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ABSTRACT

Discountinuous System of Allowances: The Response of Prosocial Health-Care Professionals*

This paper examines the unintended strategic effects of non-linear incentives in public policies. A system of health care subsidies structured in discrete intervals may lead to strategic behaviour. We provide new evidence on this issue, focusing on a case where the strategic actions are taken by healthcare providers (HCPs). We show that HCPs adjust the score of claimants in long-term care needs assessments, giving them the opportunity to access higher levels of care benefits. This adjustment does not bring any pecuniary gain for HCPs. By using a quasi-natural experimental setting –the implementation of Spanish long-term care (LTC)– we show that the distribution of the claimants' needs includes kinks around the thresholds set for the LTC system. These kinks reveal that healthcare providers adopt prosocial behaviour, helping claimants jump to a higher level of benefits without discriminating by health status, residence, or gender. By developing a new non-parametric estimator, we prove that these adjustments lead to a welfare loss. The additional cost per adjusted claimant per annum is approximately 1000 euro on average. We finally propose an alternative continuous system to allocate LTC benefits that could mitigate the prosocial behaviour of healthcare providers.

JEL Classification: D63, D82, D61, H510, I380

Keywords: long-term care, non-linear incentives, needs assessment, prosocial behaviour

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1 Introduction

Prosocial theory, altruism, intrinsic motivation, and other phenomena, have been used to demonstrate that there are non-pecuniary aspects of work, jobs, and processes within organizations that can affect worker behaviour. Economists have emphasised that individuals often care for the well-being of others (Becker (1974); Samuelson (1993)). It has been widely documented that employees in some settings, such as education, social services, healthcare, etc. are more inclined to respond to non-market incentives.[1] In the healthcare sector the utility function of physicians is usually modelled not only on their salary, but also on patients' health status and/or patient utility (Ellis et al. (1986); Evans (1984); Feldstein (1970); Siciliani and Verzulli (2009)). Additionally, other factors may affect physicians' utility, such as intellectual stimulation, reputation and/or the intrinsic motivation from doing a good job (Fehr and Camerer (2007); Fehr and Falk (1969); Frey and Oberholzer-Gee (1997); Frey and Jegen (2001), Charness and Haruvy (1999)). In this paper, we provide empirical evidence of how prosocial motivation affects healthcare providers' (physicians and social workers, henceforth HCPs) behaviour in classifying the elderly into different severity grades of Long-Term Care (LTC), which are used to give access to care benefits. LTC is required by individuals who have lost the ability to independently perform activities of daily living (ADL).[2] In 2007 the Spanish government implemented a universal LTC system, which classifies benefits claimants into six grades (with appropriate thresholds) based on the loss of autonomy suffered. All grades entitle individuals to some subsidized care, via vouchers or in-kind care services, with more care provided to those at a higher grade. An official scale was designed to determine LTC needs. The scale ranges from 0 to 100, with patients rated 100 those with the maximum level of LTC needs. The score varys in a continuous way between 0 and 100, but benefits have been defined for just six grades. Consequently, the distribution of LTC needs, measured using the official scale, tends to kink around the scores that determine a higher level of benefits, see Figure 1. We claim that these notches represent strategic behaviour of HCPs. HCPs appear to adjust the scores of claimants when the assessed level of needs (score) is just below a threshold (25, 40, 50, 65, 75 and 80), allowing claimants to access care benefits in the next grade up.

Given this hypothesis, this paper has two objectives: first, we document that HCPs behave strategically under a non-linear classification system and, second, we estimate the economic con-

[1] Le Grand (2003) and Perry et al. (2010) survey the empirical literature on workers' motivation in public sector. See Francois and Vlassopoulos (2008) for a review of theoretical research on the motivation of public workers.

[2] Activities of daily living (ADL) include basic activities, such as bathing, and instrumental activities, such as cooking.

sequences of this behaviour in terms of LTC financial cost in Catalonia, the North-East region of Spain, using a novel administrative dataset from social services authorities (ICASS).

We show that prosocial motivation causes HCPs to help claimants become eligible for higher level of benefits, increasing their comfort and well-being. We report robust evidence to prove that the distribution of the observed scores is produced by the prosocial motivation of the HCPs. We first analyse the characteristics of the claimants around each cut-off, finding no significant differences in the observables between individuals with scores above and below the thresholds. We also provide evidence that the adjusting behaviour occurs in other Spanish regions, [3] and finally, we demonstrate that there are no significant differences across the assessments of local teams of HCPs. Three additional factors of the assessment process need to be stressed to support the prosocial hypothesis. First, claimants do not have any prior relationship with the examiners, as they meet only once to undertake the assessment. This feature eliminates other factors that could be responsible for the HCPs adjustment, such as competition with other doctors, and/or reputational/satisfaction issues amongst patients. Second, the obtained score is not disclosed by the HCP to claimants during the assessment. The score is reported to the central agency, who tell the claimants only the grade assigned. This reduces the possibility of bribery, reputational or coercion motives (for more discussion on this see Andreoni (1990)). Third, when a policy reform eliminated intermediate grades in 2012(reducing the number of categories of benefits from six to three), we observe that the adjusting behaviour around the pre-reform cut-off points disappeared, but grew stronger around the remaining cut-offs. Furthermore, we conclude that neither altruism nor personal satisfaction can cause the strategic behaviour observed.

We first model the HCP's adjusting decision under a discontinuous scheme of benefits. The strategic actions of HCPs around the local cut-offs is equivalent to a left shift of the threshold, with an increase in social expenditure for the government. Second, to measure the public financial cost, we develop a new non-parametric econometric model to estimate the counterfactual distribution of LTC needs (i.e. the shape of the distribution in the absence of adjustments) using data of Spanish LTC claimants between 2007 and 2010. This method allows us to recover the real distribution.[4] Finally, we predict the HCP' s adjusting decision under a continuous system of subsidies, as the literature relating to taxation suggests that this framework minimises strategic behaviour (Hotz (2003)). Under a continuous scheme of public benefits, a pro-social HCP could still have incentives

[3] Using data from the Basque Country we find that the distribution of scores follows the same pattern with kinks.

[4] It is not possible to use kink regression models in this case as the decision to be above or below to the cut-off is not causal.

to adjust the score, but with a simple calculation, we show that a continuous scheme of benefits would allocate public resources in a more egalitarian way across claimants, increasing total social welfare. This system could be improved further by introducing a fixed budget for LTC payments, which would internalise the financial consequences of adjustment behaviour of HCPs.

This paper contributes to the literature on prosocial motivation. Although theoretical models in health economics have identified this factor for decades, empirical economic works attempting to measure it are in their infancy. Laboratory experiments have been used to identify prosocial motivation (seeLevitt and List (2007) for an overview), but real-world experiments have been less well utilised. Only one paper has measured the degree of altruism amongst medical students, namely Godager and Wiesen (2013). They examine the marginal rate of substitution between profit and patient health benefits for 42 medical students. Altruism was found to be important and the majority of students placed more weight on altruism than profit. Other studies have examined heterogeneity in the monetary motivation of physicians in an indirect way by using proxy variables in surveys (see Rizzo and Zeckhauser (2003); Rizzo and Zeckhauser (2007); Iversen and Lurås (2000), among others). Our paper is built on this idea and explores how prosocial motivation interacts with the design of social policies. So far, studies of the unintended consequences of social policies have focused on taxation, where the benefits are obtained by the agent who is behaving strategically. However, we identify a situation where the agent making the strategic decision is not the party who gains directly from it.[5] This leads to a second contribution we make to the literature, on the unintended consequences of public policies. The paper also contributes to the methodological literature on the counterfactual estimation in the presence of notches, using non-parametric methods where the kink regression method is inappropriate given that the assessment behaviour is not randomly distributed near the cut-offs.

The remainder of this paper is organised as follows. Section 2 describes the Spanish LTC system. Section 3 analyses the prosocial behaviour of health-care professionals. In Section 4 we quantify the unintended consequences of this prosocial behaviour. A smoother scheme of benefits is proposed and discussed in Section 5 before Section 6 concludes.

[5] Aside from taxation and social policies, strategic behaviour has also been studied in public reimbursement systems, for example in the upgrade of patient DRG or 30-day mortality quality measures that are used to determine the budgets of publicly funded hospitals ADD REF.

2 Long-Term Care system in Spain

In 2006, the Spanish Government approved the *Act to Promote Personal Autonomy and Care* establishing a universal system of Long-Term Care subsidies.[6] LTC is defined as the permanent assistance required to perform activities of daily living (ADL) required by persons who suffer from a reduction of functional capability.[7] Despite the universality of the coverage, the system allocates resources on a needs basis, categorising claimants into six different grades of LTC (as Figure A.1, in the Appendix, details). Grades are increasing in the intensity of care (i.e. the number of hours or the value of subsidy), according to the severity of autonomy lost. There is a broad set of subsidised care offered, including from institutions such as nursing homes and day care centres, professional home care, tele-assistance and subsidies for informal caregivers. Figure 2 summarises the average monthly subsidy provided in each grade (Table A.1, in the Appendix, provides the exact numbers for the different care options). The severity of needs is calculated by HCPs using a scale with 47 determinants which accounts for the loss of functional capabilities, and the frequency and type of assistance required as a result.[8] The outcome of this needs assessment gives a score, which is mapped into a grade as follows:

- from 0 to 24 not eligible for public LTC benefits
- from 25 to 39, Grade I-I, giving access to the first menu of benefits
- from 40 to 49 , Grade I-II, giving access to the second menu of benefits
- from 50 to 64, Grade II-I, giving access to the third menu of benefits
- from 65 to 74, Grade II-II, giving access to the fourth menu of benefits
- from 75 to 89, Grade III-I, giving access to the fifth menu of benefits
- from 90 to 100, Grade III-II, giving access to the sixth menu of benefits.

HCPs are not directly employed by the social services authorities that provide and manage the LTC system. They are organised at local level and receive a fixed wage, with no financial incentive for the quality/quantity of assessments performed. There is no auditing of their assessments, but

[6]The Act 39/2006 on December, 14 ((BOE, 2006)).

[7]Activities of Daily Living consist of *Basic* activities –such as eating, dressing, bathing, getting in and out of bed, using the toilet and continence– plus supplementary *Instrumental* activities –which include preparing own meals, cleaning, laundry, taking medication, getting to places beyond walking distance, shopping, managing money affairs and using the telephone/internet–.

[8]The measure is called Barem de Valoració de la Dependència, BVD, and is defined in the Royal Decree 504/2007 ((BOE, 2007)). The 47 items are tasks involved with ten basic and instrumental daily activities: eating and drinking, control of physical needs, bathing and hygiene, other physical care, dressing and undressing, maintaining one's health, mobility, moving inside the home, moving outside the home, and housework.

there is a protocol to follow. HCPs do not have a repeated relationship with claimants, like the one between claimants and their general practitioner (GP), meeting just for one-off assessments. With claimants only informed of the grade (not the score) at a later date by the social services authorities, there should be no pressure on them to adjust the score during the process. Moreover, HCPs have to medically justify their decisions regarding claimants' mental and physical limitations in any of the 47 tasks that are assessed to obtain the score. In particular, they have to list the medical diagnosis registered in Spanish NHS (public records) that leads to each limitation identified.

3 Hypothesis and Model

Given these circumstances, why do HCPs adjust claimant scores? This question arises after observing the distribution of LTC scores assigned to the claimants in Figure 1.[9] The main features of the distribution are the *notches* just above the thresholds. The distributions of scores for the 23 assessment local teams present in Catalonia have similar shapes (see Figure 3). In addition, the same discontinuities are also identified in the distributions of scores in another Spanish region. Figure 4 presents the score distribution in the Basque Country, and the clusters around the care-level thresholds are apparent.[10] Moreover, using the Spanish Disability and Dependency Survey for 2008 (SDDS) we can show that the discontinuity is not representative of the real LTC needs distribution of the Spanish population. The SDDS includes questions on limitations that are very close to the 47 tasks in the basic and instrumental ADL included in the scale used by the HCPs. These questions were used by Prieto to compute the LTC need score for the individuals who answered the survey, and their needs distribution does not feature any notches around the thresholds of different grades (see Figure 5).[11] Thus, we claim that the discontinuities are linked to policy implementation.

Prosocial motivation, common amongst public workers (see Besley and Ghatak (2005); Dur et al. (2014)), could explain adjusting behaviour in the needs assessment and therefore be responsible for the shape of the needs distribution. There is solid evidence that HCPs are concerned about their patients' utility (altruism) and that they are willing to adjust assessed needs (when a threshold determines the level of care) if this could increase the amount of care received (Ellis et al. (1986) and Almond et al. (2010)). However, given the protocols associated with assessment (described in the

[9]The Figure 1 represents the distribution of scores in 2011. The distributions of the years 2008-2010 have a similar pattern. These Figures are available upon request.

[10]Unfortunately, from Basque Country we have only the score assigned and the total number of applicants.

[11]The spike around 0 is because the survey is representative of the Spanish population and thus includes a large number of people with full-functional capacity and autonomy.

previous section), there is not room for large adjustments. This explains why prosocial HCPs do not exercise substantial discretionary power that would shift the distribution of assessment scores to the right. They only adjust those individuals at the margin, who could benefit from the modest/limited adjustment that the system allows. In this vein, we also observe that examiners are responsive to policy changes. In 2012, a reform of the LTC Act reduced the number of care grades from six to three ((BOE, 2012)). The distribution of scores after the reform does not demonstrate any clustering around the suppressed thresholds. By 2014, the distribution of scores had become smooth around the suppressed cut-offs, and at the same time, the notches at remaining cut-offs increased substantially as depicted in Figure 6).[12] We also discard the possibility that re-assessment (increasing future workload) could incentivise the adjustments because the number of reassessments is low: only 27% of claimants between 2008 and 2011 applied for a reassessment and most are concentrated in grade III, in cases where the health status of the claimant is deteriorating rapidly.

The possibility that adjusting assessment results could be due to reputational concerns of HCPs is also dismissed, because (i) there is only one encounter between the HCP and the claimant, and (ii) the score obtained in the assessment is not directly communicated to the claimant (i.e. is not public information). We do not rule out the possibility that other human traits, such as altruism, or warm glow giving could play a role. If HCPs were acting altruistically, they would likely be more favourable towards disadvantaged groups (the low-income, those who live alone, people with chronic conditions or those who live in rural areas etc), but there is no significant difference in the distribution of the scores for these groups (see Section 4 for more details). On the other hand, the warm glow theory would propose that HCPs should give some of her wealth or time to claimants, and there is no evidence to suggest that this happens.

We now present a theoretical framework in which we can identify the unintended consequences, caused by HCP behaviour, of a non-linear scheme of benefits when there are no financial incentives in place.

We consider a standard model, where the individual's utility depends on Health and Income $U(Y,H)$. For an individual with LTC needs, d, her health status and income (b, the social benefits associated) are determined by the severity of her needs (θ). Thus, the utility function can be expressed as $U_d(Y(b),H(\theta))$, where $H'(\theta)<0$ and $Y'(b)>0$, and rewritten as:

$$U_d(b_d,\theta_d)=\gamma b_d-(1-\gamma)\theta_d \tag{1}$$

[12] Figure 4 shows the same pattern in the Basque Country, another Spanish region.

where γ $(0 < \gamma < 1)$ is the weight for each component health and income, (θ and b). We assume that the severity of LTC needs is uniformly distributed among the population; $\theta \sim U(0,1)$, and $f(\theta)$ is the associated density function.

Policy-makers allocate benefits to LTC claimants based on the extent of their needs. As needs are not directly observable to policy-makers, they are measured by HCPs in an assessment process or test. The HCP is assumed to be interested in both her profits and the benefits awarded to her patients/claimants (Ellis and McGuire, 1986). The HCP receives a fixed salary so the components of her utility function can be simplified to the claimant's utility and any costs incurred to the HCP as a result of performing the assessment, and can be expressed as:

$$U_{hcp}(U^d(b_d(\theta_d + x_{hcp}), \theta_d), C(x_{hcp})) = \alpha\left(\gamma b_d - (1-\gamma)\theta_d\right) - \left(\frac{x_{hcp}^2}{2}\right) \tag{2}$$

where α $(\in [0,1])$ accounts for the prosocial preferences of the HCP. When $\alpha > 0$ the HCP could marginally adjust the score, θ_d, increasing it by x_{hx} points: $\theta_d^{hcp} = \theta_d + x_{hcp}$. The adjustment cannot exceed a certain amount, ($0 \leq x_{hcp} \leq \epsilon$, where $0 < \epsilon < 1$). [13] However, adjusting supposes a convex cost, generating disutility for the HCP: $C(x_{hcp}) = \frac{x_{hcp}^2}{2}$. There is a risk that an adjustment may be discovered by the wider authorities and if so, the assessor responsible is likely to be reprimanded at a personal cost. This means that HCPs will have an aversion to lying. This cost is likely to get larger as the adjustment increases due to the risk of being discovered going up –so that the cost function (θ_d^{hcp}) is convex.

Assuming that the policymaker has fixed a threshold of LTC needs, claimants with needs below the threshold, θ_j, receive y, while claimants with needs above it, receive $y+\Psi$, as specified below:

$$b_d = \begin{cases} y & \text{if} \quad \theta_d^{hcp} \in [0, \theta_j) \\ y + \Psi & \text{if} \quad \theta_d^{hcp} \in [\theta_j, 1] \end{cases}$$

As the utility of the HCP depends on their prosocial preferences and the benefits that claimants could receive, any decision to adjust claimant assessments will be affected by the structure of the LTC benefits available. We distinguish two scenarios:

[13] The adjustment can only be a marginal adjustment for two reasons. First the medical conditions of the claimants need to be certificated, and secondly, even if there is some personal cost, it is well documented that people tend to tell the truth (Gneezy (2005); Fischbacher and Heusi;Erat and Gneezy (2009))

(a) The *HCP* does not have prosocial preferences. If examiners do not have *prosocial preferences* $(\alpha = 0)$, no adjustments take place: $x_{hcp} = 0 \; \forall \theta_d$, and the adjustment cost of the HCP is zero. From a Utilitarian Government perspective, the Applicants' Welfare (AW) of this benchmark case (denoted by 0) is :

$$\begin{gathered} AW_0 = \textstyle\int_0^{\theta_j} U_d(b_d, f(\theta_d))d\theta_d + \int_{\theta_j}^1 U_d(b_d, f(\theta_d))d\theta_d = \\ \textstyle\int_0^{\theta_j} \left[\gamma y - (1-\gamma) f(\theta_d)\right] d\theta_d + \int_{\theta_j}^1 \left[\gamma(y+\Psi) - (1-\gamma) f(\theta_d)\right] d\theta_d = \gamma(y + \Psi(1-\theta_j)) \end{gathered} \tag{3}$$

With an associated budget of LTC:

$$Budget_0 = y\left(\int_0^{\theta_j} f(\theta_d)d\theta_d\right) + (\Psi + y)\left(\int_{\theta_j}^1 f(\theta_d)d\theta\right) = y + \Psi(1-\theta_j) \tag{4}$$

(b) The *HCP* has prosocial preferences. If examiners have *prosocial preferences* $(0 < \alpha \leq 1)$, score adjustment could happen in the assessment process. As we discuss earlier, adjusting the score is costly, and this cost is higher when the manipulation is bigger, i.e. when the applicant's score is far from the threshold that defines the benefits. The HPC will take one of three decisions depending in part by the (*true*) score of the applicant (θ_d):

- **(i)** $\theta_d \geq \theta_j$: The adjustment does not increase the patient's benefits and the HCP incurs only a positive cost, thus the adjustment is not made. Formally:
  $U^a_{hcp} \leq U^{na}_{hcp} \iff \alpha\left(\gamma(y+\Psi) - (1-\gamma)\theta_d\right) - \frac{(x_{hcp})^2}{2} \leq \alpha\left(\gamma(y+\Psi) - (1-\gamma)\theta_d\right)$
- **(ii)** $\theta_d < \theta_j$ and the patient's score (θ_d) is far from the threshold (θ_j): $\theta_d^{hcp} = \theta_d + x_{hcp} < \theta_j$. Thus, the cost of adjusting is larger than the benefit from adjusting, so that the adjustment is not made. Formally:
  $U^a_{hcp} \leq U^{na}_{hcp} \iff (\alpha\left(\gamma y - (1-\gamma)\theta_{dhcp}\right) > \frac{(x_{hcp})^2}{2}) \leq \alpha\left(\gamma y - (1-\gamma)\theta_d\right)$
- **(iii)** $\theta_d < \theta_j$ and the patient's score (θ_d) is close to the threshold (θ_j): $\theta_d^{hcp} = \theta_d + x_{hcp} \geq \theta_j$ (where $0 < x_{hcp} \leq \epsilon$), the adjustment will take place. Formally:
  $U^a_{hcp} > U^{na}_{hcp} \iff \alpha\left(\gamma(y+\Psi) - (1-\gamma)\theta_{dhcp}\right) - \frac{(\theta_{dhcp}-\theta_d)^2}{2} > \alpha\left(\gamma y - (1-\gamma)\theta_d\right)$
  which occurs if $\frac{(\theta_{dhcp}-\theta_d)^2}{2} \leq \alpha\left(\gamma y - (1-\gamma)\theta_d\right)$

A graphical representation of these three cases is presented in the Appendix (see Figure A.2). The number of individuals whose scores are adjusted depends positively on: the prosocial preferences of the HCP ($\frac{\partial x_{hx}}{\partial \alpha} > 0$), the difference in the value of benefits between categories ($\frac{\partial x_{hx}}{\partial \Psi} > 0$), and the weight assigned to the LTC benefits in the HCP utility function ($\frac{hx}{\partial \gamma} > 0$). Assuming that all examiners have the same prosocial preference level, their decision is equivalent to a shift of the threshold towards the left, denoted by $\theta_{j'} = \theta_j - \epsilon$. Applicants' whose score is $\theta_d \leq \theta_j - \epsilon$ would all be adjusted as illustrated in Figure A.3 in the Appendix. The larger the ϵ, the more applicant scores will be adjusted.

From a Utilitarian Government perspective, the Applicants' Welfare (AW_1) is:[14]

$$\begin{gathered} AW_1 = \int_0^{\theta_{j'}} U^d(b_d, f(\theta_d))d\theta_d + \int_{\theta_{j'}}^1 U^d(b_d, f(\theta_d))d\theta_d = \\ \int_0^{\theta_{j'}} \left[\gamma y - (1-\gamma) f(\theta_d)\right] d\theta_d + \int_{\theta_{j'}}^1 \left[\gamma(y+\Psi) - (1-\gamma) f(\theta_d)\right] d\theta_d = \gamma(y + \Psi(1-\theta_{j'})) \end{gathered} \tag{5}$$

With an associated budget of:

$$Budget_1 = y\left(\int_0^{\theta_{j'}} f(\theta_d)d\theta_d\right) + (\Psi + y)\left(\int_{\theta'_j}^1 f(\theta_d)d\theta_d\right) = y + \Psi(1-\theta_{j'}) \tag{6}$$

Compared to the non-prosocial preferences case, the AW is larger as $\theta'_j < \theta_j$, in concrete $\triangle AW = (\theta_j - \theta_{j'})\Psi\gamma$. But, the budget required would also be greater $\triangle Budget = \Psi(\theta_j - \theta_{j'})$.

4 Data

The administrative database used in this study is drawn from the Catalan Institute of Care and Social Services (ICASS). It consists of all records of individuals who have claimed LTC benefits in Catalonia, the Northeast Spanish region, between 2008 and 2011. It contains 361,292 individuals and includes information on their socio-demographic characteristics (age, gender, marital status, zip code, health-care records, labour disability status, cognitive impairments, date of death, and income) and their application (application dates, team performing needs assessment, LTC score, LTC grade and benefits in cases where the claimant was deemed eligible). Table 1 reports the descriptive statistics of claimant characteristics by LTC grades.

The sample is dominated by women (66%), widows (41%) and individuals resident in Barcelona (73%). On average, applicants are 79 years old. Around 25% of the sample have labour disability and half of the sample (46%) have cognitive impairments. Their average annual income is around 11000 euros. 31% of claimants were classified in Grade III, 26% in Grade II, 21% in Grade I and the remaining 22% were found to be ineligible for benefits.

[14] For simplicity, the welfare analysis under the system of benefit does not consider the effect of the adjustment on the HCP's welfare, they receive a fixed wage.

5 Empirical Analysis

In this Section we quantify the extra expenditure on LTC benefits due to adjustments made by HCPs in assessments. Using a linear probability model, we estimate differences in observable characteristics for claimants above and below the grade levels. Results reported in Table 2 suggest that the observable variables do not to explain the adjustment. The observable characteristics –such as age, gender, illness, etc. that could affect the adjustment decision– are not significantly different between individuals above and below the thresholds for the different grades of benefits. As the behaviour of the HCPs affect how people are allocated to the groups above the threshold (the "treated" group) and below the threshold (the "non-treated" group) discontinuity regression models cannot be used for estimating the counterfactual distribution. To reconstruct the distribution of LTC scores, we propose and develop a non-parametric model using a geometric progression, to quantify the number of claimants affected by the adjustments. This method allows us to estimate"back of the envelope" calculations to approximate the costs associated with adjustments.

The distribution of the scores around the thresholds could be represented by a geometric progression, a sequence of numbers where each term (after the first) is found by multiplying the previous one by a fixed, non-zero number called the common ratio (λ) (see Hazewinkel, 2001 for more details). To recover the frequency of claimants below the threshold n_0 (for example 24) we need to eliminate some of the observations at the scores after n_0 (for example 25, 26, etc.) and add them to the n_0. Defining the true frequencies (i.e. the number of applicants in each score) as: n_0, n_1,n_2,n_3... n_k, and applying the geometric progression rule, we can write the following model:

$$n_1 = (1 - \lambda)\theta_1$$

$$n_2 = (1 - \lambda^2)\theta_2$$

$$n_k = (1 - \lambda^k)\theta_k$$

$$n_0 = \theta_0(1 + \lambda + ... + \lambda^k)$$

Assuming that the parameter (θ) is the same for each score n we can rewrite our model as:

$$n_{s+1} = (1-\lambda^{s+1})\theta$$

$$n_{s+2} = (1-\lambda^{s+2})\theta$$

$$n_{s+k} = (1-\lambda^{s+k})\theta$$

$$n_s = \theta(1+\lambda^s + ...\lambda^{s+k})$$
$$= \theta\frac{1-\lambda^{s+k+1}}{1-\lambda}$$

We assume that this is distributed according to a Poisson distribution, with estimated θ and λ for each threshold to recover the *true* distribution of the LTC needs. A Poisson function with two parameters can be written as:[15]

$$f(\mu, k) = e^{-\mu} * \mu^{n_k}/k!$$

Where $\mu = \theta(1-\lambda^i)$

Assuming that k is five, defining two points above and two points below to the threshold, the associated likelihood is:

$L(\theta,\lambda) = \frac{1}{n_0!}\exp\left\{-\theta\left(\frac{1-\lambda^5}{1-\lambda}\right)\right\}\left\{\theta\left(\frac{1-\lambda^5}{1-\lambda}\right)\right\}^{n_0}\prod_{i=1}^{4}\frac{1}{n_i!}\exp\left\{-\theta\left(1-\lambda^i\right)\right\}\left\{\theta\left(1-\lambda^i\right)\right\}^{n_i}$

and its log-Likelihood is:[16]

$$l(\theta,\lambda) = \log L(\theta,\lambda) = -\theta\left(\frac{1-\lambda^5}{1-\lambda}\right) + n_0\log(\theta) + n_0\log\left(\frac{1-\lambda^5}{1-\lambda}\right) +$$
$$\sum_{i=1}^{4} -\theta\left(1-\lambda^i\right) + n_i\log(\theta) + n_i\log\left(1-\lambda^i\right)$$

$\frac{\partial l(\theta,\lambda)}{\partial\theta} = -\left(\frac{1-\lambda^5}{1-\lambda}\right) + \frac{n_0}{\theta} + \sum_{i=1}^{4}\left(-\left(1-\lambda^i\right) + \frac{n_i}{\theta}\right)$

$\frac{\partial l(\theta,\lambda)}{\partial\lambda} = -\left(\frac{5\theta\lambda^4 - \theta(1-\lambda^5)(1-\lambda^{-1})}{1-\lambda}\right) + \frac{n_0}{1-\lambda^5}\left(-5\lambda^4 + \frac{1-\lambda^5}{1-\lambda}\right) + \sum_{i=1}^{4}\left(\left(i\theta\lambda^{i-1}\right) - \frac{i\lambda^{i-1}n_i}{1-\lambda^i}\right)$

Using a Newton-Rapson estimator we calculate θ and λ close to the thresholds. Table A.2, in the Appendix, reports the number of adjusted claimants and the estimated λ and θ, by year for each cut-off. We estimate that almost 9000 claimants (3%) between 2008 and 2011 had their score adjusted. In Figure 7 we show the counterfactual score distribution in 2010 with and without the

[15] The gradual implementation of the Spanish LTC system affects the distribution of score by year. We capture this by estimating the parameters also by year of implementation.

[16] As the maximum likelihood is not a closed form, we solve the optimization by Newton Rapson procedure.

adjustments.[17] To ensure the validity of our approach, we test whether this methodology recovers the scores far away from the thresholds of the original distribution (see Figure 8). The non-parametric model developed fits quite well the original number of claimants in all scores not affected by the adjustments.

We estimate that approximately 838,136 euro per month extra is spent on benefits as a result of 9000 claimants being in a higher grade of benefit due to upgrading. (see Table 3). To calculate the cost, we multiply the number of adjusted individuals in each category by the average expenditure per claimant above and below the threshold. The difference between these numbers gives the cost of adjustment at each cut-off. However, this cost could be underestimated, because we use the value of the voucher awarded, not the costs incurred by the service provider as this information is not provided. In addition, we perform the calculation without knowing the family income of the applicant, a factor which is taken into account when deciding the amount of the benefits.

6 An Alternative Scheme of Benefits: a linear function

In July 2012, the Spanish government, under their austerity reforms, changed the structure of LTC benefits, allowing for only three grades of benefits instead of the previously used six. Figure 6 shows the distributions of claimant scores (in percentages) before (2011) and after the reform (2014). We observe that the reduction in the number of grades appears to cause: (i) the notches around the removed cut-offs to disappear, and (ii) an increase in the percentage of claimants whose scores were adjusted at the remaining cut-offs. According to our theoretical model, an increase in the number of categories of benefits should reduce the adjusting behaviour because the marginal gain from adjustment decreases.

In this section, we consider a continuous scheme of benefits, which in this setting is equivalent to matching the number of benefits grades to the number of possible scores in the needs assessment. Using the conceptual framework described in section 3, we study the HCPs behaviour under this hypothesis.

We begin by defining the benefits for claimant d as:

$$b_d = \tau\theta_d^{hcp} = \tau(\theta_d + x_{hcp})$$

[17] The other years studied are available upon request.

where τ represents the fixed value or price awarded for each point of claimant scores, θ_d^{hcp}. The score defining the level of needs depends on the true level (θ_d) plus some adjustment made by the examiner (x_hcp). Following the utility function for the prosocial HCP, defined in equation 2, the examiner maximizes the optimal level of adjustments as follows:

$$\max_{x_{hcp}} \quad \alpha\left(\gamma\tau(\theta_d + x_{hcp}) - (1-\gamma)\theta_d\right) - \frac{x_{hcp}^2}{2}$$

Under this continuous scheme of benefits, the FOC of the examiner's utility solves the optimal level of adjustment as: $x^* = \alpha\gamma\tau$. Adjustments increase with the HCP prosocial motivation (α: as $\frac{\partial x_{hcp}}{\partial \alpha} > 0$), the additional benefits received from being on the right-side of the threshold (τ: as $\frac{\partial x_{hcp}}{\partial \tau} > 0$), and the weight the claimant assigns to income (γ: as $\frac{\partial x_{hcp}}{\partial \gamma} > 0$). From a Utilitarian Government perspective, the Applicants' Welfare under this alternative (denoted by the subscript 2) is:

$$\begin{gathered} AW_2 = \int_0^1 U^d(b_d, f(\theta_d))d\theta_d = \\ \int_0^1 \left[\gamma\tau(f(\theta_d) + x_{hcp}^*) - (1-\gamma)f(\theta_d)\right] d\theta_d = \gamma\tau + (\gamma\tau)^2\alpha - (1-\gamma) \end{gathered} \tag{7}$$

With an associated budget of:

$$Budget_2 = \tau\left(\int_0^1 f(\theta_d)d\theta_d\right) + \tau\left(\int_0^1 (x_{hcp}^*)d\theta_d\right) = \tau + \alpha\gamma\tau^2 \tag{8}$$

As predicted, the implementation of a linear scheme of benefits reduces the adjusting behaviour as x^* is minimised. However, a prosocial HCP will adjust the score to all claimants by x^*. Consequently, the score distribution will be shifted to the right, increasing the cost of the LTC system. In order to avoid this increase in expenditure, imposing a fixed budget would force the HCP to internalise this consequence of their adjustments.

Under this scenario, the HCP now maximises as follows:

$$\begin{aligned} \max_{x_{hcp}} \quad & \alpha\left(\gamma\tau(\theta_d + x_{hcp}) - (1-\gamma)\theta_d\right) - \frac{x_{hcp}^2}{2} \\ \text{s.t.} \quad & \tau\int_0^1 \left[f(\theta_d) + x_{hcp}\right] d\theta_d = y + \Psi(1-\theta_{j'}) = M \end{aligned}$$

By isolating τ in the budget constraint and substituting in the objective function we have:

$$\max_{x_{hcp}} \quad \alpha\left(\gamma\frac{M}{\int_0^1[f(\theta_d) + x_{hcp}]d\theta_d}(\theta_d + x_{hcp}) - (1-\gamma)\theta_d\right) - \frac{x_{hcp}^2}{2}$$

Solving this case, $\hat{\tau} = \left(-\frac{1}{2}\right)\sqrt{1 + 4(\alpha\gamma)(y + \Psi(1 - \theta_{j'}))}$ represents the optimal τ for the given level of expenditure, M. The optimal adjustment is the same as above, with the addition that τ takes the value $\hat{\tau}$: $x^* = \alpha\gamma\hat{\tau}$. From a Utilitarian Government perspective, the Applicants' Welfare under this alternative (denoted by the subscript 3) is:

$$\begin{gathered} AW_3 = \int_0^1 U^d(b_d, f(\theta_d))d\theta_d = \\ \int_0^1 \left[\gamma\tau(f(\theta_d) + x^*_{hcp}) - (1-\gamma)f(\theta_d)\right] d\theta_d = \gamma\hat{\tau} + (\gamma\hat{\tau})^2\alpha - (1-\gamma) \end{gathered} \tag{9}$$

With an associated budget of:

$$Budget_3 = \text{Budget}_1 = y + \Psi(1 - \theta_j) \tag{10}$$

We illustrate the difference in the amount of benefits under the two schemes, namely with thresholds versus continuous, using the LTC level of coverage and expenditure in November 2011.[18] First, we find that the monthly value of a score point, τ, is 8 euro on average (see Appendix for calculation details). Secondly, we find this value for all socioeconomic groups and care options because the amount of benefits depends on these two parameters (reported in Table A.5). Figures A.4 depict a simple example (whose details appear in the Appendix) of the average amount of benefits by score, for home residence (12.8% of the total care) and informal care-givers (86.7% of the total care), calculated for both schemes: discrete intervals and continuous.

The linear scheme of benefits could reduce inequality within and between categories.

7 Conclusions

This paper provides one of the few empirical pieces of evidence on prosocial motivated health care professionals (HCPs). First, we document that prosocial motivation affects the behaviour of HCPs. Second, we identify the unintended consequences that occur when prosocial HCPs use a continuous scale to determine the LTC needs of claimants in a system where there is a discontinuous scheme of public LTC benefits. In this setting, HCPs adjust the score of claimants whose real scores are just below the thresholds to move them up to the next grade, granting access to greater benefits. We find that around one million euros of the total annual expenditure is due to adjusting, and affects 3%

[18] In this example, we have to assume that the alternative schemes of benefits (i.e. the continuous) would not change the choice of care. We exclude in-kind expenditure because the monetary amount of the benefit is unknown.

of claimants. Thirdly, we present a theoretical framework where we suggest defining LTC benefits with a linear function based on the needs score, instead of on categories. Increasing the number of thresholds, as the literature shows (see Hillman (2003)), would minimize adjusting behaviour.[19] By minimizing the size of each bracket, the unfairness within and between grades tends to disappear, as well as the clustering, without reducing the utility of beneficiaries. However, in this scenario, the use of a fixed budget or other mechanisms to force HCPs to internalise the cost of adjusting is required to control the budget. Whether the adjustments improve or not the quality of life of these claimants is beyond the scope of this paper, but should be analysed in future research.

[19] See, for instance, the Earned Income Tax Credit designed by policy-makers to reduce the poverty trap.

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Tables & Figures

Figure 1: **Score's Distribution in 2011**

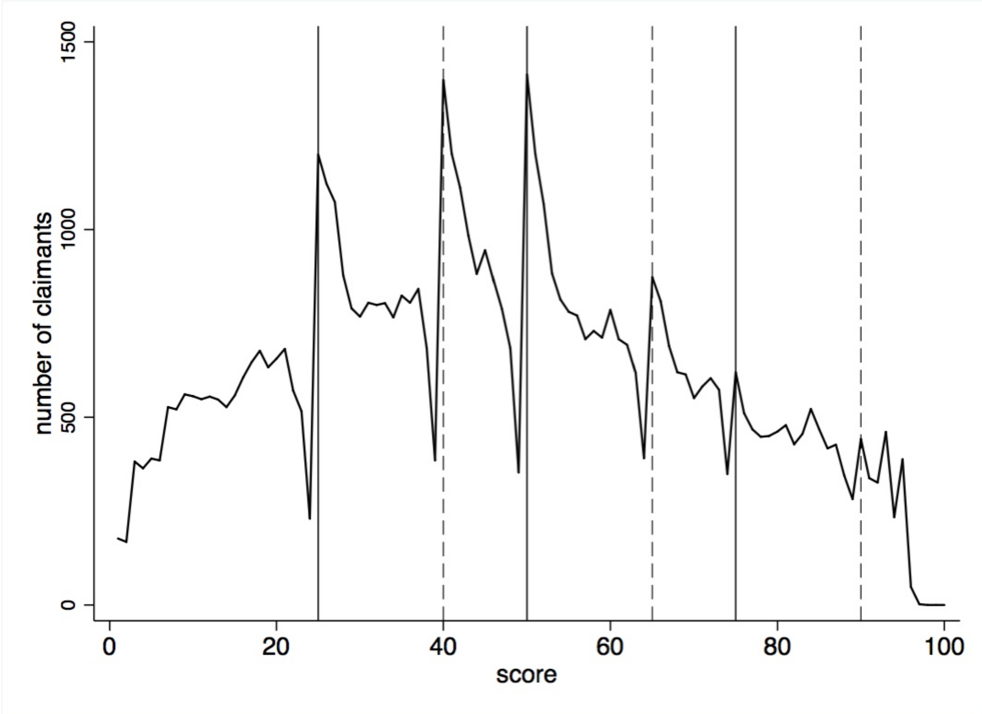


Figure 2: **Average Monthly LTC Benefits by Scores**

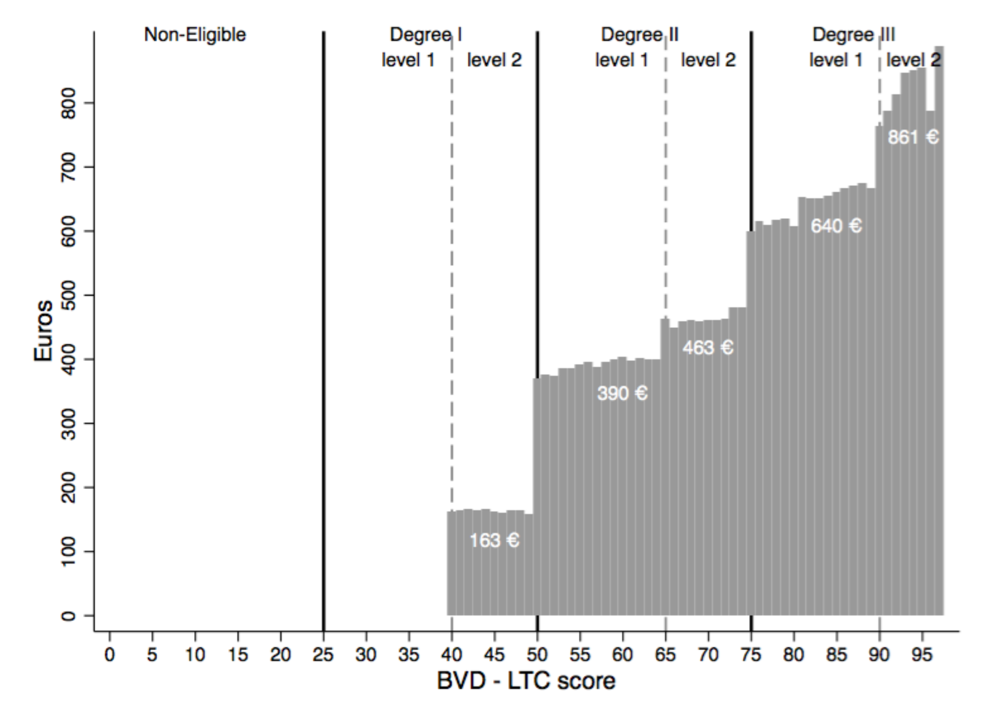


Figure 3: **Scores' Distribution by HCP Local Assessment Teams (SEVADs)**

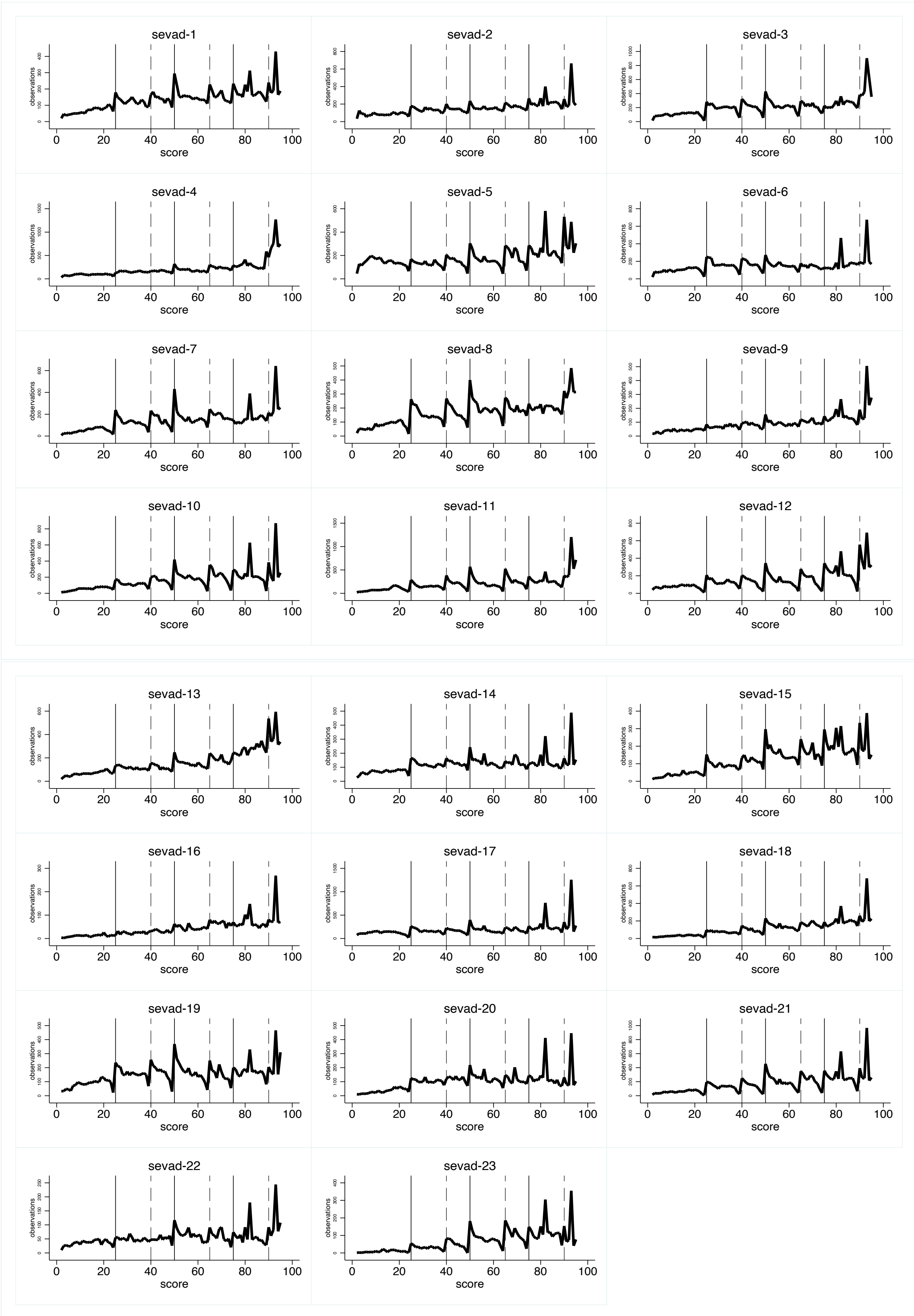
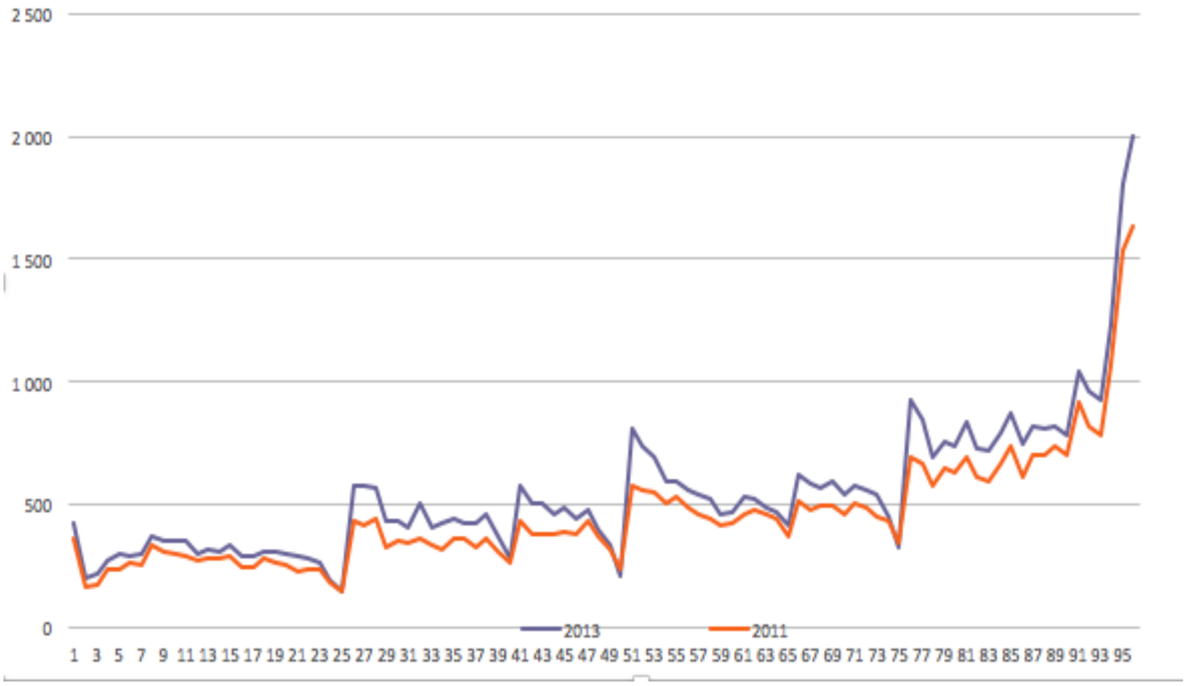
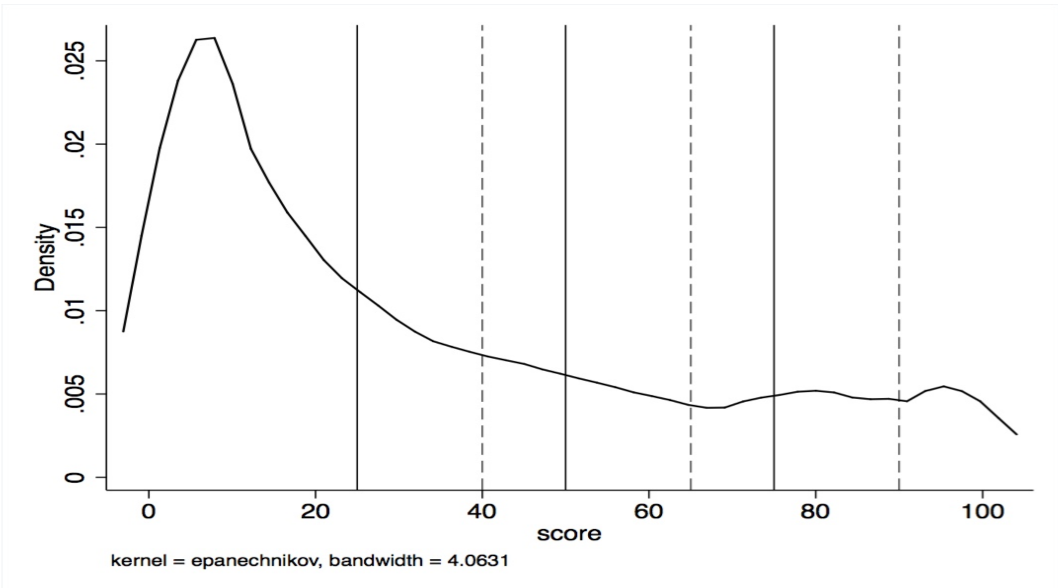


Figure 4: **Score Distribution in the Bask Country**



Source: Bask Country Region administrative records.

Figure 5: **Kernel density of the Estimated Score from SDDS' Survey Responses**



Source: Vilaplana, 2010.

Figure 6: **Score Distributions Before and After Levels' Removal**

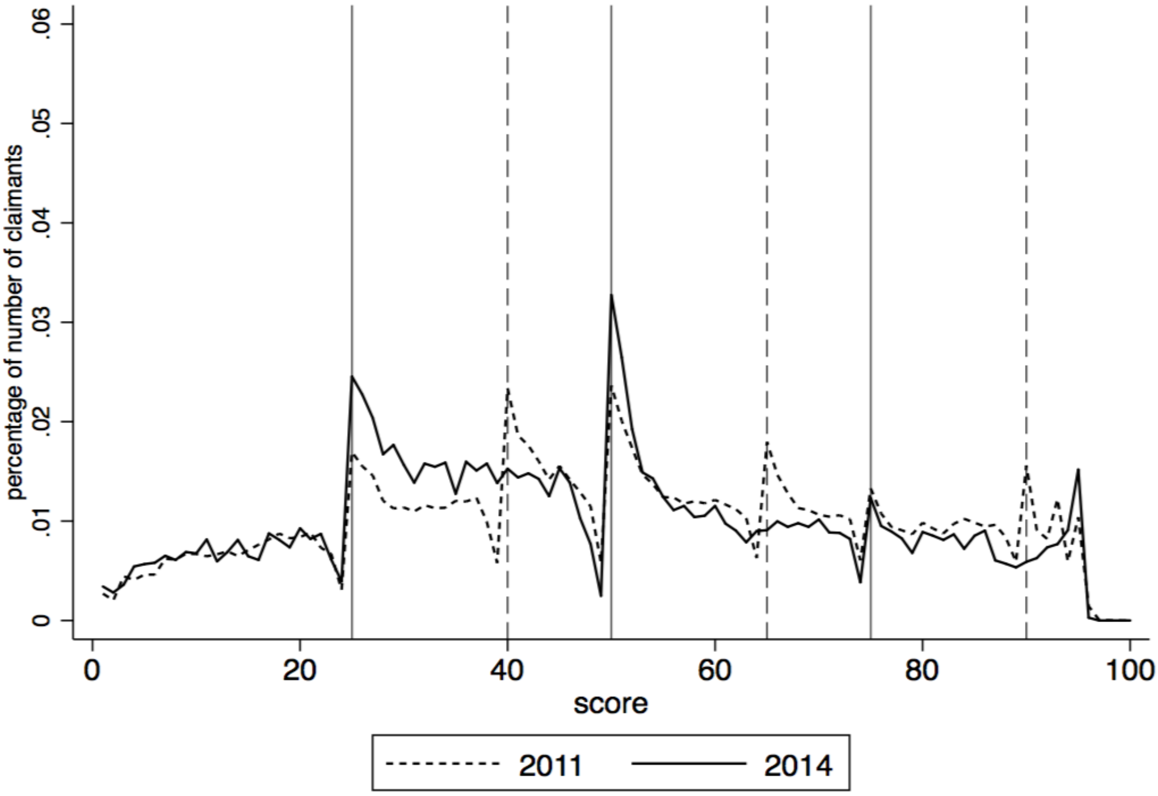


Table 1: **Descriptive Statistics**

	(1) All Sample	(2) No Grade	(3) Grade I	(4) Grade II	(5) Grade III
Female	0.66	0.61	0.69	0.66	0.68
Age	78.99	77.93	77.09	78.37	81.43
Age: 40-54	0.05	0.05	0.07	0.06	0.04
Age: 55-69	0.11	0.13	0.14	0.11	0.07
Age: 70-84	0.48	0.52	0.53	0.48	0.43
Age: +85	0.35	0.30	0.27	0.34	0.45
Civil Status					
Married	0.37	0.42	0.42	0.38	0.30
Widow	0.41	0.38	0.39	0.42	0.45
Single	0.10	0.10	0.11	0.12	0.09
Other CS	0.11	0.09	0.08	0.08	0.16
Region (province)					
Barcelona	0.73	0.75	0.73	0.71	0.73
Girona	0.09	0.07	0.08	0.10	0.10
Lleida	0.07	0.07	0.07	0.07	0.07
Tarragona	0.11	0.10	0.13	0.12	0.11
Year of Application					
*2007**	0.15	0.07	0.03	0.08	0.35
2008	0.27	0.20	0.20	0.28	0.33
2009	0.24	0.22	0.29	0.29	0.18
2010	0.20	0.22	0.30	0.23	0.10
*2011**	0.14	0.28	0.18	0.11	0.04
Labour Disability	0.26	0.23	0.29	0.28	0.26
Cognitive impairment	0.46	0.24	0.29	0.53	0.76
Annual Income (euros)	11028.62	11629.84	11036.01	10810.79	11295.37
Missing Income	0.61	0.92	0.37	0.41	0.73
Score	52.53	6.39	36.58	61.24	86.13
Access to benefits	0.55	0.00	0.19	0.87	0.83
Voucher or Cash Transfer	0.77		0.69	0.83	0.74
Type of Benefit					
At home Care	0.07		0.13	0.07	0.06
Day Care Centre	0.03		0.03	0.03	0.02
Informal Caregiver	0.63		0.69	0.72	0.54
Medical Nursing Home	0.02		0.01	0.01	0.03
Nursing Home	0.24		0.07	0.15	0.34
TeleAssistance	0.02		0.07	0.02	0.01
Observations	361292	76233	74252	95723	115084
		0.21	0.21	0.26	0.32

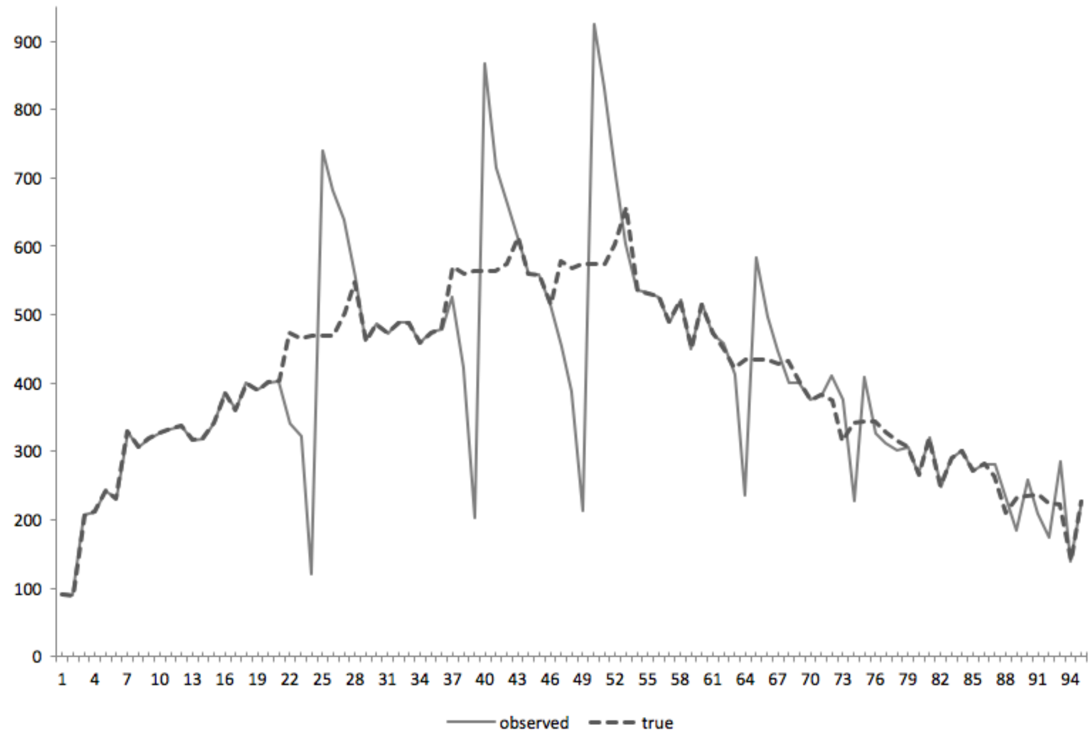
Notes: (*) The implementation in 2007 started in June, and observations of 2011 do not include December.

Table 2: **Above the cutoff**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Grade I l1 VS Grade I l2	Grade I l2 VS Grade II l1	Grade II l1 VS Grade II l2	Grade II l2 VS Grade III l1	Grade I l1 VS Grade I l2	Grade I l2 VS Grade II l1	Grade II l1 VS Grade II l2	Grade II l2 VS Grade III l1
	37-42	47-52	62-67	72-77	37-42	47-52	62-67	72-77
Female	-0.014**	-0.002	0.003	0.010	-0.016**	-0.004	0.004	0.008
	(0.007)	(0.007)	(0.011)	(0.011)	(0.007)	(0.006)	(0.010)	(0.011)
Age: 55-69	0.016	-0.004	-0.022	0.013	0.016	0.005	-0.020	0.024
	(0.020)	(0.017)	(0.015)	(0.029)	(0.020)	(0.017)	(0.015)	(0.028)
Age: 70-84	0.021	0.022	-0.025*	-0.003	0.028	0.036***	-0.012	0.012
	(0.016)	(0.014)	(0.013)	(0.022)	(0.016)	(0.012)	(0.013)	(0.020)
Age: +85	0.026	0.026*	0.001	0.028	0.038*	0.045***	0.018	0.042**
	(0.019)	(0.013)	(0.016)	(0.021)	(0.020)	(0.012)	(0.014)	(0.018)
Married	0.016	0.001	0.022**	0.035**	0.006	-0.004	0.018*	0.035**
	(0.010)	(0.010)	(0.008)	(0.015)	(0.011)	(0.011)	(0.009)	(0.015)
Widow	0.030***	-0.001	-0.011	0.004	0.022*	-0.006	-0.015	0.008
	(0.010)	(0.009)	(0.009)	(0.016)	(0.012)	(0.009)	(0.010)	(0.015)
Disability	-0.009	-0.015	-0.015	-0.014	-0.004	-0.007	-0.003	-0.006
	(0.011)	(0.010)	(0.009)	(0.011)	(0.010)	(0.009)	(0.009)	(0.010)
Number of Diagnosis					0.008	-0.007	-0.007	-0.012**
SEVAD F.E.	No	No	No	No	Yes	Yes	YES	Yes
Province F.E	No	No	No	No	Yes	Yes	Yes	Yes
Observations	17,108	23,334	22,317	21,366	17,105	23,324	22,304	21,347

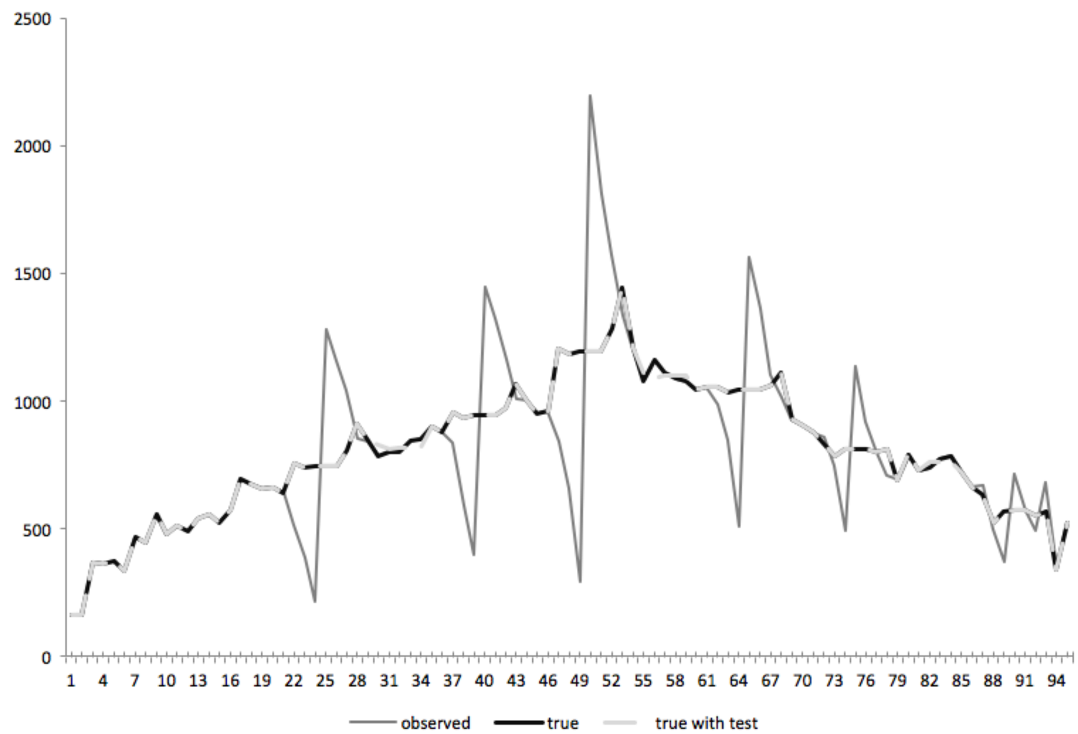
Notes: The dependent variables is a dummy which takes value one if the score is 3 points above the threshold, 0 if 3points below. All OLS regressions include time fixed effects. Robust Standard errors, clustered at SEVAD level. The reference variables are age cohort from 40 to 54 years old and divorced. Significance levels: One star (*) if $p < 0.05$, two stars(**) if $p < 0.01$, and three stars (***) if $p < 0.001$.

Figure 7: **Score distributions: observed vs *true***



Notes: This graph presents the distribution of 2010. The *true* distribution is obtain with the counterfactual estimation.

Figure 8: **Score distributions: observed vs *true* robustness check**



Notes: This graph presents the distribution of 2010. Compared to Graph 7 it includes the *true with test distribution*, which is constructed estimating the counterfactual values in other parts of the distribution which are not affected by the adjustments.

Table 3: **Back of the envelope Calculations**

	(1)	(2)	(3)	(4)	(5)
	Grade I	Grade II		Grade III	
	Level II	Level I	Level II	Level I	Level II
Number of adjusted claimants	31	3424	2395	2063	981
Monthly Expenditure					
With Adjustments	5583	1040948	811797	566136	584345
Without Adjustments	0	605052	723589	471456	442576
Difference or "potential savings"					
Total	5583	435896	88208	94680	141769
Percentage	100.00	41.87	10.87	16.72	24.26

Appendix A Supplementary Tables and Figures

Figure A.1: **Spanish LTC system: Funnel procedure**

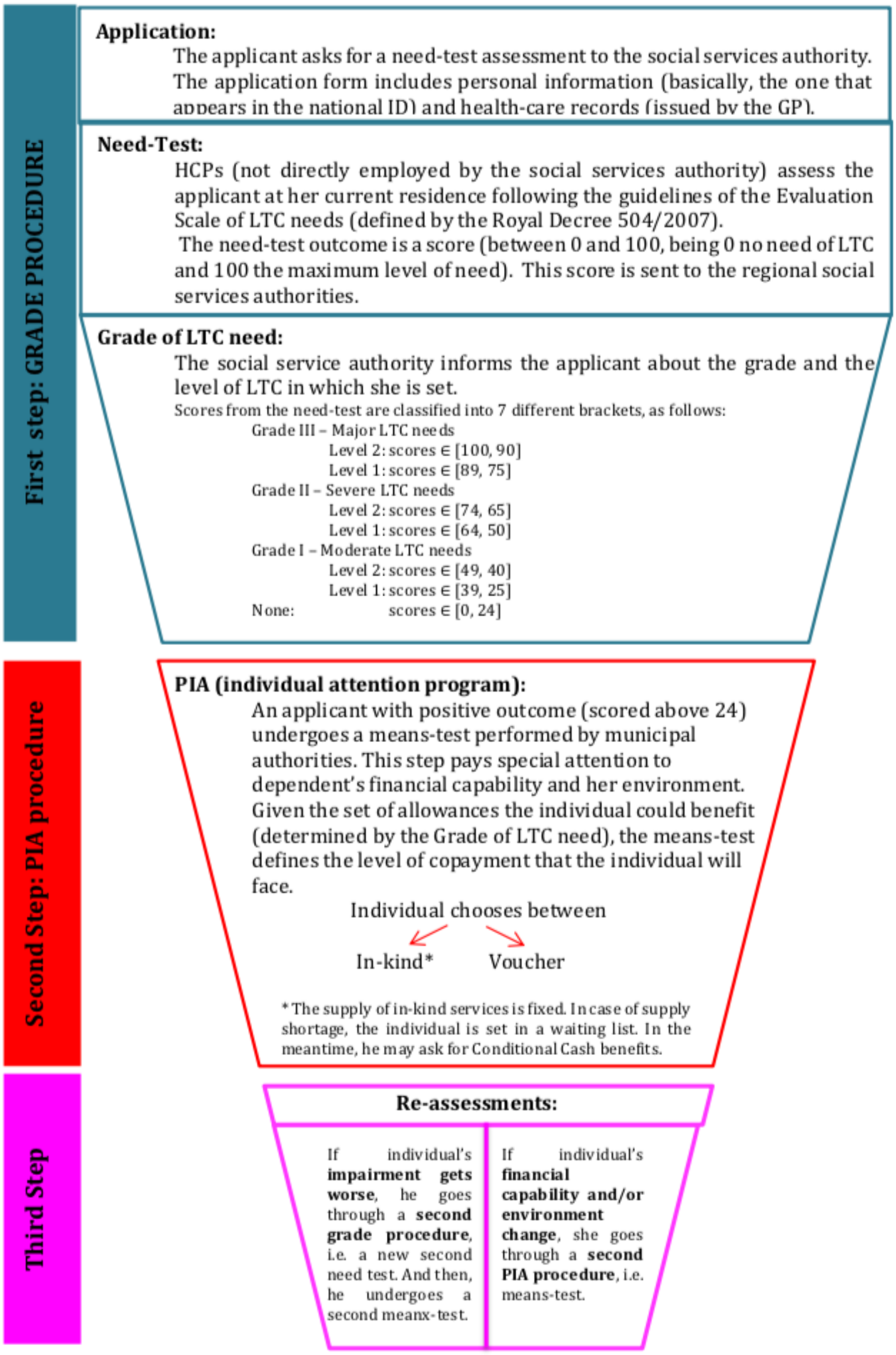


Figure A.2: **Prosocial HCP**

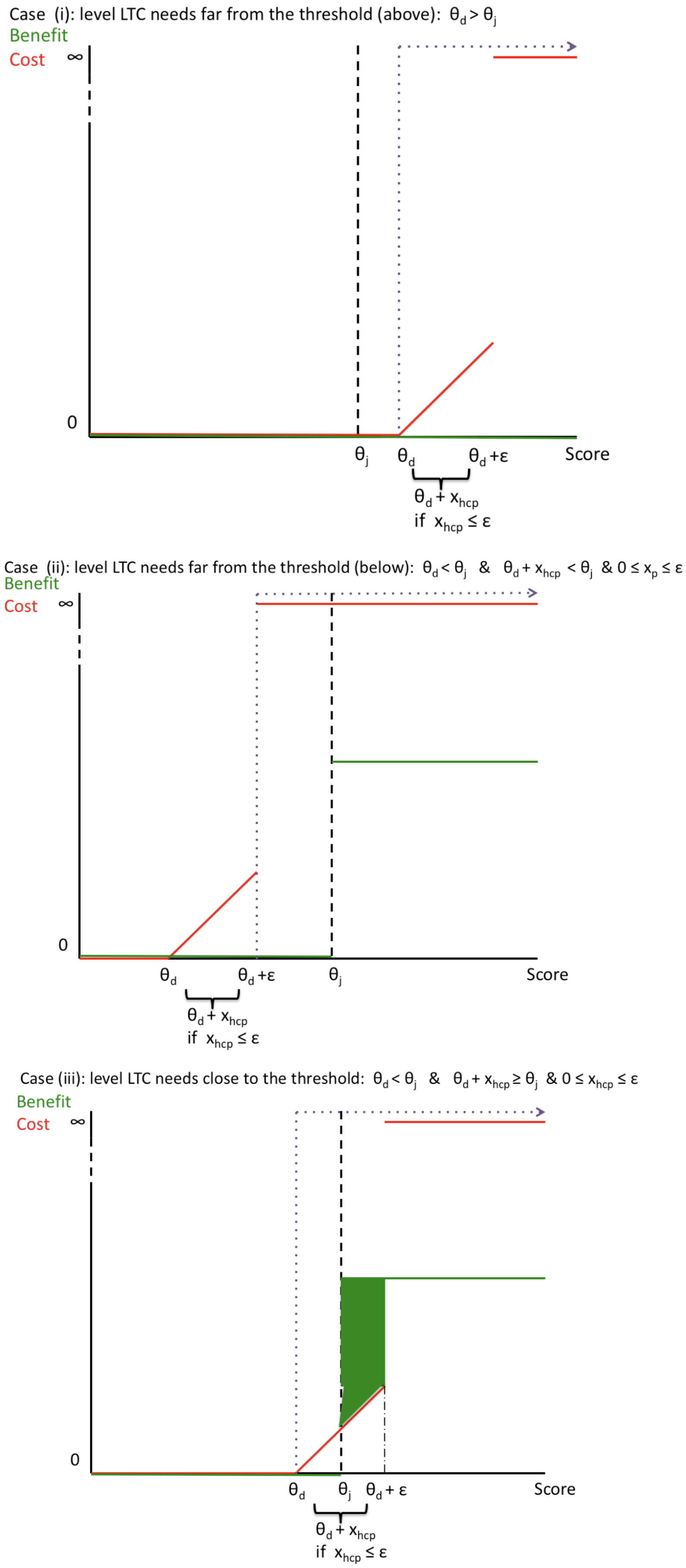


Figure A.3: **Threshold Shift: the unintended consequence of a discrete scheme of benefits with prosocial HCP**

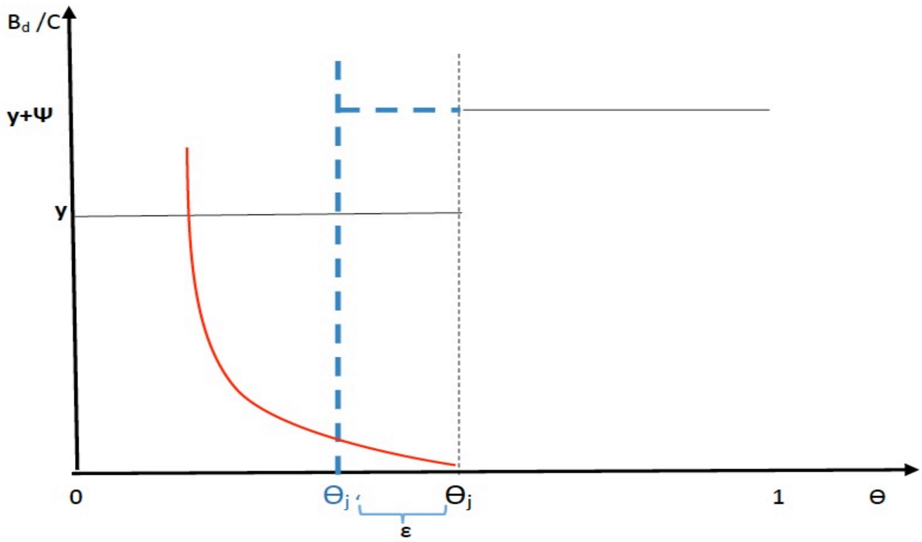


Table A.1: **Monthly Monetary Value of LTC Benefits**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Informal Caregiver (IC)	Nursing Homes (NH)		Day Care Centre (DCC)		Home Care (HC)	TeleAssistance (TA)
type of benefit	*cash transfer*	*voucher*	*in-kind*	*voucher*	*in-kind*	*in-kind*	*voucher*
Grade III	431	831	1870-c	409	853-c	537	
Grade II	303	494	1595-c	247	730-c	307	20-c
Grade I	168			171	597-c	211	

Notes: All amounts are in euros 2012. For the benefits in *voucher* or *cash transfers* the reported amount is the average, as the amount depends on beneficiary's financial capability. For *in-kind* benefits, the monthly value is defined as the public cost/price of the service minus the copayment (C), which depends on beneficiary's financial capability.

Table A.2: *Adjusted claimants and estimated parameters, by years and threshold*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	From none to Grade I-I: 23-27						
	Δ23	Δ24	Δ25	Δ26	Δ27	λ	θ
2008	255	285	-222	-134	-184	0.067	479.40
2009	474	559	-485	-293	-255	0.088	816.00
2010	487	549	-466	-344	-226	0.065	819.00
2011	251	315	-246	-182	-138	0.128	500.80
	From Grade I-I to Grade I-II: 38-42						
	Δ38	Δ39	Δ40	Δ41	Δ42	λ	θ
2008	192	215	-159	-128	-120	0.072	624.61
2009	361	410	-370	-225	-176	0.064	950.40
2010	379	646	-515	-336	-174	0.067	973.67
2011	224	294	-293	-139	-86	0.123	567.00
	From Grade I-II to Grade II-I: 48-52						
	Δ48	Δ49	Δ50	Δ51	Δ52	λ	θ
2008	527	604	-1043	-119	31	0.039	1021.60
2009	707	846	-1075	-381	-97	0.067	1257.18
2010	433	916	-808	-367	-174	0.099	1086.00
2011	235	290	-278	-179	-68	0.100	556.20
	From Grade II-I to Grade II-II: 63-67						
	Δ63	Δ64	Δ65	Δ66	Δ67	λ	θ
2008	620	701	-702	-411	-208	0.058	1223.60
2009	500	574	-645	-326	-103	0.058	1107.80
2010	151	535	-444	-237	-5	0.112	837.80
2011	86	119	-137	-64	-4	0.122	374.00
	From Grade II-II to Grade III-I: 73-77						
	Δ73	Δ74	Δ75	Δ76	Δ77	λ	θ
2008	476	530	-540	-297	-169	0.050	1368.40
2009	245	321	-428	-132	-6	0.090	963.20
2010	35	322	-295	-93	31	0.115	631.20
2011	18	39	-72	-1	16	0.180	283.40
	From Grade III-I to Grade III-II: 88-92						
	Δ88	Δ89	Δ90	Δ91	Δ92	λ	θ
2008	532	621	-823	-161	-169	0.055	1828.80
2009	182	220	-430	-33	61	0.039	869.00
2010	19	177	-201	-18	23	0.094	429.80
2011	6	12	-45	-4	31	0.058	183.00

Comparison between a discrete-interval vs a continuous schemes of benefits

In order to compare a discrete-interval scheme of LTC benefits with a continuous one, we first calculate the value or price (τ) for a score point, assuming the beneficiary population of a given month, e.g. November 2011. We assume that the number of individuals, the severity of their conditions, their income levels and their care preferences would not have changed under a linear system of benefits. This assumption is required because the value of a recipient's voucher's depends on her financial capabilities (wealthiest individuals received 80% of the amount given to the least wealthy beneficiaries with the same needs) and the type of benefit (because the cost of care varies). This discrimination by income and care means that we need to the find the value of τ for all the possible combinations of care and income groups, following the criterion established in the Act 39/2006. The Act establishes a maximum amount of benefit and applies discount rates to this amount as the financial position increases, or the cost of the care reduces. Tables A.3 and A.4 report the income discount and type of care discount, defined in the above mentioned Act. We also set the fixed budget, B equal to the amount of public expenditure in 2011.

We define the set of care options as:

$$I \equiv \{nh, hch, hcl, dcc, ic\}$$

where nh refers to nursing home; hch and hcl are professional care at home at high or low level respectively; dcc is the day-care centre; and, ic is the informal caregiver cash transfer. We define the annual income levels as establish by the government

$$c \equiv 1, 2, ..., 6.$$

where 1 is the lowest annual income level (less than 7,000 euro) and 6 is the maximum(more than 46,000 euro). $n_{s,i,c}$ determines the number of benefit issued by score, s (where $s = 1, 2....100$), care choice, i and income group c. In order to determine τ, we have to solve:

$$B = \sum_{s=0}^{100} \sum_{i \in I} \sum_{c=1}^{6} \tau(1 - \delta_i)(1 - \gamma_c) n_{s,i,c} \tag{11}$$

In November 2011, with the given budget B and all care choice $n_{s,i,c}$, the value of τ is:

$$\tau = B/(\sum_{s=0}^{100}\sum_{i\in I}\sum_{c=1}^{6}(1-\delta_i)(1-\gamma_c)n_{s,i,c}) = 8.43€ \quad (12)$$

Table A.5 presents the value of one point in the score in euros (2011 prices), by the type of care and income groups. For the wealthiest group with the cheapest care, the value is estimated to be around 4 euro, whereas the value for the least wealthy group of claimants with the most expensive care (nursing homes) is 13.5 euro. These values depend on claimants' choice, which we assume will be unchanged if a linear scheme of benefits would be implemented. Figure A.4 shows the distribution of the average allowances by each base point of the score, for nursing homes (12.8% of the total care) and informal care-giver (86.7% of the total care) calculated for both schemes: namely bracket and smooth. The linear scheme of benefits avoids both within- and between-grades inequality. Compared to the discontinuous system, claimants receiving informal caregiver cash subsidies with scores from 50 to 55, and from 90 to 92, will see their benefits reduced. The maximum lost represents the 17% of the subsidy received under the discontinuous system, and people with any other score are always better off. Similarly, the majority of claimants receiving a voucher for a nursing home are also better off with the continuous system (only claimants with scores between 90 and 96 have the value of the voucher reduced, by approximately 13%).

Table A.3: **Discounts by Care Options (LTC Act 39/2006)**

		Discounts
Nursing Homes	δ_{nh}	0
Informal Caregiver	δ_{ic}	0.37
At home care (high)	δ_{hch}	0.2
At home care (low)	δ_{hcl}	0.4
Day Care Centre	δ_{dcc}	0.4

Table A.4: **Discounts by Care Options (LTC Act 39/2006)**

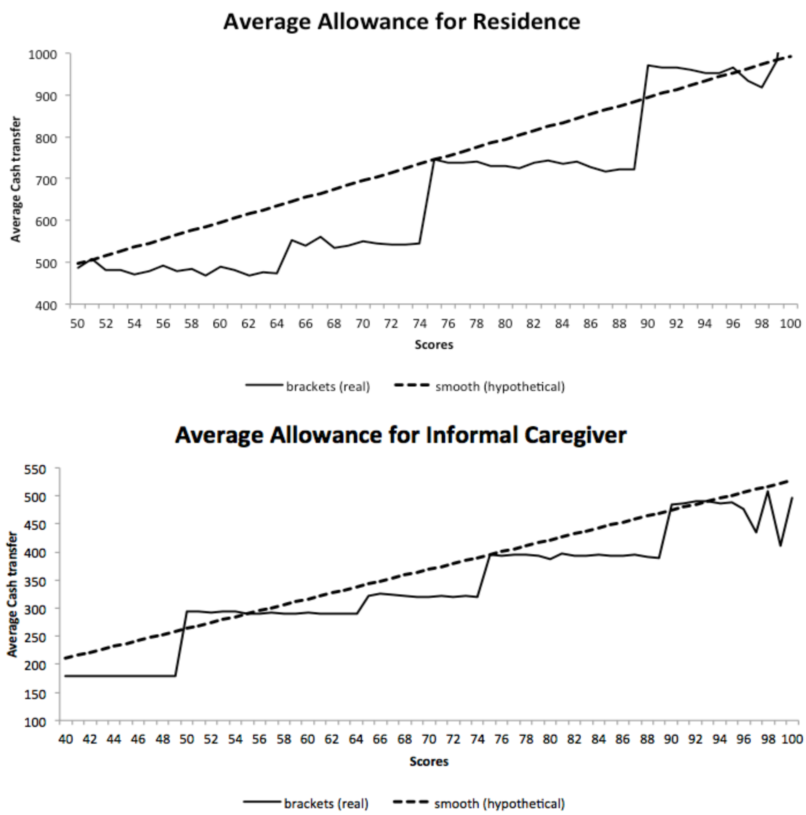
	Annual Income Group		Discounts j= *ic, hch, hcl, dcc*	j=*nh*
1	$\leq$ 7967.73	$\gamma_{j,1}$	0	-0.6
2	(7967.73,11951.6]	$\gamma_{j,2}$	0	-0.3
3	(11951.6,19919.33]	$\gamma_{j,3}$	0	0
4	(19919.33,35854.79]	$\gamma_{j,4}$	0.05	0.05
5	(35854.79,43822.52]	$\gamma_{j,5}$	0.1	0.1
6	$\geq$ 43822.5	$\gamma_{j,6}$	0.2	0.2

Notes: The discount nursing home is negative for the three lowest income groups. As the maximum voucher for nursing home is insufficient to cover the cost for the lowest income groups, the system provides a financial complement.

Table A.5: **The value of τ, by care and income group**

	Annual Income Group		(1) Nursing Homes δ_{nh}	(2) Informal Caregiver δ_{ic}	(3) At home care (high) δ_{hch}	(4) At home care (low) δ_{hcl}	(5) Day Care Centre δ_{dcc}
1	$\leq$ 7967.73	$\gamma_{j,1}$	13.49	5.31	6.75	5.06	5.06
2	(7967.73,11951.6]	$\gamma_{j,2}$	10.96	5.31	6.75	5.06	5.06
3	(11951.6,19919.33]	$\gamma_{j,3}$	8.43	5.31	6.75	5.06	5.06
4	(19919.33,35854.79]	$\gamma_{j,4}$	8.01	5.05	6.41	4.81	4.81
5	(35854.79,43822.52]	$\gamma_{j,5}$	7.59	4.78	6.07	4.55	4.55
6	$\geq$ 43822.5	$\gamma_{j,6}$	6.75	4.25	5.40	4.05	4.05

Figure A.4: **Continuous vs Discontinuous schemes of benefits**



Notes: The average score under the bracket system of payment is computed directly with our data. To build the comparable allowances for each score under the smooth system of payment, we use the weighted average monetary value of a point, and then when multiply this value per each score. The weights used are the proportion of individuals by care option.