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

Catastrophic health care expenditures in Portugal between 2000-2010: Assessing impoverishment, determinants and policy implications

Ana Rita Galrinho Borges #533

Masters in Economics

A Project carried out on the area of Applied Policy Analysis under the supervision of

Professor Pedro Pita Barros

JUNE 2013

Abstract

Objectives: This work assesses the extent and evolution of catastrophic health care expenditures (CHE) in Portugal in the years of 2000, 2005 and 2010, to reveal household factors predicting this outcome, and simulates changes in 2010 CHE levels' following recent reforms in user charges and prices of pharmaceutical products.

Methods: The main contribution of this paper is the calculus and analysis of statistical measures to capture CHE incidence, intensity, income distribution and impoverishment effects on households using INE Household Budget Surveys. A logistic model to determine statistical significance and economic effects of 38 variables on the incidence of CHE is also estimated. Finally, a scenario analysis is presented to analyse reforms concerning user charges and prices of pharmaceuticals.

Results: Incidence and intensity of CHE decreased between 2000 and 2010, from 5,005% to 2,439% and 4,693% to 0,334%, respectively. During the period, CHE were concentrated amongst the poorer income quintiles. Statistical significance in CHE prediction for all analysed years was observed for households' income, smoking and drinking habits, area of the house and secondary education of the household head. Scenario analysis shows that the new levels of user charges in 2012, even if mitigated by the new and enlarged economic exemptions, would increase CHE incidence of 2010 to 3,529%. On the other hand, the reduction in the price of ambulatory pharmaceuticals in 2011 and 2012 is effective in reducing CHE incidence, for price demand elasticities equal or smaller (in absolute value) than 0,4. When the two effects are combined, CHE incidence increases, meaning that reductions in the price of pharmaceuticals are not sufficient to countervail the changes in user charges, even with enlarged economic exemptions.

Keywords: catastrophic health care expenditures (CHE); determinants; scenario analysis; Portugal.

1. Introduction

Guaranteeing the access of all citizens to health services by making funding available and setting the correct incentives to providers should be the purpose of health systems financing, according to the World Health Organization (2000). Portugal respects these principles, as the Portuguese Constitution (1976) defends the right to universal and comprehensive health services approximately free of charge.[1]

In this context, the debate over CHE gained relevance in 2000, when *The world health report* (World Health Organization, 2000) claimed that to increase the fairness and the financial risk protection in any health system,

[1]The right of Portuguese citizens to universal and extensive health services was firstly defined as "free of charge" in article 64 of the 1976 Portuguese Constitution. The change in the definition to "approximately free of charge" was made by the constitutional revision of 1989, and raised discussion until the present concerning the degree of allowed cost-sharing in Portugal.

prepayment or risk pooling mechanisms should be developed so as to avoid CHE by households. Several studies confirmed this view, showing that out-of-pocket payments with health care (OOP) and the inexistence of prepayment mechanisms are closely related with the occurrence of CHE.[2] Portugal is an interesting case study, because OOP accounted for more than one quarter of total health expenditures between 2000-2010, reaching 27,5% in 2010 (OECD, 2012b). The study of CHE addresses the impacts of the economic crisis that the country is facing, which led to substantial reforms in its health system, many under the Memorandum of Understanding (MoU) ruling the financial rescue since May 2011.

This research work has two main objectives. The first is to analyse the extent and evolution of CHE in Portugal in the years of 2000, 2005 and 2010, and to assess household factors predicting this outcome. My contribution to the literature is the calculus of statistical measures for Portugal in the three years that capture incidence, intensity, income distribution and impoverishment effects of CHE. I innovate by calculating CHE according to most definitions in the literature, even though I only present in the main work the more universal measure of CHE: OOP that equal or exceed 40% of households' capacity to pay.[3] My findings show that even though CHE incidence in Portugal decreased between 2000 and 2010, from 5,005% to 2,439%, these values are significantly above the average of a group of 89 countries.[4] I prove that CHE have been concentrated on lower income quintiles, which reveals lack of social support for this vulnerable group. I also find that statistically significant factors predicting CHE are small, and that their economic effects are counterintuitive in some aspects. Income has a negligible economic effect on the likelihood of CHE occurrence, while smoking and drinking habits are associated with its decrease.

The second purpose of this work is to determine effects on CHE (using 2010 levels as baseline) of increases in user charges in conjunction with enlarged economic exemptions and the reduction of pharmaceuticals' prices. Such a relationship has never been studied for Portugal, and constitutes an important tool for policy making. I find that increases in user charges raise CHE incidence in 2010, even with improved economic exemptions. Reduction in the prices of pharmaceuticals in 2011 and 2012 reduce the extent of CHE in 2010, using price demand elasticities between -0,4 and 0. The combination of the two measures always increases CHE incidence.

[2] Wagstaff et al. (2003); Xu et al. (2003); Waters et al. (2004); Habitch et al. (2006); Knaul et al. (2006); Saksena et al. (2006); Xu et al. (2007); van Doorslaer et al. (2007); Ekman (2007); Gotsadze et al. (2009); Yardim et al. (2010) and Hajizadeh et al. (2011).
[3] Xu (2005) and O'Donnell et al. (2008).
[4] Xu et al. (2007).

This study is organized as follows. Section 2 presents a literature review on the measurement of CHE incidence, intensity, income distribution, impoverishment effects and determinants. The description of the data and the methodology is addressed in section 3. Section 4 contains the empirical results of CHE measurement in Portugal between 2000 and 2010, including a logistic regression model to investigate its determinants. A scenario analysis to evaluate recent reforms in the Portuguese health system concerning user charges and prices of pharmaceuticals is presented in section 5. Finally, section 6 concludes.

2. Literature review

Research concerning CHE is vast and may be divided in three groups: region or country specific, multi-country and conceptual.

Wagstaff and van Doorslaer (2003) were pioneers in the definition of CHE by two different approaches. In the first one, households' OOP were assessed relatively to total expenditure and considered catastrophic when they equalled or exceeded a threshold for which the authors attributed several values: 2,5%; 5%; 10% and 15%. Their second measure assessed households' OOP with respect to their capacity to pay, i.e, total expenditure except the subsistence need. These payments were considered catastrophic if they equalled or exceeded a threshold which took the values 10%; 15%; 20%; 25%; 30% and 40%. The authors also developed several measures to assess the incidence, intensity, distribution and impoverishment caused by OOP.

Xu et al. (2003) provided a more precise in the definition of CHE and the conditions for its existence. CHE occurred whenever OOP as a percentage of capacity to pay equalled or exceeded 40%. They identified three pre-requisites for the occurrence of catastrophe: the existence of health services requiring OOP, low capacity to pay and the lack of prepayment mechanisms of financial protection, such as health insurance. Besides that, they highlighted the limitations of CHE measures, namely the failure to capture CHE in households so poor that they cannot even have access to medical services.

Both pioneer studies applied their measures; to Vietnam in the case of Wagstaff and van Doorslaer (2003) and to 59 countries in Xu et al. (2003). This promoted studies for countries as diverse as the USA (Waters et al, 2004), Estonia (Habicht et al, 2006), Mexico (Knaul et al, 2006), Kenya (Saksena et al, 2006), Asian countries (van Doorslaer et al, 2007), Zambia (Ekman, 2007), Georgia (Gotsadze et al, 2009), Turkey (Yardim et al, 2010) and Iran (Hajizadeh et al, 2011). Xu et al. (2007) have also performed a cross-country analysis on 89

countries. Overall, these studies document that CHE exists in all countries, even though with great variability among them. They also document that CHE is caused by the extent of OOP in health systems.[5]

3. Data and methodology

3.1 Survey description

Data comes from the Portuguese Household Budget Survey (*Inquérito às Despesas das Famílias*) for the years of 2000, 2005 and 2010. This survey is carried out every five years by Statistics Portugal (INE). It contains annualized data describing Portuguese individuals and households expenditure structure and income distribution. The household is here the unit of analysis. This implies 10200 households in 2000, 10403 in 2005 and 9489 in 2010, in a nationally representative sample. The sampling weights developed by INE are used. They reflect the unequal selection probability of each household in the sample, in statistical and econometric work.[6]

3.2 Catastrophic health care expenditures

3.2.1 Definition

CHE occur when households spend more than a given fraction of their resources in health care. The economic intuition behind this concept is that all households should be able to spend a given fraction of their resources on other goods and services besides health, and whenever they cannot due to excessive OOP, their opportunity cost becomes catastrophic. This means that the calculus of CHE is based on two key variables: households' OOP and their resources. In addition, it is crucial to define a threshold above which health care costs are considered catastrophic.

OOP are a cost-sharing financing method of health systems whose purpose is to contain and regulate the demand for health care, i.e, control moral hazard. They may exist in public or private arrangements and take two forms: co-payments or user charges, whereby the user pays a fixed fee for a good or service, or co-insurance, with the consumer paying a fraction of the final fee.

The definition of household resources is more complex. Two variables are available to researchers: income and expenditure (O'Donnell et al, 2008). The main difference between them is that income is not directly responsive to health care financing, while expenditure is. This is a disadvantage as the ratio of health care costs as a fraction of income will not take into account health financing sources. For instance, consider two households

[5] For the specific findings of each country study, an interested reader may refer to "Annex A – Detailed literature review".
[6] A more interested reader may refer to "Annex B – The importance of using sample weights" to understand the reasons behind the use of weights in statistical and econometric modelling.

that have the same level of OOP and income but different saving levels, i.e, while one finances health care from its savings, the other must cut back on current expenditure to pay for it. The ratio of OOP to income will be the same for both households, but assuming that current consumption has a sufficiently high opportunity cost, the occurrence of CHE may be more likely for the household without savings. This is only possible to measure if expenditure is used as the denominator in the definition of CHE. Still, measuring CHE based on the fraction of OOP relatively to total expenditure ignores that health spending tends to be income elastic. As such, poorer households may not register relatively greater health expenses as they face subsistence constraints with goods such as food (O'Donnell et al, 2008), while in reality they are more prone to suffer from CHE. A partial solution to the problem is to define CHE with respect to capacity to pay (Wagstaff and van Doorslaer, 2003; Xu et al, 2003). This corresponds to the difference between total spending and the subsistence spending of a household, which in turn is generally defined as the median food expenditure for the sample in analysis[7], adjusted for the household size (Xu, 2005).[8] Besides, only OOP greater than 0 should be considered in the calculus of CHE. Otherwise, households so poor that they have no expenditure in health care would be miscounted as not having incurred in CHE.

The threshold above which the ratio of OOP relatively to capacity to pay is considered catastrophic depends on the purpose of the work and on the country analysed (O'Donnell et al, 2008). The most common threshold in the literature when capacity to pay is used as the denominator in the calculus of CHE, 40%, is also adapted here.[9]

Analytically, let Y be OOP, x the total household expenditure, $f(x)$ the household subsistence spending and z the chosen threshold. A household i is said to incur in CHE if: $\frac{Y_i}{[x_i - f(x_i)]} \geq z \ \wedge Y_i > 0$ where $z = 40\%$ (1).

3.2.2 Measuring incidence and intensity

[7] The use of the median instead of the arithmetic average is related with the possible existence of outliers, which tend to bias the value for the arithmetic average, but not the median.

[8] The adjustment for household size is necessary to reflect economies of scale that might arise in the consumption of goods by households, i.e, the needs of a household with factors such as housing space and water do not grow proportionally to their size. Based on OECD (2013) an adjustment for household size using the square root equivalent scale is made. It should be noted that a scale where each household member is weighted by 0,6 instead of 0,5 is also commonly used (Xu, 2005).

[9] See "Annex C – Incidence and intensity measurement of CHE using different approaches to the concept", where CHE incidence and intensity measures for 2000, 2005 and 2010 in Portugal are calculated relatively to total expenditure and capacity to pay using a wider range of thresholds: 10%, 20% and 30% with respect to capacity to pay and 2,5%, 5% and 15% relatively to total expenditure. I also include incidence measures of CHE using an extended basket definition proposed by Evetovits et al. (2012), which adds utility bills and clothing to the subsistence basket, besides food. Finally, I compute distribution-sensitive measures of CHE relatively to 10% of total expenditure, as an example of the performance of different definitions of CHE in this type of measures.

The incidence of CHE, measured by the CHE headcount, corresponds to the fraction of households with OOP as a share of capacity to pay which equal or exceed the chosen threshold of 40%. Defining an indicator E which equals 1 when condition (1) is satisfied and 0 otherwise, an estimate of CHE headcount is: $H = \frac{1}{N}\sum_{i=1}^{N} E_i$ (2) where N is the sample size.

However, this measure does not indicate the amount by which CHE exceed the chosen threshold, i.e, their intensity. Hence, I define the mean CHE overshoot, which shows the average degree by which OOP as a fraction of capacity to pay exceed the threshold z of 40%: $O = \frac{1}{N}\sum_{i=1}^{N} O_i$, with $O_i = E_i\left(\left(\frac{Y_i}{x_i - f(x_i)}\right) - 40\%\right)$ (3).

The two measures are related by the mean positive overshoot, which describes the amount of overshoot among households incurring in CHE: $MPO = \frac{O}{H}$ (4).

3.2.3 Distribution-sensitive measures of CHE

Under diminishing marginal utility of income, the opportunity cost of health expenses for poor households tends to be greater than for the rich. To place a social welfare interpretation on the assessment of CHE, measures that weight this differential opportunity cost for poor and rich households are needed. One technique is to compute the concentration indexes for CHE headcount – C_E – and overshoot – C_O. These are defined against a concentration curve plotting the cumulative share of the sample ranked by income level on the *x*-axis and the cumulative share of those exceeding the catastrophic threshold on the *y*-axis, and correspond to twice of the area between the concentration curve and the line of equality. To compute them, I use a formula by Kakwani et al. (1997) which establishes a "convenient regression" of a transformation of the health variable of interest (CHE headcount or overshoot, in this case) on the fractional rank in the income distribution: $2\sigma_r^2\left(\frac{h_i}{\mu}\right) = \alpha + \beta r_i + \varepsilon_i$ (5), where σ_r^2 is the variance of the fractional rank, h_i is the health variable being studied, μ is its mean, β the estimation of the concentration index and ε_i the error term. Note that given data characteristics, the weighted fractional rank is used and given by: $r_i = \sum_{j=0}^{i-1} wj + \frac{wi}{2}$ (6), where w_i is the sample weight scaled to sum 1, observations are in ascending order of income, and $w_0 = 0$.

A positive value for these concentration indexes indicates a greater tendency for better-off households to exceed the catastrophic threshold or to have a greater overshoot, respectively. A negative value, on the other hand, indicates that poorer households are more likely to exceed the catastrophic threshold or to have more overshooting, respectively.

A second approach is to adjust headcount and overshoot measures to reflect the distribution of income across the population, giving more weight to poorer than richer households. Wagstaff and van Doorslaer (2003) showed that the adjustment of these measures is given by multiplying their value by the complement of the respective concentration index, as in: $H^w=H.(1-C_E)$; $O^w=O.(1-C_o)$ (7).

Intuitively, if those who have catastrophic payments or greater overshooting of CHE are poorer households, concentration indexes are negative, which makes the weighted indexes greater than their non-weighted counterparts. This means that the CHE problem in the analysed data is worse than it appeared, as it tends to be concentrated on poorer households. Conversely, if the better-off that tend to exceed catastrophic threshold or have greater overshooting, concentration indexes are positive, and non weighted indexes exceed their weighted counterparts.

3.2.4 Health care costs and impoverishment

The measures of CHE already described are insufficient to establish a relationship between impoverishment and health care costs. Hence, in this subsection, I adjust standard measures of poverty to reflect the impoverishment caused by OOP.

First, I define a poverty line (PL) against which poverty measures are calculated.[10] Since this study analyses Portugal in three distinct years, I use relative PLs (one for each year) and for simplicity and comparability they are based on current methodology of the OECD (2012a). An individual is considered poor if its equivalised disposable household monetary income falls below 60% of the median for Portugal in each year. Equivalised refers to the fact that household income is adjusted by the square root of household size.

Poverty measures that reflect the impoverishment effect of health care costs neither correspond to gross measurements of poverty based on total household resources (these underestimate poverty, as some OOP are deemed as necessary and should not be included as part of households' resources) nor to poverty measures net of OOP (these would overestimate poverty, as some OOP are not essential for living).[11] Their best estimate is the difference between gross and net poverty estimates of OOP if they are completely nondiscretionary and total household resources are fixed (Wagstaff and van Doorslaer, 2003). These two conditions rarely verify, as they do not in this study. Besides the fact that health care costs may be discretionary, a household that chooses to

[10] PLs may be absolute or relative. Absolute PLs are defined relatively to an absolute amount of household expenditure per capita or a basic consumption basket, and are independent of time and place. On the other hand, relative PLs depend on time and place and aim at assessing whether individuals can achieve the same living standards of their peers in society.

[11] According to O'Donnell et al. (2008), health care expenditure is a basic need when it supports essential treatment for living. A practical example is the purchase of pharmaceutical products for chronic conditions.

spend excessively on health care is not necessarily driven below a PL: since its resources are not fixed, it may borrow, sell assets or receive transfers to cover its expenses. For these reasons, the difference between poverty measures gross and net of OOP cannot be interpreted as the change in poverty that would arise if those payments are eliminated. Nonetheless, they are a good indicator of the scale of the impoverishment effect of health payments (Wagstaff and van Doorslaer, 2003).

Let Y be the household per capita spending with OOP, x the per capita income, i each household and PL the relative poverty line.[12] A first measure is the added poverty headcount ratio (H^{added}), i.e, the differential between poverty headcounts gross (H^{gross}) and net of OOP (H^{net}), which gives the fraction of people living in poverty due to OOP. Analytically: $H^{added} = H^{gross} - H^{net} = \frac{\sum_{i=1}^{N} s_i p_i^{gross}}{\sum_{i=1}^{N} s_i} - \frac{\sum_{i=1}^{N} s_i p_i^{net}}{\sum_{i=1}^{N} s_i}$ (8), where N are households in the sample, s_i is the size of the household, pi^{gross} is a dummy variable equal to 1 if $x_i \leq$PL and 0 otherwise and pi^{net} is a dummy variable equal to 1 if $(x_i - Y_i) \leq$PL and 0 otherwise.

A second measure is the added poverty gap (G^{added}), which takes into account the intensity of poverty, i.e, the amount by which households fall short of reaching the PL due to OOP. It corresponds to the difference between gross (G^{gross}) and net of OOP (G^{net}) poverty gaps: $G^{added} = G^{gross} - G^{net} = \frac{\sum_{i=1}^{N} s_i g_i^{gross}}{\sum_{i=1}^{N} s_i} - \frac{\sum_{i=1}^{N} s_i g_i^{net}}{\sum_{i=1}^{N} s_i}$ (9), where g_i^{gross} measures the individual-level gross poverty gap, given by $pi^{gross}.(PL - x_i)$, and g_i^{net} the individual-level net poverty gap, as in $pi^{net}.(PL - (x_i - Y_i))$. For a more direct interpretation, G^{added} may be normalized in terms of the PL, which is done through division by the relative value of the PL.

Finally, the intensity of added poverty alone may be computed by defining an added mean poverty gap, as in: $MPG^{added} = \frac{G^{added}}{H^{added}}$ (10). This measure may also be normalized by the PL. It gives a more direct interpretation of the added poverty gap (G^{added}), which corresponds to the fraction of households impoverished by OOP (H^{added}) multiplied by the average deficit of the impoverished by these costs (MPG^{added}).

3.3 Econometric modelling of CHE determinants

3.3.1 Determinants of CHE

The choice of variables as likely determinants of CHE considers three parameters: their interest for the research project, the availability of data, and the potential problems they might pose. I test a total of 38 variables,

[12] Following Wagstaff and van Doorslaer (2003) and O'Donnell et al. (2008), I use income as the per capita standards living proxy for the population in the calculus of impoverishment due to health care costs.

grouped within 5 categories: financial determinants, household characteristics, NUTS II regions, health related factors and housing determinants.[13] These variables are described in the following table:[14]

Table 1 - Description of independent variables

Variable	Definition
Financial determinants	
Income	Disposable annual income of the household, in Euros.
Employed Ratio	Fraction of employed individuals per household.
Unemployed Ratio	Fraction of unemployed individuals per household.
Household characteristics	
Seniors Ratio	Individuals with 60 or more years/ Number of household members.
Juniors Ratio	Individuals with 14 or less years/ Number of household members.
Household Size	Number of individuals per household.
Urban; Semi-Urban or Rural	Equal 1 if the individual lives in the area type, 0 otherwise. Rural is the base group in econometric modelling.
Household Head (HH) Gender	Takes the value 1 if male and 0 if female.
HH Aged 20-29; 30-39; 40-49; 50-59; 60-69 or 70 onwards.	Equal to 1 if the HH has x to y years (excluded); 0 otherwise. HH Aged 20-29 years is the base group in econometric modelling.
HH with no education; 4th grade; 6th grade; 9th grade; secondary education or higher education.	Equal 1 if the HH has the respective level of education; 0 otherwise. HH with no education is the base group in econometric modelling.
NUTS II regions	
North; Center; Lisbon; Alentejo; Algarve; Azores and Madeira	Take the value 1 if true and 0 otherwise. Algarve is the omitted region in the econometric modelling.
Health related factors	
Smoking	Equals 1 if there are smoking expenses in the household, 0 otherwise.
Drinking	Equals 1 if there are drinking expenses in the household, 0 otherwise.
Incapacity[a]	Equals 1 if the household receives a disability pension, 0 otherwise.
Housing determinants	
Running Water[b]	Equals 1 if the household has running water; 0 otherwise.
Electricity[b]	Equals 1 if the household has electricity; 0 otherwise.
Sanitary[b]	Equals 1 if the household has sanitary equipment; 0 otherwise.
Construction Year until 1949; between 1950-1959; 1960-1969; 1970-1979; 1980-1989; 1990-1999 or 2000 onwards[b]	Equal 1 if the household house was built in the period; 0 otherwise. Construction year until 1949 is the base group in econometric modelling.
Area[b]	Area of the primary lodging of the household, in m^2.
Notes	***[a] Variable not available for 2005; [b] Variable not available for 2000.***

3.3.2 The model

The dependent variable, the existence of CHE (y) is a limited dependent variable which takes a binary form: y=1 if the household incurs in CHE and y=0 otherwise.

[13] Refer to "Annex D - Motivation for the choice of independent variables" for an explanation of reasons behind the choice of these regressors.
[14] For the descriptive statistics of these variables in each year, refer to "Annex E – Variables descriptive statistics".

A regression model is parameterized so that the probability p of having CHE is: $p_i = Pr(y_i = 1|x) = F(x_i'\beta) = \frac{e^{xi'\beta}}{1+e^{xi'\beta}}$ (11), where $F(.)$ is a cumulative distribution function ensuring that $0 \leq p \leq 1$. In this case, CHE are modelled through the logit model, so $F(.)$ is the logistic distribution.[15]

The coefficients in the logit model are interpreted as the change in the logit for a unit change in the explanatory variable, i.e, they are the log-odds, corresponding to $x'\beta = ln\frac{p}{1-p}$ (12). To have a more informative measure, I report the odds ratio, which gives the odds of an event occurring relatively to the odds of another event. These are computed as the exponential of the reported coefficient, i.e, $e^{(x'\beta)} = \frac{p}{1-p}$ (13), and vary between 0 and positive infinity. When the odds ratio is below 1, a regressor x has lower probability of causing y than the comparator; when it is above 1, the regressor has a greater chance of driving y than the baseline; a value of 1 means that both regressors have the same probability of causing y.

Marginal effects, generally used to analyse the magnitude of a given regressor, are observation specific in the logit model, and so the choice of where to report them is necessary to avoid inconsistencies, as the following expression shows: $\frac{dp_i}{dx_{ij}} = p_i(1-p_i)\beta_j$ (14). Given this, I report the average marginal effects (AMEs). They compute the marginal effect of a regressor for each household in the sample and present as final output their average. In doing so, they avoid the specification problems of choosing a representative category or use marginal effects at the mean.[16]

I also report the predicted probabilities of CHE between the minimum and the maximum level of each regressor, i.e, the marginal change in probability due to a unitary change in one regressor, conditional on specified values of other regressors. For dummy variables, this change is from 0 to 1 and for continuous variables the change is between their minimum and maximum values, specific to the sample year being used.

Finally, I present the p-value of the t-test (p) and of the Wald test to determine whether individual and joint coefficients are statistically significant, respectively. The Pseudo R^2 is used to measure the overall quality of fit of the model.

4. Results

4.1 Incidence and intensity of CHE

[15] For a deeper understanding of the choice of the logit model, refer to "Annex F – Why the logistic model?".

[16] Representative categories were difficult to pick in this study given the great number of variables and the existence of three databases whose representative category differed. Marginal effects at the mean of regressors did not make sense given the existence of dummy variables whose mean is not binary and the fact that no real household would have all regressors at the mean.

Table 2 reports the results by NUTS II region and across income quintiles.

Table 2 - Incidence and intensity of CHE in Portugal in 2000, 2005 and 2010: overall, by Nuts II region and income quintile

	2000	2005	2010	*Trend 2000-2005*	*Trend 2005-2010*
Incidence - CHE headcount					
40%	5,005%	3,177%	2,439%	*-1,828 p.p*[17]	*-0,738 p.p*
Standard Error	*0,003*	*0,002*	*0,002*		
Intensity - CHE overshoot					
40%	4,693%	0,799%	0,334%	*-3,894 p.p*	*-0,466 p.p*
Standard Error	*0,017*	*0,002*	*0,000*		
Incidence vs intensity - Mean positive overshoot					
40%	93,772%	25,166%	13,681%	*-68,606 p.p*	*-11,484 p.p*
By NUTS II region					
North	3,527%	3,011%	2,439%	*-0,516 p.p*	*-0,572 p.p*
Standard Error	*0,004*	*0,004*	*0,003*		
Center	6,097%	3,836%	2,485%	*-2,261 p.p*	*-1,351 p.p*
Standard Error	*0,006*	*0,004*	*0,004*		
Lisbon	4,990%	2,287%	2,264%	*-2,702 p.p*	*-0,023 p.p*
Standard Error	*0,006*	*0,004*	*0,004*		
Alentejo	7,315%	5,350%	2,969%	*-1,964 p.p*	*-2,381 p.p*
Standard Error	*0,007*	*0,006*	*0,005*		
Algarve	7,794%	2,749%	1,827%	*-5,045 p.p*	*-0,922 p.p*
Standard Error	*0,007*	*0,004*	*0,004*		
Madeira	5,832%	3,964%	3,062%	*-1,868 p.p*	*-0,902 p.p*
Standard Error	*0,006*	*0,005*	*0,006*		
Azores	7,331%	2,552%	3,090%	*-4,779 p.p*	*0,538 p.p*
Standard Error	*0,007*	*0,005*	*0,006*		
By income quintile					
1st	15,711%	8,519%	5,556%	*-7,192 p.p*	*-2,963 p.p*
Standard Error	*0,012*	*0,008*	*0,005*		
2nd	8,218%	5,558%	2,283%	*-2,660 p.p*	*-3,275 p.p*
Standard Error	*0,009*	*0,006*	*0,004*		
3rd	3,384%	1,930%	1,112%	*-1,454 p.p*	*-0,818 p.p*
Standard Error	*0,006*	*0,004*	*0,003*		
4th	1,417%	0,854%	0,813%	*-0,563 p.p*	*-0,041 p.p*
Standard Error	*0,004*	*0,002*	*0,003*		
5th	0,393%	0,593%	0,681%	*0,200 p.p*	*0,088 p.p*
Standard Error	*0,002*	*0,002*	*0,003*		

The proportion of Portuguese households incurring in CHE decreased between 2000 and 2010, with a greater reduction between 2000 and 2005 than between 2005 and 2010. Indeed, the 5,005% of households exceeding the threshold in 2000 fell to 3,177% in 2005 and 2,439% in 2010, less than half. Despite the decreasing trend in all indicators, the incidence of CHE in Portugal is above that of many countries. In Xu et al. (2007), an incidence analysis of CHE in 89 countries between 1990 and 2003 showed that it varied between 0,01% in countries such as Czech Republic and Slovakia and 10,5% in Vietnam, with an average level of 2,3% and a median of 1,47%. Portugal, in the three years in analysis, has failed to reach at least the average level of this study, which confirms the worrisome degree of the problem.

Concerning the intensity of CHE between 2000 and 2010, this also decreased, from 4,693% in 2000 to 0,799% in 2005 and 0,334% in 2010. Again, the reduction was more pronounced between 2000 and 2005 than

[17] The abbreviation "p.p" stands for percentage points.

2005 and 2010. There are not many studies for countries with similar characteristics to Portugal in terms of GDP or years in analysis which compute intensity of CHE. Wagstaff and van Doorslaer (2003), who did it for Vietnam in 1993 and 1998, found overshoot levels of 0,92% and 0,61%, respectively, which are below the values for Portugal in 2000 and 2005. Nonetheless, a cross-country comparison of this measure is difficult.

The mean positive gap also decreased between 2000 and 2010, with a more pronounced reduction between 2000 and 2005. This decrease is caused by a larger reduction of intensity of CHE compared to the decrease in the headcount, and means that among households with CHE, the amount by which they exceed the 40% threshold has been decreasing.

At a regional level, the incidence of CHE varied considerably in the three years. Overall, the decreasing trend in CHE levels in the country was also visible across regions between 2000 and 2010, with the exception of Azores between 2005 and 2010. It is interesting to note that in 2000, the region where households incurring in CHE were more concentrated was Algarve, and the least affected by the problem was the North. In 2005, Alentejo was the most affected region and Lisbon the least. The region with the greatest improvement from 2000 turned to be Algarve, the worst performer before. In 2010, Algarve becomes the least affected region by CHE and Azores the most. Alentejo, the most affected region by CHE in 2005, has the greatest reduction in CHE during the period.

There are also differences in the number of the households incurring in CHE by income quintile. The poorest income quintile (1st) registers the higher levels of incidence, and this decreases from poorer to richer quintiles, in the three years analysed. This feature is common in the literature, having been found for Vietnam (Wagstaff and van Doorslaer, 2003), the USA (Waters et al, 2004), Estonia (Habitch et al, 2006), Kenya (Saksena et al, 2006), Georgia (Gotsadze et al, 2009), Iran (Hajizadeh et al, 2011) and on the multi-country study of Xu et al. (2003). Income quintiles until the 4th (inclusive) had a reduction in CHE incidence during the period, while it has been increasing slightly in the richest income quintile, for all years in analysis. The reduction in CHE incidence was always greater the poorer the income quintile. The decrease in CHE occurrence between 2000 and 2010 was mostly driven by the poorest income quintiles.

4.2 Distribution-sensitive measures of CHE

Table 3 - Income sensitive measures of CHE for Portugal, 2000-2010

	2000	2005	2010	*Trend 2000-2005*	*Trend 2005-2010*
Concentration index for CHE headcount	-13,020%	-7,287%	-5,426%	*5,734 p.p*	*1,861 p.p*
Robust Standard Error	*0,008*	*0,006*	*0,006*		
Rank-weighted headcount	5,651%	3,407%	2,562%	*-2,244 p.p*	*-0,846 p.p*

Concentration index for CHE overshoot	-18,244%	-2,415%	-0,957%	*15,829 p.p*	*1,458 p.p*
Robust Standard Error	*0,074*	*0,006*	*0,002*		
Rank-weighted overshoot	5,549%	0,819%	0,337%	*-4,730 p.p*	*-0,482 p.p*

The concentration index for CHE headcount is always negative, meaning that CHE are concentrated amongst the poorer income quintiles. The result is in accordance with previous studies by van Doorslaer et al. (2004), Simões et al. (2008) and Bago d'Uva et al. (2009) which based on utilization measures, concluded that the Portuguese health system tends to be pro-rich. The results also show that CHE concentration on poorer households is being attenuated. Progress was stronger between 2000 and 2005 than 2005 and 2010, either due to diminishing returns or a negative impact of the economic crisis in Portugal since 2008.

4.3 Health care costs and impoverishment

Table 4 - Poverty impact of OOP in Portugal for 2000-2010 taking into account each year relative PL

	2000: PL of 5591,634€			**2005: PL of 4615,569€**			**2010: PL of 7101,408€**		
	Gross	**Net**	**Diff.**	**Gross**	**Net**	**Diff.**	**Gross**	**Net**	**Diff.**
Poverty headcount	14,460%	17,357%	2,897%	14,503%	18,618%	4,115%	13,617%	17,415%	3,798%
S.E	*0,004*	*0,005*		*0,005*	*0,005*		*0,006*	*0,006*	
Poverty gap (1 Euro)	250,835	354,236	103,401	173,015	282,085	109,070	219,586	323,522	103,935
S.E	*0,084*	*0,128*		*0,072*	*0,096*		*0,125*	*0,144*	
N. poverty gap	4,486%	6,330%	1,844%	3,748%	6,110%	2,362%	3,090%	4,556%	1,466%
S.E	*0,002*	*0,002*		*0,002*	*0,002*		*0,002*	*0,002*	
N. mean positive gap	31,020%	36,500%	5,480%	25,840%	32,830%	6,990%	22,710%	26,160%	3,450%
S.E	*0,006*	*0,009*		*0,007*	*0,007*		*0,008*	*0,007*	

The incidence of impoverishment associated with health care payments (column "Diff") has varied from 2,897% (2000) to 4,115% (2005). It increased between 2000 and 2005, decreasing in 2010. The poverty gap, its normalized counterpart and the normalized mean positive gap also followed this trend. Given the evolution of the added poverty gap and headcount, the trend of the normalized mean positive gap implies that the rise in health impoverishment in 2005 was due to a rise in poverty intensity and that its decrease in 2010 was caused by a decrease of poverty intensity.

Overall, an increase in the incidence and intensity of impoverishment caused by OOP occurred between 2000 and 2005, with a reduction in 2010. Although this may seem counterintuitive due to the constant reduction of CHE during the period, note that while catastrophe is measured relatively to households' capacity to pay, impoverishment is measured relatively to their income. Confirming this hypothesis, Knaul et al. (2006) also found unrelated trends across the years for CHE and health impoverishment in Mexico. Besides that, since PLs

vary across the different years analysed, the evolution of health impoverishment may not be as meaningful as the absolute values of each measure.

4.4 Econometric modelling of CHE determinants

Table 5 – Coefficient and odds-ratios from logistic regression to assess CHE determinants for Portugal, 2000-2010[18]

	2000		2005		2010	
Number of observations	10020		10403		9342	
P-value of Wald test	0,000%		0,000%		0,000%	
Pseudo-R2	23,660%		21,710%		17,480%	
	Odds	**Coeff.**	**Odds**	**Coeff.**	**Odds**	**Coeff.**
Financial determinants						
Income	1,000	0,000***	1,000	-0,000*	1,000	-0,000**
Employed Ratio	0,428	-0,848**	0,596	-0,517	0,332	-1,103**
Unemployed Ratio	0,785	-0,242	1,436	0,362	1,403	0,339
Household characteristics						
Seniors Ratio	2,020	0,703	3,671	1,301***	2,707	0,996
Juniors Ratio	0,107	-2,232	0,810	-0,211	0,176	-1,736
Household Size	0,998	-0,002	1,171	0,158	1,179	0,165*
Urban	1,197	0,180	0,656	-0,422**	0,906	-0,098
Semi-Urban	1,057	0,056	0,567	-0,567***	0,883	-0,124
HH Gender	1,013	0,013	2,359	0,858**	1,004	0,004
HH Aged 30 to 40	5,407	1,688**	21,861	3,085***	3,154	1,149
HH Aged 40 to 50	1,169	0,156	12,663	2,539**	2,966	1,087
HH Aged 50 to 60	5,927	1,780**	31,498	3,450***	2,051	0,718
HH Aged 60 to 70	5,455	1,697**	24,768	3,210***	1,604	0,473
HH Aged 70 or more	7,065	1,955**	32,888	3,493***	1,507	0,410
HH with 4th grade	0,790	-0,236	0,850	-0,163	0,548	-0,602***
HH with 6th grade	0,507	-0,679	1,027	0,027	0,386	-0,951*
HH with 9th grade	0,582	-0,541	0,524	-0,647	0,403	-0,909**
HH with Secondary Education	0,179	-1,721*	0,192	-1,651*	0,156	-1,856***
HH with Higher Education	0,423	-0,859	0,162	-1,821*	0,579	-0,546
NUTS II regions						
North	0,629	-0,463***	1,133	0,125	1,360	0,307
Center	0,754	-0,282*	1,108	0,103	0,989	-0,011
Lisbon	0,942	-0,059	1,184	0,169	1,328	0,284
Alentejo	0,817	-0,202	1,209	0,190	1,005	0,005
Azores	1,567	0,449***	1,111	0,106	2,048	0,717**
Madeira	0,769	-0,262	1,612	0,477**	1,651	0,501
Health related factors						
Smoking	0,284	-1,259***	0,479	-0,736***	0,393	-0,933**
Drinking	0,616	-0,485***	0,498	-0,697***	0,604	-0,504**
Incapacity	1,530	0,425	-	-	0,643	-0,441
Housing determinants						
Running Water	-	-	0,710	-0,342	0,466	-0,763*
Electricity	-	-	0,812	-0,208	1,188	0,172
Sanitary	-	-	0,676	-0,391	1,144	0,134
Construction Year 1950-1959	-	-	0,987	-0,013	1,167	0,154
Construction Year 1960-1969	-	-	0,897	-0,108	0,806	-0,215
Construction Year 1970-1979	-	-	1,008	0,008	0,465	-0,766***
Construction Year 1980-1989	-	-	0,708	-0,345	0,750	-0,288
Construction Year 1990-1999	-	-	0,660	-0,415	0,765	-0,268

[18] See "Annex G – Standard errors and t statistics" for the standard errors and t-statistics from this regression.

Construction Year 2000 Onwards	-	-	1,723	0,544	0,403	-0,909
Area	-	-	0,881	-0,127***	0,939	-0,063**
Constant	0,032	-3,444***	0,004	-5,509***	0,086	-2,452**
Notes	****** p<0,01; **p<0,05; *p<0,10***					

I now proceed to an analysis by category of statistical and ceteris paribus economic significance of each regressor, measured respectively by the coefficients and the odds-ratio (conjugated with predicted probability changes and AMEs).[19]

4.4.1 Financial determinants

In this category, the variable ***Income*** is the only that is statistically significant in the three years at least at 10%, but its economic impact in the occurrence of CHE is quite small. Indeed, its odds ratio of 1 suggests that there is no difference in income levels relatively to CHE incidence. The AME of ***Income*** implies the same, as it is always 0. Based on descriptive statistics and the works of Habitch et al. (2006); Xu et al. (2007); Ekman (2007); Gotsadze et al. (2009) and Hajizadeh et al. (2011), the odds-ratio of ***Income*** was expected to be lower than 1, implying a lower probability of incurring in CHE for wealthier households.[20] Controlling for variables such as ***Education*** levels, ***Smoking***, ***Drinking*** and all from the category of housing determinants (which are correlated with ***Income***) the economic impact of ***Income*** on CHE occurrence is the same.[21] Still, the difference in the predicted probability of CHE between the household with the maximum income and the household with the lowest one shows differentiated economic impacts of ***Income*** on CHE incidence, as it is 4% in 2000, 1,9% in 2005 and 2,2% in 2010. Also, further tests of the economic impact of ***Income*** on CHE through the creation of dummy variable for each income quintile in the three years confirm that it varies across quintiles.[22]

Employed Ratio is statistically significant for 2000 and 2010 at a 5% level, and its odds ratio always below 1 suggests households with employed individuals have lower probability of incurring in CHE. The AME of ***Employed Ratio*** confirms this idea, as it is always negative. Also, there is a negative change in the probability of CHE when households increase the ratio of employed individuals from 0 to 1, of -1,2% in 2000, -0,6% in 2005 and -1,1% in 2010. This is in line with economic theory and the findings of Habitch et al. (2006), Ekman (2007) and Yardim et al. (2010).

Unemployed Ratio is not statistically significant to determine the occurrence of CHE. It is economically interesting to note that its odds ratio is only above 1 in 2005 and 2010. An odds-ratio for ***Unemployed Ratio***

[19] Predicted probability changes from minimum to maximum values of the variables and AMEs may be found in Table i of the section Annexes.
[20] Refer to "Annex H – Expected economic effects of CHE determinants" to a broad discussion of the expected economic effects of these variables.
[21] Refer to "Annex I – Controlling for income effects" for a detailed overview of these tests.
[22] See footnote 21.

above 1 would indeed indicate that households with unemployed individuals have higher probability of incurring in CHE. The fact that the odds ratio for ***Unemployed Ratio*** is below 1 in 2000 is related with the existence of few households with at least one unemployed in this sample (only 6,776%, which contrasts with 12,506% in 2005 and 13,742% in 2010) and their particular characteristics regarding low incidence of CHE, in contrast with the 2005 and 2010 samples.

4.4.2 Household characteristics

The only variable statistically significant in the three years at least at 10% in this category is ***HH with Secondary Education***. Households whose head has secondary education are less likely to incur in CHE than those where the household head has no education. The other dummy variables related to education, even though not statistically significant at the usual levels in the three years, have a lower than 1 odds ratio (with the exception of ***HH with 6th grade*** for the 2005 sample). Economically, this result is interesting, as it shows that a degree of education for the household head decreases the odds of incurring in CHE compared to none. Similar economic effects have been found by Hajizadeh et al. (2011).

The dummy variables related to ***Ages of the HH*** are statistically significant in 2000 and 2005 at least at a 5% level, with the exception of ***HH Aged 40 to 50*** in the 2000 sample. The probabilities of incurring in CHE for households whose heads are aged above 30 are higher than for households whose head is between 20 and 29. This is an intuitive result, and has also been found by Ekman (2007). Using the age of the HH as a proxy for the average age of the household (which has limitations, except for the case when the household head is single) this may also be interpreted this in light of the studies of Alemayehu et al. (2004) and Forget et al. (2008), which characterize the pattern of lifetime costs with health care as being high during infancy, low during childhood and rising thereafter, especially in senior years. In this sense, households whose average age is higher should be more prone to use health care, and thus more likely to incur in CHE.[23]

None of the other regressors in this category is statistical significant for more than one year. In economic terms, ***Senior Ratio***, ***Junior Ratio*** and ***Gender of the HH*** maintain a coefficient sign which is expected and consistent over time. For households with seniors have greater likelihood of incurring in CHE and households with juniors have lower odds of incurring in CHE. These economic impacts for ***Senior Ratio*** and ***Junior Ratio*** support the theories of a pattern in the lifetime costs with health care of Alemayehu et al. (2004) and Forget et al.

[23] Note that effects such as income, likely to be higher for households with a given average age due to savings and better paid job positions, were already took into account in the model.

(2008) and are consistent with the findings of Habitch et al. (2006) and Yardim et al. (2010). On the ***Gender of the HH***, households headed by men are more likely to incur in CHE than those headed by women. However, the predicted change in the probability of CHE is close to 0 when changing from female to male and the same happens with respect to AMEs, which are 0 with the exception of 2005. ***Gender of the HH*** has thus a mixed economic effect on CHE incidence in Portugal, which is in line with the findings of Hajizadeh et al. (2011). For ***Urban***, ***Semi-Urban*** and ***Household Size***, the expected economic effects with respect to CHE occurrence are not verified in the three years in analysis, differing across them.

4.4.3 NUTS II regions

None of the regional dummies is statistically significant at least at 10% in the three years. Their economic effects on the occurrence of CHE are year-specific and were already reflected in the other variables, with the exception of the variable ***Azores***. This is the only one statistically significant at least at a 5% level in two years, 2000 and 2010. Living in ***Azores*** increases the odds of incurring in CHE comparing to ***Algarve***, the base group, in the three years.

4.4.4 Health related factors

Smoking and ***Drinking*** are statistically significant at least at a 5% level for the three analysed years. Perhaps unexpectedly, ***Smoking*** and ***Drinking*** have a consistent protective effect against the likelihood of CHE. The finding is consistent with earlier literature, which suggests that Portuguese individuals that smoke and drink are more educated relative to the rest of the western world, and as such earn more (Cavelaars et al, 2000). This also happens in these samples, as ***Smoking*** and ***Income*** have positive correlations with educational levels above the 4th grade in the 2000 and the 2005 samples and with the 6th grade in the 2010 sample. ***Smoking*** and ***Drinking*** are also positively correlated with ***Income*** in 2000, 2005 and 2010.[24]

Incapacity is never statistically significant and its odds ratio is above 1 in 2000 but below 1 in 2010. Due to the different economic interpretation of this ratio on the two years, its impact on the occurrence of CHE in Portugal is unknown, contrarily to what was expected and the findings of Yardim et al. (2010).

4.4.5 Housing determinants

Only ***Area*** of the house is statistically significant at least at a 1% level in two analysed years. One additional m^2 in the household lodging reduces the likelihood of CHE. This is probably related with the positive correlation

[24]Refer to "Annex J – Correlations between ***Smoking***, ***Drinking***, ***Income*** and ***Educational levels***" for more information on the correlation between these variables.

between ***Area*** and ***Income***, of 0,314 in 2005 and 0,387 in 2010. Overall, all housing determinants have a protective effect against CHE, with the exception of ***Electricity*** and ***Sanitary*** in 2010. The reason is that most households in 2010 had electricity and sanitary installations, so these variables do not explain CHE occurrence because they are similar for households with or without CHE.

5. The impact of public policies

In this section, the effect of two recent changes in the health sector - updates in user charges and variations on the expenditure in pharmaceutical products – on the incidence of CHE in 2010 is simulated.

5.1 The revision of user charges for 2012

User charges are a form of cost-sharing whose main purpose is the control of moral hazard in the health care demand decided by patients. In Portugal, they are applied for consultations (primary care and hospital outpatient visits), the realization of diagnostic tests and therapeutic procedures and emergency or home visits on both the National Health Service (NHS) and private services.

In May 2011, the acceptance of the MoU implied that the Portuguese Government had to revise the user charges for the NHS, as part of a set of measures to guarantee the financial sustainability of the Portuguese health system. Three areas were set for revision: the existing exemption-categories, which should be better monitored and defined according to ability to pay and continuous need of medical care; the levels of the user charges, that were to be increased yearly and according to inflation and finally the structure of user charges, so that they would guide patients from emergency departments to primary care. The revision of these aspects was legally achieved with the Decree-Law 113/2011 of 29th November and entered into force as of 1 January 2012.[25]

The simulation takes into account two of the proposed changes in user charges: the increase in their levels and the change in exemptions for patients with incapacity to pay.

I define as user charges the expenditure categories "Medical Services", "Auxiliary Means of Diagnosis" and "Hospital Services". The aggregation of these expenditures under the label of user charges is an upper limit on what can be considered a user charge, since some refer to expenditure on private entities. The establishment of an upper limit in this case seems to be of greater interest than an average or a limit from below, since it gives the greatest possible impact of user charges' changes in the incidence of CHE. Following Barros (2012) I assume

[25] Decree-Law 113/2011 was already revised by the Decree-Law 128/2012 of 21st of June and complemented by the Government Ruling (*Portaria*) nº311-D/2011.

for convenience that user charges have doubled from 2010/2011 to 2012. As a first approximation, it is assumed that consumption of medical services is exactly the same.

In what concerns exemptions from user charges, these were traditionally given to four types of individuals: those with incapacity to pay, children and pregnant women, chronic patients and groups contributing with positive externalities to society, namely firemen and blood donors. For simplicity, I assume that the exemptions of 2010 regarding all groups except households unable to pay are exactly the same, as it is not possible to make inferences about chronic illnesses, pregnancy or privileged groups with the household data available.

In 2010, individuals were exempted from paying user charges for economic reasons whenever their monthly income (wage or pension) was equal or below the minimum wage (475€ per month). In 2012, with the new legislation, households exempted from user charges should have a gross monthly monetary income lower or equal to 1,5 times the value of the social support index (IAS) of 419,22€ divided by the number of people responsible for the household, with a maximum of 2. This corresponds to a value of gross monthly monetary income of 628,83€ and of gross annual monetary incomes of 7545,96€ for single households and 15091,92€ for households headed by two individuals. Since the Household Budget Survey for 2010 only considers net annual monetary incomes, it was necessary to convert the previous gross to net values. I thus gathered information on the corresponding IRS threshold for these values, which corresponded to the category [7410€-18375€], taxed at 24,50% and with an abatement of 900,50€.[26] Direct calculus then shows that the net level at which single households are exempted from paying user charges is 6597,700€, while it is 12294,900€ for households with two adult individuals.

Table 6 shows the results on the incidence of CHE following these simulations:

Table 6 - Scenario analysis based on the new levels of user charges for 2012

	2010	**2012 after doubling of user charges**	***Variation 2010-2012***	**2012 after doubling user charges and applying new exemptions**	***Variation 2010-2012***
CHE	2,439%	3,899%	*1,460 p.p*	3,529%	*1,090 p.p*
Standard Error	*0,002*	*0,002*		*0,002*	
By NUTS II region					
North	2,439%	3,880%	*1,441 p.p*	3,614%	*1,175 p.p*
Standard Error	*0,003*	0,004		0,004	
Center	2,485%	4,206%	*1,721 p.p*	3,838%	*1,354 p.p*
Standard Error	*0,004*	0,005		0,005	
Lisbon	2,264%	3,449%	*1,185 p.p*	3,086%	*0,821 p.p*
Standard Error	*0,004*	0,005		0,005	

[26] IRS is the Portuguese personal income tax, collected upon annual income of individuals.

Alentejo	2,969%	4,395%	*1,426 p.p*	3,737%	*0,768 p.p*
Standard Error	*0,005*	0,006		0,005	
Algarve	1,827%	3,105%	*1,278 p.p*	2,869%	*1,042 p.p*
Standard Error	*0,004*	0,005		0,005	
Madeira	3,062%	5,761%	*2,700 p.p*	5,093%	*2,032 p.p*
Standard Error	*0,006*	0,008		0,008	
Azores	3,090%	4,974%	*1,884 p.p*	3,895%	*0,805 p.p*
Standard Error	*0,006*	0,008		0,006	
		By income quintile			
1st	5,556%	8,160%	*2,603 p.p*	6,854%	*1,298 p.p*
Standard Error	*0,005*	*0,006*		*0,006*	
2nd	2,283%	3,812%	*1,529 p.p*	3,769%	*1,486 p.p*
Standard Error	*0,004*	*0,005*		*0,005*	
3rd	1,112%	2,363%	*1,251 p.p*	2,363%	*1,251 p.p*
Standard Error	*0,003*	*0,004*		*0,004*	
4th	0,813%	1,674%	*0,860 p.p*	1,674%	*0,860 p.p*
Standard Error	*0,003*	*0,004*		*0,004*	
5th	0,681%	1,104%	*0,423 p.p*	1,104%	*0,423 p.p*
Standard Error	*0,003*	*0,003*		*0,003*	

The level of CHE in 2010 increases by 1,460 p.p to 3,899% when the user charges of 2012 are applied. Analysing by NUTS II region, this increase is the greatest in Madeira and the lowest in Lisbon. The lower the income quintile is, the greater the increase in CHE incidence with the application of 2012 user charges.

With the increase in user charges moderated by the new economic exemptions, the level of CHE increases compared to the baseline by 1,090 p.p, to 3,529%. This increase is lower than when the new economic exemptions were not applied. Furthermore, it is more evenly distributed across NUTS II regions, with Madeira still registering the highest increase and Alentejo the lowest. As expected, the new economic exemptions do not affect income quintiles from the 3rd onwards. Thus, the reductions in the level of CHE compared to the case without exemptions are due to the 1st and 2nd income quintiles.

To sum up, the simulations show that if the new user charges were in place the level of CHE would have increased approximately between 1,090 to 1,460 p.p in 2010, with the lower bound considering the economic exemptions and the upper bound not. Economic exemptions were insufficient to contain greater CHE incidence after user charges increased to 2012 values. Estimates show that CHE always increase more in Madeira, and that the increase affects less the richer income quintiles.

5.2 The change in the expenditure on pharmaceuticals of 2011 and 2012

The price of pharmaceuticals used for ambulatory in Portugal has registered a significant decrease since 2005 (Barros et al, 2011), due to factors such as the promotion of the use of generics and administrative price reductions.[27] This trend is expected to continue following the proposed reduction in the margins of pharmaceutical products' distribution by the MoU.

[27] In October 2005 and February 2007, respectively.

I perform two simulations for CHE in 2010 had the prices of 2011 or 2012 been in place. The first assumes a price elasticity of demand for the consumption of pharmaceuticals of 0. The second, based on a literature review on the topic (Ringel et al, 2002), uses lower and upper bounds found by researchers on the price elasticity of demand for pharmaceuticals. These are -0,1 and -0,4, meaning that a reduction of 10% in pharmaceuticals' price leads to a 1% or 4% increase, respectively, in the consumption of ambulatory pharmaceuticals.

Data from Infarmed (2012) provided the average annual prices of pharmaceuticals in 2010, 2011 and 2012 and the change in expenditure for the three elasticities of interest.[28] The results are in table 7:

Table 7 - Inputs to study the evolution of pharmaceutical prices between 2010 and 2012

	Average annual price	Exp. change if e=0	Exp. change if e=-0,1	Exp. change if e=-0,4
2010	13,209 €			
2011	12,425 €	-5,934%	-5,341%	-3,560%
2012	10,709 €	-18,922%	-17,030%	-11,353%

As expected, the average expenditure in pharmaceuticals decreased in the period, with a more pronounced decrease between 2011 and 2012, regardless of the price elasticity of demand for pharmaceuticals assumed. The decrease in pharmaceutical expenditure is motivated by the price decrease over time, given that the consumption of pharmaceuticals packages has remained somewhat stable.[29]

Table 8 - CHE levels with pharmaceutical prices' changes at three price elasticities of demand

	2010	2011 with e=0	2012 with e=0	2011 with e=-0,1	2012 with e=-0,1	2011 with e=-0,4	2012 with e=-0,4
CHE	2,439%	2,209%	1,668%	2,268%	1,762%	2,393%	2,013%
Standard Error	*0,002*	*0,002*	*0,002*	*0,002*	*0,002*	*0,002*	*0,002*

The incidence of CHE decreases with the reductions in the average annual price of pharmaceuticals of 2011 and 2012, for all elasticities of demand assumed. Price reductions of 2011 may lead to a CHE incidence between 2,209% and 2,393%, depending on whether 0 or - 0,4 as elasticities of demand are used, respectively. The greatest price reductions of 2012 achieve CHE incidences between 1,668% and 2,013%, depending on whether a 0 or a -0,4 elasticity of demand are used, respectively.

5.3 Combined effects of user charges and expenditure in pharmaceuticals

To extract further conclusions of reductions in the price of pharmaceuticals and increases in user charges on CHE, I combine both. It seemed particularly relevant to assess whether the reduction in CHE due to the price of pharmaceuticals was enough to compensate its increase caused by a raise in user charges, already mitigated by the new and enlarged economic exemptions. Table 9 summarizes the results.[30]

[28] In the tables hereafter, "e" is used as an abbreviation for price elasticity of demand in the consumption of pharmaceuticals.
[29] Refer to "Annex K - Evolution of prices and quantities of ambulatory pharmaceuticals sold in Portugal" for a complete overview of the setting.
[30] For a more complete overview of the results, considering only the increase in user charges and the reductions in the price of pharmaceuticals, refer to "Annex L – Combined effects of doubling user charges and reductions in the prices of pharmaceuticals".

Table 9 - CHE incidence in 2010 after doubling of user charges, new economic exemptions and reductions in the price of pharmaceuticals (using three price elasticities of demand for pharmaceuticals)

	2010	2011, with e=0	2012, with e=0	2011, with e=0,1	2012, with e=0,1	2011, with e=0,4	2012, with e=0,4
CHE	2,439%	3,285%	2,679%	3,316%	2,773%	3,438%	3,121%
SE	*0,002*	*0,002*	*0,002*	*0,002*	*0,002*	*0,002*	*0,002*

As shown, CHE increase with the application of the new user charges, even after the application of better economic exemptions and reductions in the price of pharmaceuticals, whatever the price elasticity of demand for pharmaceuticals considered. This is an interesting phenomenon, which contrasts with macroeconomic data. Indeed, revenues from the increase in user charges were approximately 64 million Euros in 2012, less than the estimated savings for households in pharmaceutical products, of 91,8 million Euros.[31] Also, while expenditure in user charges represented approximately 1,0% of the health budget in Portugal in 2011, pharmaceuticals had a higher share of 21,7%.[32] In this sample, though, the new levels of user charges, after the application of economic exemptions, have lead households to spend approximately 2205986€ more, while reductions in the prices of pharmaceuticals saved them approximately 320177€ in 2011 and 1020961€ in 2012.[33] Thus, the fact that CHE incidence is dominated by the outcome of higher user charges when the two effects are combined ought to be better studied, since it contrasts with macroeconomic data and may be a consequence of a broader definition of user charges in the sample, with the excessive inclusion of expenditures to private entities.

6. Conclusions

This paper analyses the degree and magnitude of CHE in Portugal for the years of 2000, 2005 and 2010, as well as factors predicting this outcome and the effect of revisions of user charges and pharmaceutical products prices on 2010 CHE incidence. Its contribution to the literature on CHE is three-fold: first, it presents statistical measures to capture CHE incidence, intensity, income distribution and impoverishment effects using INE Household Budget Surveys; second, it uses a logistic model based on 38 variables for the three years to determine statistical and economic significance of factors associated with CHE; thirdly, it simulates how user charges' revisions and reductions in pharmaceuticals prices would affect incidence of CHE in 2010.

I find that incidence and intensity of CHE decreased between 2000 and 2010, from 5,005% to 2,439% and 4,693% to 0,334%, respectively. Still, the degree of CHE remains high when compared to the average level of

[31] According to Infarmed (2013), households incurred in expenditures with pharmaceuticals of 682719129€ in 2012 and 774538491€ in 2011, hence the value of savings of approximately 91,8 million Euros from 2011 to 2012. Revenues with user charges come from ACSS (2011) and information provided by the Ministry of Health to the press, namely to Diário de Notícias (http://tinyurl.com/m4pos2n).

[32] According to ACSS (2011), user charges represented 1,0% of the Health Budget for Hospitals, Local Units of Health, and administrative regions of health (ARS), which compares to values of 0,8% and 0,6% for 2010, respectively. Pharmaceutical products represented 21,7% of the Health Budget of Hospitals and Local Units of Health in 2011, and 20,1% in 2010.

[33] Assuming a price elasticity of demand for consumption of pharmaceuticals of 0.

2,300% found by Xu et al. (2007) in a study of 89 countries. Although CHE remain concentrated on poorest income quintiles, most of its decrease between 2000 and 2010 was driven by this group. Note, however, that the statistical measures calculating the extent of CHE may be underestimating it, especially in the lowest income quintiles. Indeed, there might be households reporting none or very low expenditures with health care because they are so poor that they cannot afford them, and these households are not counted as incurring on CHE.

Regarding the factors associated with CHE, only income, having a household head with secondary education, smoking, drinking and area of the house are statistically significant in all analysed years. Unexpectedly, the economic effect of income was negligible on CHE incidence and smoking and drinking habits decreased its likelihood. This and other counterintuitive results ought to be further explored in future research. It would also be interesting to explore the relationship between other health related factors (such as chronic illnesses) or the predominant health insurance type of the household and the incidence of CHE.

Simulations shows that the increases in user charges of 2012, even if mitigated by new and enlarged economic exemptions, would contribute to increase CHE incidence of 2010 by at least 1,090 p.p. Meanwhile, reductions of pharmaceuticals prices of 2011 and 2012 would always decrease CHE incidence in 2010 for price demand elasticities equal or smaller (in absolute value) than 0,4, the greatest reduction of 0,677 p.p corresponding to a 0 elasticity of demand for prices of 2012. The joint effect of these factors always leads to an increase in CHE, showing that in this sample, reductions in pharmaceuticals prices and enlarged economic exemptions would not suffice to countervail the increase in user charges. This contrasts with macroeconomic data, which reveals a greater level of savings from pharmaceuticals than revenues derived from user charges for 2012. Future research with new and improved samples should therefore be carried out to clarify the impact of these and other measures to deal with the economic crisis on CHE incidence.

References

ACSS. 2011. "Serviço Nacional de Saúde - Desempenho económico-financeiro". http://tinyurl.com/mf9gjlq (accessed 20th May 2013).

ACSS. 2012. "Revisão de categorias de isenção e atualização de valores das taxas moderadoras". http://tinyurl.com/brbrkwv (accessed 7th April 2013).

Alemayehu, B. and K. Warner. 2004. "The lifetime distribution of health care costs". *Health Policy*, 39(3): 627-642.

Assembleia da República. 1976. "Constituição da República Portuguesa". http://tinyurl.com/bwaboa (accessed 7th April 2013).

Bago d'Uva, T., A. Jones and E. van Doorslaer. 2009. "Measurement of horizontal inequity in health care utilization using European Panel Data". *Journal of Health Economics*, 28(2): 280-289.

Barros, P.P. 2012. "Health Policy reform in tough times: The case of Portugal". *Health Policy*, 106: 17-22.

Barros, P.P., S. Machado and J. Simões. 2011. *Portugal - Health system review*. Portugal: European Observatory on Health Systems and Policies.

Cameron, A.C. and P.K. Triverdi. 2005. *Microeconometrics: methods and applications*. New York, USA: Cambridge University Press.

Cameron, A.C. and P.K. Triverdi. 2009. *Microeconometrics using Stata*. College Station, USA: Stata Press.
Cavelaars, A.E.J.M., A.E. Kunst, J.J.M. Geurts, R. Crialesi, L. Grötvedt, U. Helmert, E. Lahelma, O. Lundberg, J. Matheson, A. Mielck, N. Rasmussen, E. Regidor, M. do Rosario-Giraldes, T. Spuhler, J.P. Mackenbach. 2000. "Educational differences in smoking: international comparison." *BMJ*, 320(7242): 1102-1107.
Deaton, A. 1997. *The analysis of household surveys: A microeconometric approach to development policy.* Baltimore, MD: John Hopkins University Press.
Ekman, B. 2007. "Catastrophic health payments and health insurance: Some counterintuitive evidence from one-low income country". *Health Policy*, 83: 304-313.
Evetovits, T., P. Gaál, S. Szabolcs, F. Lindeisz and J. Habicht. 2012. "Informing decision makers: Analysis of financial protection over time in the context of policy changes". Paper presented at ECHE 2012, Zurich, Switzerland.
Forget, E., L. Roos, R. Deber and R. Walld. 2008. "Variations in lifetime healthcare costs across a population". *Health Policy*, 4(1): 148-167.
Gotsadze, G., A. Zoidze and N. Rukhadze. 2009. "Household catastrophic health expenditure: evidence from Georgia and its policy implications". *BMC Health Services Research*, 9: 1-9.
Habicht, J., K. Xu, A. Couffinhal and J. Kutzin. 2006. "Detecting changes in financial protection: creating evidence for policy in Estonia". *Health Policy and Planning*, 2: 421-431.
Hajizadeh, M. and H. Nghiem. 2011. "Out-of-pocket expenditures for hospital care in Iran: who is at risk of incurring catastrophic payments?" *International Journal of Health Care Finance Economics*, 11:267–285.
IMF. 2013. "Portugal – Memorandum of Understanding on specific economic policy conditionality, 5th update". http://tinyurl.com/c7foww5 (accessed 10th January 2013).
Infarmed. 2012. "Observatório do medicamento e produtos de saúde". http://tinyurl.com/cqf9d3h (accessed 7th April 2013).
Infarmed. 2013. "Monitorização mensal do mercado de medicamentos em ambulatório". http://tinyurl.com/jvsktan (accessed 20th May 2013).
Kakwani, N., A. Wagstaff and E. van Doorslaer. 1997. "Socioeconomic inequalities in health: Measurement, computation and statistical inference", *Journal of Econometrics*, 77(1): 87-103.
Knaul, F., H. Arreola-Ornelas, O. Méndez-Carniado, C. Bryson-Cahn, J. Barofsky, R. Maguire, M. Miranda, and S. Sesma. 2006. "Evidence is good for your health system: policy reform to remedy catastrophic and impoverishing health spending in Mexico". *The Lancet*, 68: 1828-1841.
Kronenberg, C. and P.P. Barros. 2010. "Catastrophic health care expenditure: The Portuguese case". Mimeo.
O'Donnell O., E. van Doorslaer, A.Wagstaff and M. Lindelow. 2008. *Analyzing health equity data using household survey data – guides and techniques for their implementation*. Washington D.C: The World Bank Institute: World Bank Learning Resources Series.
OECD. 2012a. "Metadata on OCDE database on income distribution and poverty". http://tinyurl.com/cksh4om (accessed 20th March 2013).
OECD. 2012b. "OECD Health Data". http://tinyurl.com/mfc4wjo (accessed 20th April 2013).
OECD. 2013. "What are equivalence scales". http://tinyurl.com/c29wvre (accessed 19th January 2013).
Ringel, J., S. Hosek, B. Volaard and M. Sergej. 2002. *The elasticity of demand for health care – A review of the literature and its application to the military health system.* USA: RAND Corporation.
Saksena, P., K. Xu and G. Carrin. 2006. "The impact of universal insurance program on catastrophic health expenditure: simulation analysis for Kenya". *World Health Organization*, 8: 1-21.
Simões, A., A. Paquete and M. Araújo. 2008. "Equidade horizontal no acesso a consultas de clínica geral, cardiologia e medicina dentária em Portugal". *Revista Portuguesa de Saúde Pública*, 26(1): 39-52.
van Doorslaer, E. and X. Koolman. 2004. "Explaining the differences in income-related health inequalities across European countries". *Health Economics*, 13(7):609-628.
van Doorslaer, E., O. O'Donnell et al. 2007. "Catastrophic payments for health care in Asia". *Health Economics*, 16: 1159-1184.
Wagstaff, A. and E. van Doorslaer. 2003. "Catastrophe and impoverishment in paying for health care: with application to Vietnam 1993-1998". *Health Economics*, 12: 921-934.
Waters, H., G. Anderson and J. Mays. 2004. "Measuring financial protection in health in the United States". *Health Policy*, 69: 339-349.
Wooldridge, J. 2002. *Econometric analysis of cross section and panel data.* Cambridge, MA: MIT Press.
World Health Organization. 2000. *The world health report 2000: health systems: improving performance.* Geneva, Switzerland: World Health Organization.
Xu, K. 2005. "Distribution of health payments and catastrophic expenditures – methodology". Geneva: World Health Organization
Xu, K., D. Evans, G. Carrin, A. Aguilar-Rivera, P. Musgrove and T. Evans. 2007. "Protecting households from catastrophic health spending". *Health Affairs*, 26(4): 972-983.
Xu, K., D. Evans, K. Kawabata, R. Zeramdini, J. Klavus and C. Murray. 2003. "Household catastrophic health expenditure: a multicountry analysis". *The Lancet*. 362: 111-117.
Yardim, M., N. Cilingiroglu and N. Yardim. 2010. "Catastrophic health expenditure and impoverishment in Turkey". *Health Policy*, 94:26-33.

Annexes

Table i - Predicted probability changes from minimum to maximum values and AMEs

	2000		2005		2010	
	Min-max	AME	Min- max	AME	Min-max	AME
Financial determinants						
Income	-0,040	0,000	-0,019	0,000	-0,022	0,000
Employed Ratio	-0,012	-0,036	-0,006	-0,014	-0,011	-0,024
Unemployed Ratio	-0,003	-0,010	0,005	0,010	0,005	0,008
Household characteristics						
Seniors Ratio	0,012	0,030	0,019	0,036	0,013	0,022
Juniors Ratio	-0,016	-0,094	-0,002	-0,006	-0,010	-0,038
Household Size	0,000	0,000	0,049	0,004	0,043	0,004
Urban	0,003	0,008	-0,004	-0,012	-0,001	-0,002
Semi-Urban	0,001	0,002	-0,007	-0,016	-0,001	-0,003
HH Gender	0,000	0,001	0,007	0,024	0,000	0,000
HH Aged 30 to 40	0,052	0,071	0,142	0,086	0,021	0,025
HH Aged 40 to 50	0,003	0,007	0,078	0,071	0,018	0,024
HH Aged 50 to 60	0,052	0,075	0,158	0,096	0,010	0,016
HH Aged 60 to 70	0,046	0,072	0,132	0,090	0,006	0,010
HH Aged 70 or more	0,052	0,083	0,139	0,098	0,005	0,009
HH with 4th grade	-0,004	-0,010	-0,002	-0,005	-0,006	-0,013
HH with 6th grade	-0,008	-0,029	0,000	0,001	-0,008	-0,021
HH with 9th grade	-0,007	-0,023	-0,006	-0,018	-0,008	-0,020
HH with Secondary Education	-0,014	-0,073	-0,011	-0,046	-0,012	-0,041
HH with Higher Education	-0,009	-0,036	-0,011	-0,051	-0,005	-0,012
Regions						
North	-0,006	-0,020	0,002	0,004	0,004	0,007
Center	-0,004	-0,012	0,001	0,003	0,000	0,000
Lisbon	-0,001	-0,003	0,002	0,005	0,004	0,006
Alentejo	-0,003	-0,009	0,002	0,005	0,000	0,000
Azores	0,008	0,019	0,001	0,003	0,011	0,016
Madeira	-0,004	-0,011	0,007	0,013	0,007	0,011
Health related factors						
Smoking	-0,016	-0,053	-0,008	-0,021	-0,008	-0,021
Drinking	-0,007	-0,021	-0,008	-0,019	-0,006	-0,011
Incapacity	0,008	0,018	-	-	-0,004	-0,010
Housing determinants						
Running Water	-	-	-0,005	-0,010	-0,013	-0,017
Electricity	-	-	-0,003	-0,006	0,002	0,004
Sanitary	-	-	-0,006	-0,011	0,001	0,003
Construction Year 1950-1959	-	-	0,000	0,000	0,002	0,003
Construction Year 1960-1969	-	-	-0,001	-0,003	-0,002	-0,005
Construction Year 1970-1979	-	-	0,000	0,000	-0,007	-0,017
Construction Year 1980-1989	-	-	-0,004	-0,010	-0,003	-0,006
Construction Year 1990-1999	-	-	-0,004	-0,012	-0,003	-0,006
Construction Year 2000 Onwards	-	-	0,008	0,015	-0,007	-0,020
Area	-	-	-0,016	-0,004	-0,012	-0,001