we know that the GLS estimator is the best linear unbiased predictor. However, as Baltagi (2008) shows, the FE predictor performs well and its accuracy is close to the GLS predictor in samples of comparative size to our dataset. Therefore, we choose the FE predictor also for our second approach , i.e. the counterfactual analysis. Confidence intervals for the mean difference are calculated to take into account the statistical properties of the coefficients. To avoid the retransformation problem (Ai and Norton, 2000; Manning, 1998), we predict the log of costs. Nonlinear predictions are allowed.

Standard errors are corrected using the cluster robust estimator in both approaches. When dealing with panel data, the assumption of independently and identically distributed errors (iid) is mostly violated due to three main reasons: heteroskedasticity, within-cluster correlation and serial correlation. Modern soft-

[17] The standard Hausman test assumes that the RE model is efficient. A comparison of the clustered and non clustered standard errors show that this assumption in violated in our case. When this is the case, the robust Hausman test should be used.

ware packages allow to correct for all these issues by calculating the so called HAC (heteroskedasticity and autocorrelation consistent) and cluster-robust standard errors. However, Stock and Watson (2006) show that the cluster-robust estimator is preferred in FE models if serial correlation is expected, and it is reasonable to rely on asymptotic theory. In our sample, the number of clusters is satisfactory to rely on asymptotic theory for accurate inference (Kezdi, 2004). Also, each cluster contains a sufficient number of observations.[18]

5.2 Results

Through our regression analysis we are able to control for factors explaining variation in costs over time not related to changes in the payment system. As a consequence, we disentagle the general increase in costs from the impact of policy change. In Table 5 we present the estimated coefficients of the *restricted* and *unrestricted* FE models specified in the previous equation (9). The number of observations (N) and the model fit statistic $R^2 - within$ are also provided. The models explain about 92% of the variation in the data.

Since the first-order coefficients are very similar in both specifications (*restricted* and *unrestricted* model), we focus the discussion on the *restricted* FE model. The output coefficient (δ_Y) measures the total costs elasticity with respect to output. A value lower than 1 suggests the presence of unexploited economies of scale in the NH sector. In our case it indicates that an increase by 10% in the number of resident-days would increase total costs by about 8.75%.

The parameter estimates of output characteristics (δ_{Q_1} and δ_{Q_2}) show a positive and highly-significant value meaning that total costs increase with patients severity and our quality indicator for the service provided, i.e. the nursing staff ratio. These coefficients can also be interpreted as cost elasticities. The case-mix coefficient (δ_{Q_1}) indicates that a 10% increase in patients severity increases costs by almost 3%. More important, a 10% increase in the nursing staff ratio (δ_{Q_2}) leads to a total costs increase of 4%. The input prices coefficient (δ_{P_l}) is positive and significant, meaning that the costs function is monotonically increasing in

[18]Kezdi (2004) states that a sample of 50 clusters is close enough to infinity for accurate inference if the number of observations for cluster is not too small. A cluster is considered small if it contains less than five observations per cluster (Rogers, 1994).

Estimated coefficients	Restricted FE	Std. Err.	Flexible FE	Std. Err.
δ_Y	0.875***	0.052	0.863***	0.051
δ_{Q_1}	0.285***	0.060	0.281***	0.059
δ_{Q_2}	0.409***	0.049	0.471***	0.050
δ_{P_l}	0.779***	0.026	0.795***	0.026
δ_{YY}	0.122	0.218	0.084	0.210
$\delta_{Q_1Q_1}$	0.540**	0.210	0.540***	0.198
$\delta_{Q_2Q_2}$	0.204	0.440	0.115	0.422
$\delta_{P_lP_l}$	0.201**	0.095	0.211**	0.086
δ_{YQ_1}	-0.030	0.206	0.009	0.196
δ_{YQ_2}	0.534***	0.140	0.556***	0.139
δ_{YP_l}	0.055	0.077	0.062	0.078
$\delta_{Q_1P_l}$	0.418*	0.243	0.372	0.223
$\delta_{Q_1Q_2}$	-0.172	0.349	-0.077	0.323
$\delta_{P_lQ_2}$	-0.219	0.202	-0.249	0.204
δ_t	0.010***	0.002	0.015***	0.002
δ_d	-0.020***	0.007	0.076***	0.023
δ_{td}	-	-	-0.012***	0.003
δ_0	15.483***	0.017	15.385	0.017
N	471		471	
R^2	0.915		0.920	

Notes: Significance levels: * = 10%, ** = 5%, *** = 1%.

Table 5: Results of the restricted and unrestricted fixed effect models.

the vector of input prices. This coefficient provides information on the percentage of labor costs over total costs of a representative NH. The estimated share of labor costs is around 80%, which is very close to the actual sample mean (83%). Consequently, capital costs represent is around 20% of total costs.

The estimated parameter (δ_t) is highly significant and indicates that, on average, total costs increase by 1% each year (1.5% in the unrestricted model). Increasing costs can be explained by increasing wages not associated to augmented productivity (Baumol, 1967), the adoption of more costly technologies or new procedures implemented in the whole sector due for example to new regulatory settings. This result confirms the intuition on average costs emerged from the descriptive analysis presented in Table 3. The second-order coefficients show the percentage variation in first-order coefficients in response to a percentage variation in the regressors. We observe that the second-order coefficient of output (δ_{YY}) is not statistcally significant, meaning that there is no evidence of decreasing economies of scale. Total costs grow at increasing rates with patients severity ($\delta_{Q_1Q_1}$) and labor price ($\delta_{P_lP_l}$).

Our main coefficients of interest are those related to the impact of the reform. In the *restricted FE model*, the impact of the policy change is captured by the dummy variable coefficient (δ_d), which measures the average impact of PPS over the whole period considered. As discussed above, costs increased by roughly 1% yearly from 1999. However, the negative and highly significant coefficient of the policy dummy suggests that the reform reduced mean total costs by 2% from its introduction in 2006. Concerning the *unrestricted FE model*, the impact of the policy reform is allowed to vary in each year and is given by the combination of changes in the intercept and slope coefficients of the time trend (δ_d and δ_{td}). The intercept of the time trend increases by 7.6%. However, the slope coefficient decreases by 1.2%. The effect of the reform on costs in different years is given by $\Delta TC = 0.076 - 0.012(t - 1998)$, where $t \geq 2006$. The effect is -0.02 in 2006, -0.032 in 2007, -0.044 in 2008, -0.056 in 2009 and -0.068 in 2010. Hence, in five years the new payment system led to a reduction in costs of roughly 6.8%.

Regarding the results of the counterfactual analysis, we report the annual impact of the reform on costs in Table 6 together with the 95% confidence intervals. The values shown are comparable to the joint estimation of coefficients δ_d and δ_{td} of the FE model and are indeed very similar.[19] Although the coefficients of the first two years are not statistically signicant, a clear pattern arises in the following years: -6.2% in 2008, -6.5% in 2009 and -7.8% in 2010. Figure 2 illustrates these results. On the y-axis we report the observed and the predicted logs of costs. Note that before 2006 observed and predicted costs are very similar, suggesting that the specified cost model is adequate. From 2006 the two cost curves diverge.

It is worth noticing that we estimated the impact of the policy change after controlling for quality, measured by the nursing staff ratio (Q_2). As shown in the descriptive statistics, the nursing staff ratio has slighly decreased after the reform. However, the relationship between the nursing staff ratio and quality may not be straightforward. Although the relative number of nurses has decreased, it might be that their productivity has increased to preserve the quality of services provided

[19] By imposing linear predictions, the estimated value of the policy dummy is -0.322, which is higher than the result obtained with the *restricted* FE model. Nonlinear predictions allow us to model the impact of PPS in a more flexible way.

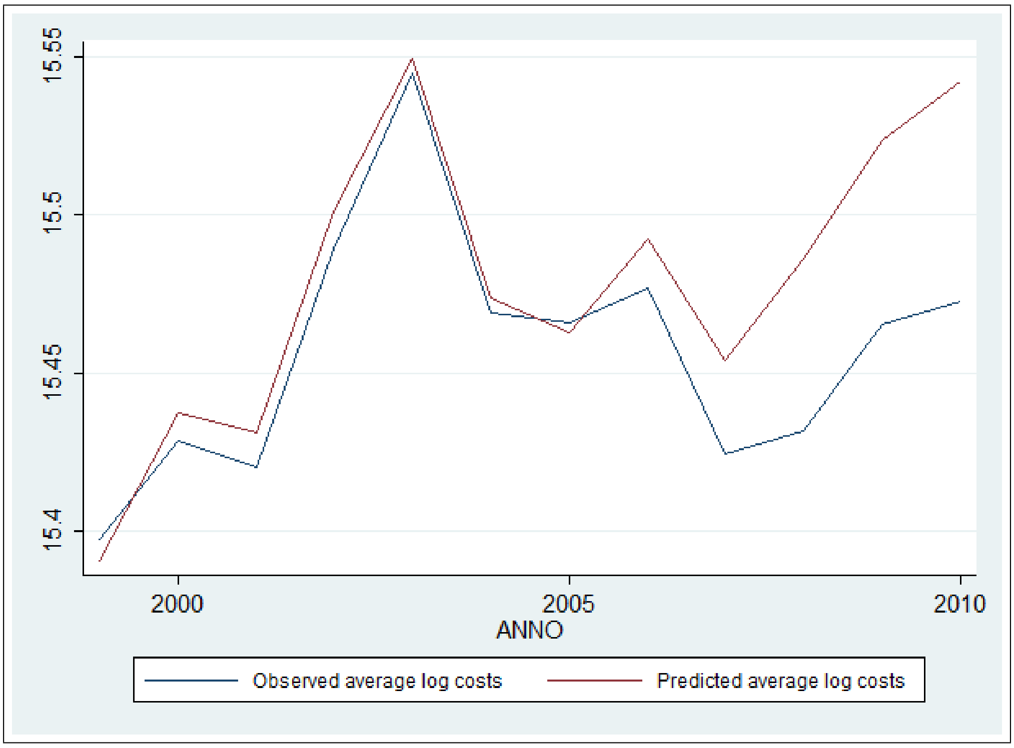

Figure 2: Observed log total costs versus predicted log total costs.

Year	Costs variation (mean)	CI (95%) min	CI (95%) max
2006	-0.020	0.034	-0.077
2007	-0.035	0.023	-0.093
2008	-0.062	-0.006	-0.118
2009	-0.065	-0.007	-0.123
2010	-0.078	-0.016	-0.140

Table 6: Counterfactual analysis and confidence intervals.

to the residents. Improved managerial/organizational practices induced by the reform and hardly measurable, for instance, may have offset the small reduction in the nursing staff ratio. We remind the reader that the nursing staff ratio is periodically controlled by the cantonal authority who forbids NHs falling below a given threshold. Therefore, small reductions in Q_2 can be interpreted as a positive, cost-reducing effect of PPS.[20] This may also explain why our endogeneity test fails to reject the exogeneity hypothesis.

6 Conclusions

Because of increasing healthcare costs and continuous pressure on public expenditures to provide healthcare and residential services to the elderly population, prospective payment systems may represent a promising way to enhance efficiency in nursing home care. Few empirical studies investigated the effects of PPS in nursing home care, mostly relying on U.S. data.

In 2006, the Italian speaking canton of Switzerland (Ticino) introduced global budgets to finance NHs. Through this paper we provided new evidence on the impact of PPS in the form of global budgets on the performance of NHs.

Among important differences as with respect to the nursing home sector in the U.S., our context is characterized by nursing home services mainly provided by nonprofit firms as local monopolies. We investigated the impact of PPS on the costs of providing NH care using a panel data set of 41 nursing homes observed

[20] We perform some sensitivity analysis. For example, we include a dummy variable for the organizational form. Although the coefficient is statistically signifcant, it does not affect the estimates of the policy dummy. We also perform the analysis without controlling for the level of nursing staff ratio. The estimated coefficient of the dumy variable is larger, as expected. We decide to include Q_2 in the cost function to provide more conservative estimates of the impact of PPS.

for a 12-years period from 1999 to 2010. The impact of the policy change was captured by s time dummy included in panel data models. A counterfactual approach was also considered to predict costs in the absence of a policy change. In this case, the policy impact was calculated as difference between predicted and observed costs.

Our analysis shows that the new payment system had a mild impact on costs after controlling for quality aspects using the nursing staff ratio. The new payment system reduced costs by about 7% after five years of policy implementation. This relatively mild effect can be interpreted based on the theoretical predictions. First, we know that PPS changed incentives only for the overfinanced NHs. Second, these incentives are reduced by the fact that NHs are allowed to use only part of the savings in an autonomous way (25%). And finally, the model predicts that if NHs attach a high weight to "human costs" of reorganizing the working conditions of their employees to reduce costs, then NHs may be better off by not reducing costs. Coversely, we believe that additional resources make NHs better off, as these allow them to carry out new projects.

Concluding, we found evidence of a cost reducing effect of PPS in the nonprofit nursing home sector in canton Ticino, Switzerland. This result is in line with the theoretical prdictions of our simple behavioral model. Eventhough we are aware that we cannot fully control for unobserved factors that may have affected the cost dynamics of NHs during the period observed, we are confident that in the present context the assumptions made to identify the impact of PPS are not only tenable but also very realistic.

References

AI, C. and NORTON, E.C. (2000). Standard errors for the retransformation problem with heteroscedasticity. Journal of Health Economics, 19(5), 697-718.

ARELLANO M. (1993). On the Testing of Correlated Effects with Panel Data. Journal of Econometrics, 59, 87-97.

BALTAGI, B. H. (2008). Forecasting with Panel Data. Journal of Forecasting, 27, 153-173.

BIORN, E., HAGEN, T.P., IVERSEN, T. and MAGNUSSEN, J. (2006). Heterogeneity in Hospitals' Responses to a Financial Reform: A Random Coefficient Analysis of The Impact of Activity-Based Financing on Efficiency. RA Paper 8100, University Library of Munich, Germany, 1-34.

BIRNBAUM, H., BISHOP, C., LEE, A. and JENSEN, G. (1981). Why Do Nursing Home Costs Vary? The Determinants of Nursing Home Costs. Medical Care, 19(11), 1095-1107.

BLUNDELL, R. and DIAS, M.C. (2000). Evaluation Methods for Non-Experimental Data. Fiscal Studies, 21(4), 427-468.

BLUNDELL, R. and DIAS, M.C. (2009). Alternative Approaches to Evaluation in Empirical Microeconomics. The Journal of Human Resources, 44(3), 565-640.

CAMERON, A. C. and MILLER, D. L. (2010). Robust Inference with Clustered Data. In: A. Ullah and D. E. Giles (eds.), Handbook of Empirical Economics and Finance, CRC Press, 1-28.

CAMERON, A. C. and TRIVEDI, P. K. (2005). Microeconometrics. Methods and Applications. Cambridge University Press: New York.

CAMERON, A. C. and TRIVEDI, P. K. (2010). Microeconometrics Using Stata. Revised Edition. Texas: Stata Press. Chambers, R. G. (1988). Applied Production Analysis. Cambridge: Cambridge University Press.

CHALKLEY, M. and MALCOMSON, J.M. (1998). Contracting for health services when patient demand does not reflect quality. Journal of Health Economics, 17, 1-19.

CHEN, L.W. and SHEA, D.G. (2002). Does prospective Payment Really Contain Nursing Home Costs? Health Services Research, 37(2), 251-271.

COBURN, A.C., FORTINSKY, R., McGUIRE, C. and McDONALD, T.P. (1993). Effect of Prospective Reimbursement on Nursing Home Costs. Health Service Research, 28(1), 45-68.

DI GIORGIO, L., FILIPPINI, M. and MASIERO, G. (2012). The impact of the institutional form on the cost efficiency of nursing homes . Quaderno N. 12-03, Facoltà di Scienze Economiche, Università della Svizzera italiana.

DISMUKE, C.E., and SENA V. (1999). Has DRG payment influenced the technical efficiency and productivity of diagnostic technologies in Portuguese public hospitals? An empirical analysis using parametric and non-parametric methods. Health Care Management Science, 2(2), 107-16.

DORMONT, B. and MARTIN, C. (2012). Quality of service and cost-efficiency of French nursing homes. 9th European Conference on Health Economics (ECHE), Zurich, July 18-21, 2012.

EUROSTAT: EUROSTAT STATISTICS (2011). http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Population_structure_and_ageing, Accessed June 2012.

EUROPEAN UNION (2011). http://europa.eu/rapid/pressReleasesAction.do?reference=STAT/11/80&type=HTML, Accessed June 2012.

EVANS, R.G. (1971). "Behavioural" Cost Functions for Hospitals, The Canadian Journal of Economics, 4(2), 198-215.

FARSI, M. and FILIPPINI, M. (2004). An empirical analysis of cost efficiency in nonprofit and public nursing homes. Annals of Public and Cooperative Economics, 75(3), 339-365.

FARSI, M., FILIPPINI, M. and M. KUENZLE. (2005). Unobserved Heterogeneity in Stochastic Cost Frontier Models: An Application to Swiss Nursing Homes. Applied Economics, 37, 2127-2141.

FORDER, J. and ALLAN, S. (2012). Competition in the English nursing homes market. PSSRU Discussion Paper 2820, 1-29.

GERTLER, P.J. and WALDMAN, D.M. (1992). Quality-adjusted Cost Functions and Policy Evaluation in the Nursing Home Industry. Journal of Political Economy, 100(6), 1232-1256.

GRABOWSKI, D.C. and TOWN, R.J. (2011). Does Information Matter? Competition, Quality, and the Impact of Nursing Home Report Cards. Health Services Research, 46, 1698-1719.

HATTON, T.J. (2005). Explaining trends in UK immigration. Journal of Population Economics, 18(4), 719-740.

HOROWITZ, M.J. (2007). Changes in Electricity Demand in the United States from the 1970s to 2003. The Energy Journal, 28(3), 93-120.

JEGERS, M., KESTELOOT, K., DE GRAEVE, D. and GILLES, W. (2002). A typology for provider payment systems in health care. Health Policy 60(3), 255–273.

JOHNSON-PAWLSON, J. and INFELD, D.L. (1996). Nurse staffing and quality of care in nursing facilities. J Gerontol Nurs, 22(8), 36-45.

KARLSSON, M., ROBERT PLUMB, L.M. and RICKAYZEN, B. (2006). Future costs for long-term care. Cost projections for long-term care for older people in the United Kingdom. Health Policy, 75(2), 187–213.

KÉZDI, G. (2004). Robust Standard Errors Estimation in Fixed-Effects Panel Models. Hungarian Statistical Review Special, 9, 96-116.

KONETZKA, R.T., NORTON, E.C., SLOANE, P.D., KILPATRICK, K.E. and STEARNS, S.C. (2006). Medicare Prospective Payment and Quality of Care for Long-Stay Nursing Facility Residents. Medical Care, 44(3), 270-276.

KONETZKA, R.T, Yi, D., NORTON, E.C. and KERRY, E.K. (2004). Effects of Medicare Payment Changes on Nursing Home Staffing and Deficiencies. Health Services Research, 39(9), 463-487.

LINNA M. (2000). Health care financing reform and the productivity change in Finnish hospitals. J Health Care Finance, 26(3), 83-100.

MANNING, W. (1998). The logged dependent variable, heteroscedasticity, and the retransformation problem. Journal of Health Economics, 17 (3), 283-295.

NAKAHARA, S., POUDELA, K.C., LOPCHANB, M., POUDELC, O.R., POUDEL-TANDUKARA, K. and ICHIKAWAA, M. (2010). Differential effects of out-of-home day care in improving child nutrition and augmenting maternal income among those with and without childcare support: A prospective before–after comparison study in Pokhara, Nepal. Health Policy, 97(1), 16–25.

NARAYANA, P.K. and PENGB, X. (2006). An Econometric Analysis of the Determinants of Fertility for China, 1952–2000. Journal of Chinese Economic and Business Studies, 4(2), 165-183.

NICHOLS, A. (2007). Causal inference with observational data. The Stata Journal, 7(4), 507-541.

NORTON, E.C. (1992). Incentive regulation of nursing homes. Journal of Health Eco-

nomics, 11, 105-128.
OHSFELDT, R.L., ANTEL, J.J. and BUCHNAN, R.J. (1991). The Effect of Prospective Payment on Medicaid Payment Rates for Nursing Home Care. Southern Economic Journal, 58(1), 54-64.
ROGERS, W.H. (1994). Regression standard errors in clustered samples. Stata Technical Bullettin, 13, 19-23.
ROTTE, R. and VOGLER, M. (1999). The Effects of Development on Migration: Theoretical Issues and New Empirical Evidence, IZA Discussion Papers 46, Institute for the Study of Labor (IZA).
SCHNELLE, J. F., SIMMONS, S. F., HARRINGTON, C., CADOGAN, M., GARCIA, E. and BATES-JENSEN, B. (2004). Relationship of Nursing Home Staffing to Quality of Care. Health Services Research, 39, 225–250.
SEXTON, T.R., LEIKEN, A.M., SLEEPER, S. and COBURN, A.F. (1989). The impact of Prospective Reimbursement on Nursing Home Efficiency. Medical Care, 27(2), 154-163.

Appendix

Average costs per resident-day in pilot NHs are significantly lower than in non-pilot NHs in the period before the full implementation of the reform (Table 7). In Table 8 we report the average costs of NHs in three different periods: the period prior the pilot phase $(1999-2002)$, the pilot phase $(2003-2005)$, and the period of full policy implementation $(2006-2010)$. Average costs have increased in both groups between the first and the second period by about CHF 30 (15.5%) for pilot NHs, and CHF 20 (8.8%) for non-pilot NHs. Average costs have also increased between the second and the third period at lower rates. Since pilot NHs experienced a more remarkable increase in costs between the first period and the second period, the subsequent increase of only CHF 5 (2.3%) suggests that they reacted more strongly to the new payment system than non-pilot NHs (5.1%).

Group	Mean costs (1999-2005)	Std. dev.	t-statistic on mean difference
Pilot (N=28)	208.50	26.20	5.258
Non pilot (N=266)	229.60	26.71	

Notes: All monetary values are in 2005 Swiss francs, adjusted by the national Consumer Price Index.

Table 7: Average costs comparison between pilot and non-pilot NHs for the whole period.

	1999-2002 (1)	Δ (2)-(1)	2003-2005 (2)	Δ (3)-(2)	2006-2010 (3)
Pilot NHs	195.579	30.20	225.700	5.30	230.957
	(N=16)	15.5%	(N=12)	2.3%	(N=20)
Non pilot NHs	220.8078	19.40	240.182	12.20	252.380
	(N=145)	8.8%	(N=121)	5.1%	(N=205)

Notes: All monetary values are in 2005 Swiss francs, adjusted by the national Consumer Price Index.

Table 8: Average costs comparison between pilot and non-pilot NHs in different periods.