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Estimating Demand for Primary Health Care Services

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Abstract

Primary health services exist with the purpose of providing basic health care to every person at a cost they can afford. But is it fully available to everyone? The objective of this work project is to estimate the demand for primary health care services having into account that in some regions the citizens are not using as much health care as they would like due to supply side constraints. Using the number of consultations as proxy for demand, and applying an econometric tool called switching regression, the demand for primary health care services will be estimated.

Keywords:

Primary health care services

Supply side constraints

Switching regression

Predicted Values

Introduction

In modern countries, health has been perceived as one essential condition for the evolution of societies. The certainty of a good healthy condition in the future is a big incentive to the investment in the present and consequently to economic growth. The knowledge that most probably one will be healthy in the future or will not need to pay for health care implies less concern for the individual and thus a smaller need to save money in order to prevent against uncertainty. So, if free health care is guaranteed to a person at the amount of use, that person will not need to save the same amount to protect her against doubt as she would otherwise. That decrease in uncertainty encourages the individuals to invest in future life projects and consequently it ends up helping economic growth. Besides, public health care is also one of the trademarks of equal opportunities. The concept of health care to everyone goes towards the idea that all the people will be able to invest in their future given that their health condition is pretty much assured. In that sense, many developed countries around the world created public systems of health that would promote that believe of guaranteed health care to each one of its citizens.

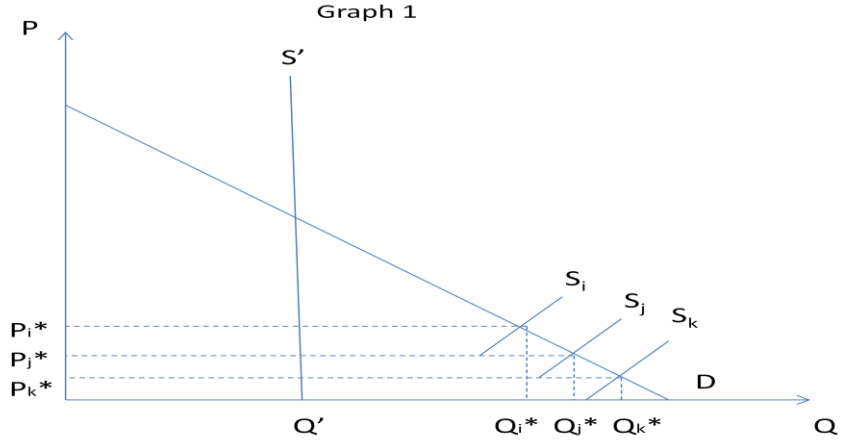
In this thesis we will focus on the primary health care services which are an important part of the National Health Service (NHS). The objective of the primary health care services is to provide basic health care to every individual in our country at a cost they can afford. These services are the ones through which the individuals make the first contact with the NHS and thus, they are generally placed near the population.

The question that arises when one thinks about the primary health care services is the following: Is everyone able to use the primary health care services as it is supposed to? The answer is clear. Many persons in our country do not have a family doctor and need

to wait a lot of time in order to attend to a consultation in the primary care centers. The primary health service is not complying with the objective of granting basic health care to all Portuguese citizens. The way to solve this problem is to estimate the demand for primary health care services for each region in order to understand how the resources need to be allocated in a way such that the ideals of the service are really applied.

In that sense, the proposal of this thesis is to find the demand for primary health care services in each region of Portugal using as a proxy the number of treatments occurred, more specifically, the number of consultations. But, the usage of the primary health care services in many cases does not correspond to the real needs of the population. So, this method would only hold if we assumed that the citizens are enjoying enough supply in their residence area. Under that assumption the estimation would be reasonable since people consume the quantity of health care correspondent to their demand. However this is not true because the services provided are not sufficient in many regions, leading the people to consume less than they would consume in other circumstances.

Graph 1



Equilibrium points and supply side constraints

For a given generic price the supply may be capable of satisfying the demand and then we will be able to identify the real demand of health care (situation illustrated by S_1, S_2 and $S_{3.)}$. With a restriction on the supply (illustrated by S'), the quantity will be Q'

independently of the price and therefore the real demand will not correspond to the number o consultations.

Given the problem of supply constraints, the answer lies in finding the areas where there is sufficient supply and the ones where there is a shortage. Then, we need to determine what would be the usage of primary health care services by the population facing a shortage in supply if they would live under the condition of sufficient supply. This question will be answered when taking the predicted values for the number of consultations in each region using the estimated coefficients of the sufficient supply regime. Also, we will be able to know how many resources are required in order to provide a good service to everyone in a particular region. In order to do that, we need to see how many consultations would occur in a regime of sufficient supply and then attribute to them the correspondent costs per consultation.

Specificities of the health care market

Before we can go further in this analysis, it is essential to understand the market of health care. Like in usual markets, it has a good, a demand and a supply. However, this market has some specificities that make it more complex than traditional markets.

The demand for health care is in fact a derived demand in the sense that people are actually looking to increase their health, and health care services are the natural way to achieve it. Health care does not give a direct utility to the consumer as it happens with common goods. The improving in the health condition in consequence of the consumption of health care will allow the individual to improve is quality of life, and that will increase his utility.

Another specificity of the health market lies in the fact that satiation comes much faster than in traditional markets. The consumption of health care can only go until a point

where the individual is in a perfect state of health and from there onwards the time loss in dislocation and in the waiting for a medical treatment can be seen as costs without correspondent benefits since the patients are already healthy. That way, given the fast achievement of satiation in this market, the consumer's utility curve can even become negative as the use of health care oversteps the real needs of one individual.

The last specificity arises from the non homogeneity and interdependence of consumption. In health care, consumption may come from different markets within the sector. One person can make consumption in health care by buying medicines in the pharmaceutical market, by attending a simple consultation in a health center, by doing exams in a laboratory and so on. There are many goods and services available in the health care market and therefore the good provided is considered to be non-homogeneous. The interdependence in consumption comes from the fact that many goods/services are related and one may need to consume one of them in order to consume the other. For example, many drugs demand a doctor's prescription and consequently, in order for an individual to buy them, it is necessary to attend a consultation first. Same goes with exams that can be only prescribed by a physician and then need to be seen by the physician as well.

Even though these three specificities are the general ones contemplated in health economics literature, we cannot ignore the social, cultural and political components associated to health. In economic and politically developed countries such as Portugal, health care is seen as a fundamental right of the population which means that everybody should have access to essential health services. That mentality ends up putting a lot of responsibility in the shoulders of the governments that need to guarantee that a good service is provided to all. Of course this tremendous duty is not easy to comply with,

both because of the great amount of institutions and people involved, as well as for the enormous inherent costs.

After studying the general features of the market of health care it is possible to extract some information that will be useful to construct a solid reasoning as a base for this thesis. The study will focus on the primary health care which is a submarket in the market of health and thus follows the specificities stated before. The interdependence between the consumption in different health submarkets needs to be taken into account when making inference about the primary health care services, namely in the dependence between these services and the hospital services, with one normally preceding the other. Also, it is important to have into account the condition of rapid satiation in the market of health care that forces anyone who is studying this subject to give even more attention to the concept of efficiency. By giving more resources to areas living in a restricted condition in terms of health care we will have a significantly greater impact than giving them to other areas with a good supply of health care. This idea gives strength to the hypothesis that estimating the demand for health care services will help the policymakers in the task of better allocating resources which will help increase efficiency.

Worthy of being highlighted is the fact that in health care, efficiency and equity are actually coupled since a bad allocation of resources will imply that we are giving more to certain regions than we are giving to others. Conversely, if we decide to take resources from one region with excess supply and redistribute them to those living with a scarce supply, then we are increasing both efficiency and equity. With a good estimation, policymakers are able to make more solid choices in the sense they will have a base for better defining priorities in terms of resources distribution.

Endogenous Switching Regression

Now that the problem is defined and the objective of this thesis is specified, we need to find the instrument that will allow us to make an empirical analysis, always having into consideration the limitations concerning the shortage of supply in some regions. Because we are in the presence of two distinct regimes, one where the supply covers all the demand and other where supply is insufficient, we cannot move to a simple regression model with all observations within it. Instead, we need to construct a model with the two separated regimes, illustrating the two possible supply conditions. This split is essential since we believe that the two distinct situations will yield different coefficients. Also, we need to define whether an observation is in one regime or in the other. To overcome this problem, the solution lies in finding an instrumental variable that may give us information concerning the regime of each observation. Summarizing, our model will be one in which we have two different regimes, yielding different coefficients, and is defined by another variable that has explanatory power relating to the switching of observations between regimes. This model is called switching regression model[1] and is described in the following way:

$$I_i = 1 \; if \; \alpha Z_i + \mu_i > 0$$

$$I_i = 0 \; if \; \alpha Z_i + \mu_i \leq 0 \tag{1.1}$$

$$Regime1: Y_{1i} = \beta_1 X_{1i} + \varepsilon_{1i} \qquad , if \; I_i = 1 \tag{1.2}$$

$$Regime2: Y_{2i} = \beta_2 X_{2i} + \varepsilon_{2i} \qquad , if \; I_i = 0 \tag{1.3}$$

In this model, Y_{ji} is the dependent variable in the continuous equations while X_{1i} and X_{2i} are the explanatory variables vectors and β_1 and β_2 are vectors of coefficients. I_i is

[1] For more details on the model consult Lokshin, Michael and Sajaia, Zurab, (2004)

the dependent variable of the defining equation, Z_i is the correspondent vector of explanatory variables and α is the coefficients vector.

This model will be the tool used in order to make empirical inference. All we have to do is to define the dependent variable for the main regression, the dependent variable for the rule regression and the explanatory variables for each of them. Our Y_{ji} will be the number of consultations per capita since it implicitly represents the demand of the consumers for primary health care services. Our I_i will be the rate of people without family doctor in each region which is a variable with explanatory power on determining the situation we are facing in terms of being in a sufficient or insufficient supply regime. The estimation of I_i will determine the probability of each observation to belong to one or another regime which will subsequently be incorporated in the likelihood function.

Applying the model

The data used in order to estimate the demand for primary health care services was provided by the ACSS (Administração Central do Sistema de Saúde – Central Administration of the Health System) and consists on the main information that characterizes the 74 ACES (Agrupamento de Centros de Saúde – Groups of Primary Care Centers) in Portugal. The data includes socio-economic variables, measures of costs of each ACES, variables characterizing the supply of primary health care services and variables with information regarding hospital supply. The socio-economic variables are the ones that will allow us to evaluate the effect of the population characteristics on the dependent variable. With those we will be able to choose a certain type of population and take conclusions about the estimation of the dependent variable either in

the regime of sufficient supply or in the regime of insufficient supply. The variables concerning costs, characterization of supply and usage of the services will be useful to complete the information about the ACES both in terms of explanatory variables and of dependent variables for the continuous and selection equation. Hospital data will be useful to evaluate the relation between the two types of services.

With this data, we are able to fill in the model, choosing our dependent variable, our rule to determine whether an observation is in the first or second regime, and also, our explanatory variables. In order to better organize the information, let us deal with the two regressions (Main regression and Rule regression) separately.

Main regression:

Endogenous variable:

Total consultations per capita on the primary health care services – As has been discussed, this is the variable that would tell us approximately the real demand of the population in case there was not a problem of insufficient supply. The number of consultations was converted in the number of consultations per capita with the purpose of eliminating the scale problems given that the level of population in each region would obviously drive the results, which would affect the efficiency and the explanatory power of the regression.

Exogenous variables:

Rate of feminine population – Is well known that women tend to use in average more health care services than men independently. Studies point out that this effect is verified independently of age. Also, the number of consultations tends to be even higher for women due to pregnancy related issues.

Total dependency ratio – Similarly to the previous variable, studies show that children and old people use more health care since they have more fragile health conditions. In the case of the children, because their bodies are still not totally developed, and, in the case of the elders, because their health stock is depreciating as their bodies become weaker. In that sense, these age groups have a tendency to make more use of health care services. Given that, it is important to take this variable into account in the regression.

Population density – Regions with a large population density are usually associated with problems of diseconomies of scale in the sense that it is difficult to put together conditions for more people in less space. The Health System seems to also suffer from that issue since in areas with greater population density, people often struggle to attend a consultation in a public primary care center. These types of areas are also associated with problems of pollution and stress which may be also important to control.

Purchasing power – This is a quite used variable in almost all economic related issues since it is always interesting to know the effect of money on social and economic matters. In this specific case it is reasonable to ask if people with more purchasing power will avoid more the public health sector when it implies they have to face a shortage of supply, and consequently more waiting time. Also, it is important to discuss if the government gives less resources to areas with more purchasing power concerning their superior capacity of resorting to the private sector.

Usage index of hospital admissions decreed by physicians – Here we have a different type of variable since it is not a socio-demographic indicator. Knowing if the number of people being admitted in a hospital influences the number of people visiting the doctor in a primary health care service allows us to take some conclusions regarding the

interaction between the two services. More specifically, if a higher offer in terms of hospital admissions may lead to a decrease in the consultations in primary health care services. This may happen because many admissions occur for individuals with chronic diseases that correspond to an important part of the demand for primary health care. After admissions in the hospitals, many of them continue being followed by the hospital services and physicians.

Costs with Drugs and complementary means of diagnosis and therapeutic per capita (MCDT – medicamentos e meios complementares de diagnostic e terapeutica) – The costs of the MCDT per capita give us some information about the way the government distributes resources among ACES which in turn may provide an idea of priorities in terms of regions. More importantly, it gives us information regarding the effect of a greater offer of complementary treatments on the number of consultations per capita. Demand for primary health care services will also depend on this variable since MCDT as the name suggests are complementary to consultations and therefore an important part of primary health care.

Rule Regression

Endogenous variable:

Rate of persons without family doctor – The rate of persons without family doctor illustrates very well the difficulties of the supply side to satisfy the demand. It is well known that many people have never had a family doctor and the health authorities have struggled to provide enough physicians to the primary health care services. Consequently this is a very good way to evaluate the supply conditions in respect to this sector of public health services. Nevertheless, we are still facing a problem of defining the adequate threshold for that rate to express in the best way the regime each

observation is in. Analyzing the observations and resorting to some intuition and capacity of judgment, the decision fell on a rule of a 10% threshold. This value seems to be adequate given the characteristics of the Portuguese primary health care system. In Portugal, a rate of people without family doctor inferior to 10% can be considered very low given that in some cases it achieves values around 50%. The threshold of 10% also happens to be convenient since it divides the sample in two almost equal parts. This way we are dividing the country in the ACES with more resources and the ACES with fewer resources in terms of family doctors supply. Dividing the sample in two similar parts ends up being a reasonable decision since the analysis has a strong comparative component highlighting the differences between most favored and less favored ACES in terms of primary health care supply.

The indicator was transformed into a dummy taking value of 1 when the rate of persons without family doctor is under 10%, which means we consider the observations to be in a state of sufficient supply. Above 10%, the variable takes the value of 0 and we consider the observations to be in a state of shortage of supply.

Exogenous variables:

Urgency consultations per capita in primary health care services – The urgency consultations are in some way a measure of resources available because in order for those to exist there must be money, equipments and doctors. In that sense it may explain the quantity of family doctors per person and therefore the number of persons without family doctor. This variable has a one year lag in order to avoid some reverse causality effects since the number of family doctors can also explain the number of urgencies. The idea is to extract only the structural effect in terms of supply of primary health care

services. However because the reverse causality may be a reality, one must still be careful and account for the possibility of a higher rate of people without family doctor implying a greater use of the urgencies services given the lack of alternatives in terms of primary health care.

Population density – This variable has a similar purpose as in the main regression. The idea is to know if there are problems concerning the supply of primary health services in areas with higher population density, more specifically when providing family doctors. The allocation of resources in these areas is usually more difficult and there is a tendency for a lack of family doctors in very crowded areas. This structural component is important to define the supply of family doctors.

Usage index of hospital urgency services – this variable should help measuring the supply of each ACES evolving area in terms of hospital services. The existence of better conditions in terms of hospital supply may weigh in the decision of providing more primary health care services, measured in family doctors, in the case of this regression. If we consider that hospital urgencies are in some way substitutes regarding primary health care services, then the government may choose to restrain supply of these last services. However, we have again a problem of possible reverse causality since larger numbers in this indicator may be strongly connected to a poor primary health care service in the sense that many people may try to "run from them" and go directly to the hospital.

Index of usage of hospital admissions decreed by physicians– The inclusion of this indicator in this equation has the objective of capturing the relation between the supply capacity of the hospitals and the supply capacity of the primary health care services.

There is a possibility that, in a specific ACES area, there is a strategy of more investment in the hospital services and consequently some disregard concerning the primary health care. The relation can also be one in which higher capacity in terms of hospital supply means higher overall investment in the respective ACES surrounding area and thus greater supply of primary health care services.

Output

Table 1

Log pseudolikelihood = -64.644046 Number of obs = 74

Regime 0 – Shortage of supply			***Regime 1 – Sufficient supply***		
	Robust Coef.	Std. Err.		Robust Coef.	Std. Err.
totconsultpc 0			**totconsultpc 1**		
purchpower	-0.0082253	0.0000628	purchpower	-0.0019687	0.0000347
femalepop	0.2403805	0.0003107	femalepop	0.3422215	0.0008336
popdensity	-0.0000852	2.40E-06	popdensity	-0.0003624	0.0000152
dependence	0.0180252	0.0003433	dependence	0.0217902	0.000288
hospphysic	0.5741185	0.0126639	hospphysic	-1.453434	0.0261756
MCDTcostspc	0.0302133	0.0000877	MCDTcostspc	-0.0141454	0.0000854
_cons	-11.53122	0.0115025	_cons	-12.90325	0.025841
select					
urgenciespc	0.1633091	0.0265804			
popdensity	-0.0004149	0.0000153	sigma0	0.2359048	0.0005952
hospurgency	-0.3156359	0.0863538	sigma1	0.4347516	0.0008167
hospphysic	1.246079	0.3298969	rho0	-0.0462266	0.1118851
_cons	-0.6625252	1.480535	rho1	-0.0257484	0.1353915

Main Regression:

Purchasing Power – this variable appears to have a negative impact in both regimes on the number of consultations per capita in the primary health care services. Economic intuition says that in fact this makes sense because people with more financial capacity tend to have better health and consequently do not need to resort as much to the primary health care services. Also, persons with more resources may decide to use more private health care services which would have impact in the public system usage. Another

argument suggests that people with higher purchase power tend to skip the primary health care services and go directly to the hospitals. Notice that the effect of the estimator is higher for the regime 0 (insufficient supply) which is also expected since insufficient supply will have impacts on waiting lines and other costs of resorting to the public system. So, as the economic costs of using the public services increase, persons with more money gain even more incentives to avoid them.

Rate of female population – this variable is positive in both regimes which means it has a positive impact on the number of consultations per capita. The positive sign was expected since in reality women use more health care services than men and so, the higher is the rate of female population the higher will be the number of consultations. The value of the coefficient is higher for the unrestricted regime which is logical considering that women will have more difficulty in attending the consultations and therefore they will consume less primary health care.

Population density – this variable has a negative impact on the number of consultations per capita for both regimes. Areas presenting a larger population density are usually associated with some scarcity in the relative supply of primary health care services. By the coefficient we found, we can verify the veracity of that statement. This probably happens because of the difficulty in allocating resources when dealing with very crowded places. More people imply a higher quantity of primary care centers or larger ones. It involves more doctors, nurses, buildings, equipments, materials, other employees, etc… Managing more people and more structures with limited resources turns out to be very difficult and to have negative implications on the final service that is provided to consumers. It is also possible that resources may be not correctly distributed among ACES and those with higher population density are not receiving as

much as they should. Regarding the difference in the coefficients for the two regimes, we can see that the one for the sufficient supply is larger than the one for the insufficient supply. Since the coefficient is negative, we conclude that higher population density leads to a higher decrease in the number of consultations per capita for the unrestricted regime. However, there is no evident economic reasoning for this difference. Such disparity may be justified by the numbers of the indicator in question that are considerably higher in the ACES of regime0 like the ones from Lisboa and Porto. These outliers are driving the coefficient to a considerably lower value.

Total Dependence Index – This variable coefficient is positive in the two regimes which means that a marginal increase in this indicator leads to an increase in the number of consultations per capita. There is no doubt that the age classes that need more medical attention are the two in the dependence index. The younger class includes the children that are more fragile since they are not fully developed yet and consequently are subject to more health problems that will lead them to consume more health care. The older class is the one of the elders that have a greater deprecation of their health condition by definition. So, it only makes sense to have the dependence index increasing the number of consultations. Concerning the differences between the two regimes, the coefficient is higher in regime 1. If people do not face as much constraints in the sufficient supply regime they will obviously use more the service than the ones in the restrained regime.

Index of usage of hospital admissions decreed by physicians – the coefficient for this variable presents different signs for the two regimes. In the unrestricted regime, the coefficient is negative, which means that more admissions by physicians in the hospitals imply a decrease in the number of consultations on primary health care centers. That result may be reasonable since many potential users of the primary health care services

can be captured by the hospitals services, especially knowing that many of these patients suffer from chronic diseases. This type of patients is used to make regular visits to the primary care centers and may start being treated in the hospitals.

For the restricted regime, a negative sign on the coefficient would not make sense because even if the hospitals can steal some of the clients from primary care centers, there would be a lot of other people ready to "fill in the vacancy". The positive value of the coefficient, however, suggests that in the presence of a restricted value the two services are complementary. In this case, it is possible that the effect is just an association, with another cause inducing it.

Costs with Drugs and complementary means of diagnosis and therapeutic per capita – similarly to the last variable, this one also presents a positive coefficient for the restricted regime and a negative coefficient for the unrestricted regime. In the presence of an insufficient supply, an increase in the MCDT leads to an increase in the number of consultations in primary health care services. When dealing with restricted conditions, increases in costs are usually related to an increase in capacity and quality which means turning the regime less limited. This obviously has a positive influence in the usage of the service. In the regime of sufficient supply, an increase in MCDT leads to a decrease in the number of consultations. It was expected that it would not have the same effect as in the restricted regime but not exactly a negative one. This result suggests that in unrestricted regimes, MCDT have impact on quality and not on quantity ensuring a better treatment related to each consultation (even if it is complementary) and therefore preventing other consultations from happening.

Rule Regression:

Urgencies – This indicator presents a positive sign suggesting that an increase in the number of urgency consultations in the primary health care services increases the probability of a given ACES to be in the sufficient supply regime. The variable is probably working as a proxy for the investment in physicians from each ACES. More urgency consultations imply more structural conditions such as doctors and consequently more supply available concerning the distribution of family doctors.

Population density – The negative coefficient indicates that ACES with higher population density have less probability of enjoying sufficient supply of family doctors. Population density is a factor that influences the efficiency in the allocation of resources and, therefore, it makes sense to observe more people without family doctors in areas with greater values for this variable.

Usage index of hospital urgency services – The coefficient for this variable is negative, which means that more usage of the hospital's urgency services leads to a lower probability of being in a state of sufficient supply in terms of primary health care services. This result may arise from two hypotheses. On one hand it may suggest that in some areas there is a greater investment in hospital structures in detriment of the investments in primary health services and thus, a larger supply of one service implies less supply of the other. On the other hand, it may be a consequence of reverse causality since less supply of primary health care services in terms of family doctors may drive the individuals to search for medical treatment in the hospitals instead of primary care centers.

Index of usage of hospital admissions decreed by physicians – The coefficient is positive meaning that higher usage in terms of hospital admissions increases the probability of an ACES belonging to the sufficient supply regime. This may suggest an association (and not direct causality) in which higher capacity in terms of hospital supply means higher overall investment in the respective ACES area and thus greater supply of primary health care services, measured in terms of people without family doctor.

Predicted Values

With the output of the previous table we are now able to take the predicted values for each of our observations. The coefficients yielded for both regimes will allow us to derive the number of consultations that each ACES should have, according to the estimation. More importantly, we can use the coefficients of the unrestricted regime and apply them to the observations of the restricted regime, getting that way a prediction for the number of consultations the restricted ACES would have if not facing supply side constraints. The results for the restricted regime ACES are presented in the table:

Table 2

ACES	total consultations per capita	prediction values for regime 0	prediction values for regime 1
Famalicão	2.866227	2.809422	3.215112
Braga	2.705395	2.708673	3.263269
Gerês/Cabreira	3.254874	3.201327	3.605773
Barcelos/Esposende	3.021037	2.922247	3.555988
Baixo Tâmega	2.827451	2.938267	3.630411
Vale do Sousa Norte	2.792556	2.921525	3.045667
Vale do Sousa Sul	3.210755	2.740669	3.295226
Santo Tirso/Trofa	3.490349	3.193511	3.26851
Porto Ocidental	3.656441	3.822991	0.912746
Porto Oriental	4.037422	4.03584	1.405413
Baixo Vouga I	3.481852	3.3382	3.361208
Pinhal Interior Norte II	3.868766	3.793168	3.63895

Dão Lafões III	3.438768	3.209184	3.645247
Lisboa Norte	2.600566	2.705766	1.917353
Lisboa Oriental	3.040978	2.820529	1.567463
Lisboa Central	2.680866	2.655382	2.035713
Oeiras	2.358782	2.047352	2.80028
Odivelas	1.744967	1.845662	1.530696
Loures	2.432309	2.642897	2.692794
Amadora	2.284467	2.368222	0.9664361
Sintra-Mafra	2.125694	2.263912	3.009858
Algueirão - Rio de Mouro	1.81685	2.012212	3.432603
Cacém-Queluz	1.652823	1.895166	3.72433
Cascais	2.235277	2.344553	3.167268
Vila Franca de Xira	2.104619	2.128432	3.489881
Almada	3.139459	2.751584	2.711807
Seixal - Sesimbra	2.525116	2.248858	3.467855
Arco Ribeirinho	2.541005	3.023467	3.273274
Setúbal- Palmela	2.428608	2.680946	3.281621
Oeste Norte	2.870529	2.981924	3.399954
Oeste Sul	2.459432	2.840478	3.400342
Serra d'Aire	2.654446	2.930797	3.750112
Zêzere	3.147637	3.338531	3.522911
Ribatejo	3.428332	2.791273	3.153685
Lezíria II	3.098489	3.106843	3.504259
Central	2.411115	2.299051	3.168006
Barlavento	2.372283	2.174469	3.046841
Average for total restricted regime ACES	**2.778555189**	**2.771171081**	**2.969158435**

In this predicted values table we find the estimation for the number of consultations in the two different supply regimes coefficients to be significantly different for the restricted regime observations. The results show that in the restricted regime ACES would consume more 0,2 consultations per capita if living in a state of sufficient supply. Adding to these values the ones predicted for the unrestricted regime would give us a national average of consultations in a hypothetical regime of sufficient supply greater than the actual observed number of consultations in approximately 0.1 consultations per capita. This implies that the state would need to do an extra effort in terms of resources to supply this level of services. Given an average cost for the consultations of 52,35€

the government would have to incur in a financial effort of approximately 53 million euros given the statistics.

The values in red

The values in red are the ones that seem to make no sense. Nevertheless, a deeper analysis may uncover some characteristics that are generating those values. All the regions in question present very high values of population density (Lisboa, Porto and respective Suburbs). The problem is that these values are very strong outliers and are all in the regime of insufficient supply. Because the same does not happen in the sufficient supply regime, the coefficient is considerably higher and has a big effect when applied to the previous observations, in this way contaminating our predictions. However, health policies should not penalize the ACES with a large population density. Living in an area of higher population density should not be a reason for people to experience less supply of basic health care services. The ideal of the primary health care services is that everyone should have equal access to basic health care and therefore, population density should not play a role in that matter.

Having the previous logic into account, it is possible to take the predicted values for the ACES in red, this time not taking into account the effect of the population density. In order to do that we computed the mean population density of all ACES and substituted it in all the red ACES population density values. That value was also applied to all other ACES in the restricted regime in order to eliminate the inferior outliers as well. The following table presents the results only for the critical ACES:

Table 3

ACES	Total consultations per capita	Predicted values for regime 0	predicted values for regime 1 (altered)
Porto Ocidental	3.656441	3.822991	2.394239866

Porto Oriental	4.037422	4.03584	2.88690736
Norte	2.600566	2.705766	3.59859533
Oriental	3.040978	2.820529	3.248704948
Central	2.680866	2.655382	3.716955365
Odivelas	1.744967	1.845662	3.306947935
Amadora	2.284467	2.368222	3.202949806

Using the average of the population density we eliminated the excess effect that the variable was inducing to the predicted values of the ACES in question. Now, the results are much more acceptable and as we can see, all the Lisboa area is living in a considerable state of insufficient supply of primary health care services. This outcome suggests that the state should invest more in the Lisboa area in order to provide the necessary services of health to the people. The Porto area however continues presenting a smaller value in the predicted values than in reality. A closer look to the real number of consultations of all the 74 ACES shows us that even though Porto is in regime 0, it presents two of the highest values for this indicator. Clearly, these areas are not in a state of insufficient supply albeit the rate of people without family doctors being superior to 20% for both zones.

With the changes in the population density values, the overall results for the average number of consultations per capita for all ACES and the extra level of expenditures that need to be done by the government will increase. The average number of consultations increased from 3,2 to 3,31 and is now superior to the real value (3,1) in 0,21 consultations per capita. Knowing that each consultation has a price of 52,35€ for the National Health Service, the costs will increase by 11€ per capita which means an absolute cost increase of approximately 111 million euros. An important note must be made on the fact that this is a ceteris paribus analysis since an increase in the supply of primary health care consultations will certainly have an impact on other variables such

as urgencies, either from hospitals or from permanent attendance services. It is pretty reasonable to assume that urgencies will decrease as a consequence of more consultations. For the analysis to be complete is important to make an estimate for the consequent saves in urgencies. The weighted average price of urgency episodes (hospitals and permanent attendance services) is 85€. The relation between this price and the price of primary care centers consultations allow us to know what should be the composition of an increase in the supply of primary health care services in order to yield no costs for the NHS. If 61% of the increase was a result of stolen episodes from the urgencies services, then the costs of creating more supply conditions would be the same as the saves in urgencies costs. Knowing the real composition of the increase in the number of consultations would allow the computation of the real costs to the NHS. For instance, if that percentage was 30%, the costs would decrease by a half making a project of this type much more appealing.

Final Remarks

In this work project, we estimated the demand for primary health care services by the observed consumption in terms of primary care centers consultations. In order to do that we had to address the problem of the observed levels of consumption, in some observations, being defined by supply side constraints and not by the demand of consumers. Resorting to a switching regression and using the ACES data, the estimation was held and some interesting conclusions were taken. However, the model in question presented many problems in terms of estimation. The switching regression model is a very sensitive instrument and proved itself not to be very reliable when applied to the problem addressed in this work project. The lack of data, both quantitatively and qualitatively also presented an unpleasant challenge mainly in determining the rule

regression. These two problems together created major difficulties in generating a statistical output, driving the use of less intuitive variables tainted with causality problems. Consequently, the credibility of the model was jeopardized.

By running the regression we got the coefficients of the explanatory variables for both the restricted and unrestricted regime. With them we computed the predicted values assuming that all observations were in the sufficient supply condition and thus subject to the unrestricted regime coefficients. The results turned out to be the expected ones with a significant increase in the number of consultations of the supply constrained ACES. Still some observations in the metropolitan area of Lisboa and Porto presented strange values driven by the outliers in the population density variable. The problem was solved by fixing the value of population density for the restricted regime.

Finally, after dealing with the problems, the values estimated in this work project, allowed us to know the estimated demand for primary health care consultations in Portugal and the extra amount of resources needed to achieve the ideal of those services. With an extra number of consultations per capita being 0.21, the NHS would need to spend more 111 million euros on consultations. Still, this value is based on a ceteris paribus analysis and does not have into account the potential saves in urgency services.

In conclusion, the ideal of the primary health care services of providing sufficient basic health care service to everyone can only be achieved through more expenditure. Since Portugal in the last years has been trying to decrease the expenditures in the sector of health, an increase in the supply of primary health care services may be in jeopardy.

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Estimating Demand for Health Care Services

Annexes

Luís Filipe Nº 421

Annex 1

Predicted values

ACES	total consultations per capita	prediction values for regime 0	prediction values for regime 1	famd oc10
ACES_ Trás-os-Montes I - Nordeste	3.413573	3.246997	3.416209	1
ACES_ Trás-os-Montes II - Alto Tâmega e Barroso	3.064265	3.310904	3.290372	1
ACES_Douro I - Marão e Douro Norte	3.288338	2.94201	3.301453	1
ACES_ Douro II - Douro Sul	3.946378	2.957247	3.67581	1
ACES_ Ave I - Terras de Basto	3.886566	3.371692	3.373744	1
ACES_ Ave II - Guimarães/Vizela	3.536749	2.74171	2.95772	1
ACES_Ave III - Famalicão	2.866227	2.809422	3.215112	0
ACES_Cávado I - Braga	2.705395	2.708673	3.263269	0
ACES_Cávado II - Gerês/Cabreira	3.254874	3.201327	3.605773	0
ACES_Cávado III - Barcelos/Esposende	3.021037	2.922247	3.555988	0
ACES_Tâmega I - Baixo Tâmega	2.827451	2.938267	3.630411	0
ACES_Tâmega III - Vale do Sousa Norte	2.792556	2.921525	3.045667	0
ACES_Tâmega II - Vale do Sousa Sul	3.210755	2.740669	3.295226	0
ACES_Porto I - Santo Tirso/Trofa	3.490349	3.193511	3.26851	0
ACES_Porto II - Gondomar	3.121216	2.827618	3.031635	1
ACES_Porto III - Valongo	3.04062	2.7852	3.074351	1
ACES_Porto IV - Maia	2.544566	2.13367	3.305923	1
ACES_Porto V - Póvoa do Varzim/Vila do Conde	2.971925	3.094994	3.313918	1
ACES_Porto VI - Porto Ocidental	3.656441	3.822991	0.912746	0
ACES_Porto VII - Porto Oriental	4.037422	4.03584	1.405413	0
ACES_Porto VIII - Gaia	2.623268	2.783488	2.943259	1
ACES_Porto IX - Espinho/Gaia	3.452784	2.564198	3.069899	1
ACES_Entre o Douro e Vouga I - Feira/Arouca	3.119093	2.444498	3.577223	1
ACES_Entre o Douro e Vouga II - Aveiro Norte	3.217659	3.001484	3.297595	1

ACES_Baixo Vouga I	3.481852	3.3382	3.361208	0
ACES_Baixo Vouga II	3.449982	2.999461	3.004776	1
ACES_Baixo Vouga III	3.532444	3.035573	3.186855	1
ACES_Cova da Beira	2.764791	3.126985	2.770941	1
ACES_Baixo Mondego I	3.543615	3.021933	3.473446	1
ACES_Baixo Mondego II	3.300218	3.15556	3.540359	1
ACES_Baixo Mondego III	3.671436	3.084395	3.712075	1
ACES_Pinhal Interior Norte I	3.629346	3.311891	3.630943	1
ACES_Pinhal Interior Norte II	3.868766	3.793168	3.63895	0
ACES_Pinhal Litoral I	3.258855	3.290536	3.230165	1
ACES_Pinhal Litoral II	2.840935	2.903812	3.138086	1
ACES_Dão Lafões I	3.233759	2.705177	3.72904	1
ACES_Dão Lafões II	3.542702	3.049021	3.940639	1
ACES_Dão Lafões III	3.438768	3.209184	3.645247	0
ACES_Lisboa I - Lisboa Norte	2.600566	2.705766	1.917353	0
ACES_Lisboa II - Lisboa Oriental	3.040978	2.820529	1.567463	0
ACES_Lisboa III - Lisboa Central	2.680866	2.655382	2.035713	0
ACES_Lisboa IV - Oeiras	2.358782	2.047352	2.80028	0
ACES_Lisboa V - Odivelas	1.744967	1.845662	1.530696	0
ACES_Lisboa VI - Loures	2.432309	2.642897	2.692794	0
ACES_Lisboa VII - Amadora	2.284467	2.368222	0.9664361	0
ACES_Lisboa VIII - Sintra-Mafra	2.125694	2.263912	3.009858	0
ACES_Lisboa IX - Algueirão - Rio de Mouro	1.81685	2.012212	3.432603	0
ACES_Lisboa X - Cacém-Queluz	1.652823	1.895166	3.72433	0
ACES_Lisboa XI - Cascais	2.235277	2.344553	3.167268	0
ACES_Lisboa XII - Vila Franca de Xira	2.104619	2.128432	3.489881	0
ACES_Setúbal I - Almada	3.139459	2.751584	2.711807	0
ACES_Setúbal II - Seixal - Sesimbra	2.525116	2.248858	3.467855	0
ACES_Setúbal III - Arco Ribeirinho	2.541005	3.023467	3.273274	0
ACES_Setúbal IV - Setúbal-Palmela	2.428608	2.680946	3.281621	0
ACES_Oeste I - Oeste Norte	2.870529	2.981924	3.399954	0
ACES_Oeste II - Oeste Sul	2.459432	2.840478	3.400342	0
ACES_Médio Tejo I - Serra d'Aire	2.654446	2.930797	3.750112	0
ACES_Médio Tejo II - Zêzere	3.147637	3.338531	3.522911	0
ACES_Lezíria I - Ribatejo	3.428332	2.791273	3.153685	0
ACES_Lezíria II	3.098489	3.106843	3.504259	0
ACES Alentejo Litoral	3.068553	2.418287	3.509495	1

ACES Alentejo Central I	4.284499	3.300348	3.703281	1
ACES Alentejo Central II	3.894444	2.652448	3.627045	1
Algarve I - Central	2.411115	2.299051	3.168006	0
Algarve II - Barlavento	2.372283	2.174469	3.046841	0
Algarve III - Sotavento	2.729423	2.413621	3.107559	1
ACES_ULS Matosinhos	3.425663	0.9909232	3.13399	1
ACES_ULS Alto Minho	4.09627	3.775848	3.809346	1
ACES_ULS Guarda	2.92522	3.235492	3.958167	1
ACES Baixo Alentejo	3.664025	2.360594	3.785244	1
ACES Caia	5.05668	2.554698	4.005961	1
ACES S. Mamede	5.018028	2.770318	4.109348	1
ACES_Beira Interior Sul	3.180307	3.150373	3.693449	1
ACES_Pinhal Interior Sul	3.776536	3.425212	3.965863	1
Total ACES	**3.10704423**	**2.83069657**	**3.206135758**	

Annex 2

ACES	Population Density
ACES_Porto VI - Porto Ocidental	5099.8
ACES_Porto VII - Porto Oriental	5099.8
ACES_Lisboa I - Lisboa Norte	5651
ACES_Lisboa II - Lisboa Oriental	5651
ACES_Lisboa III - Lisboa Central	5651
ACES_Lisboa V - Odivelas	5913.2
ACES_Lisboa VII - Amadora	7183.3

Annex 3

Predicted values with constant population density for regime 0 observations

ACES	total consultations per capita	prediction values for regime 0	prediction values for regime 1 (altered)	famd oc10
ACES_ Trás-os-Montes I - Nordeste	3.413573	3.246997	3.416209884	1
ACES_ Trás-os-Montes II - Alto Tâmega e Barroso	3.064265	3.310904	3.290372485	1
ACES_Douro I - Marão e Douro Norte	3.288338	2.94201	3.301453165	1
ACES_ Douro II - Douro Sul	3.946378	2.957247	3.675809553	1
ACES_ Ave I - Terras de Basto	3.886566	3.371692	3.373742513	1
ACES_ Ave II - Guimarães/Vizela	3.536749	2.74171	2.957707922	1
ACES_Ave III - Famalicão	2.866227	2.809422	3.092157722	0
ACES_Cávado I - Braga	2.705395	2.708673	3.246782397	0
ACES_Cávado II - Gerês/Cabreira	3.254874	3.201327	3.283543783	0
ACES_Cávado III - Barcelos/Esposende	3.021037	2.922247	3.311851473	0
ACES_Tâmega I - Baixo Tâmega	2.827451	2.938267	3.319776709	0
ACES_Tâmega III - Vale do Sousa Norte	2.792556	2.921525	2.888756145	0
ACES_Tâmega II - Vale do Sousa Sul	3.210755	2.740669	3.060222683	0
ACES_Porto I - Santo Tirso/Trofa	3.490349	3.193511	3.093807456	0
ACES_Porto II - Gondomar	3.121216	2.827618	3.031612568	1
ACES_Porto III - Valongo	3.04062	2.7852	3.07432877	1
ACES_Porto IV - Maia	2.544566	2.13367	3.305894061	1
ACES_Porto V - Póvoa do Varzim/Vila do Conde	2.971925	3.094994	3.31390871	1
ACES_Porto VI - Porto Ocidental	3.656441	3.822991	2.394239866	0
ACES_Porto VII - Porto Oriental	4.037422	4.03584	2.88690736	0
ACES_Porto VIII - Gaia	2.623268	2.783488	2.943229066	1
ACES_Porto IX - Espinho/Gaia	3.452784	2.564198	3.069868989	1
ACES_Entre o Douro e Vouga I - Feira/Arouca	3.119093	2.444498	3.577218998	1
ACES_Entre o Douro e Vouga II - Aveiro Norte	3.217659	3.001484	3.297591052	1

ACES_Baixo Vouga I	3.481852	3.3382	3.049850059	0
ACES_Baixo Vouga II	3.449982	2.999461	3.004773081	1
ACES_Baixo Vouga III	3.532444	3.035573	3.186850871	1
ACES_Cova da Beira	2.764791	3.126985	2.770941331	1
ACES_Baixo Mondego I	3.543615	3.021933	3.473444935	1
ACES_Baixo Mondego II	3.300218	3.15556	3.540358662	1
ACES_Baixo Mondego III	3.671436	3.084395	3.712074682	1
ACES_Pinhal Interior Norte I	3.629346	3.311891	3.630942692	1
ACES_Pinhal Interior Norte II	3.868766	3.793168	3.290084959	0
ACES_Pinhal Litoral I	3.258855	3.290536	3.23016488	1
ACES_Pinhal Litoral II	2.840935	2.903812	3.138084653	1
ACES_Dão Lafões I	3.233759	2.705177	3.729038622	1
ACES_Dão Lafões II	3.542702	3.049021	3.940638321	1
ACES_Dão Lafões III	3.438768	3.209184	3.311421542	0
ACES_Lisboa I - Lisboa Norte	2.600566	2.705766	3.59859533	0
ACES_Lisboa II - Lisboa Oriental	3.040978	2.820529	3.248704948	0
ACES_Lisboa III - Lisboa Central	2.680866	2.655382	3.716955365	0
ACES_Lisboa IV - Oeiras	2.358782	2.047352	3.797233073	0
ACES_Lisboa V - Odivelas	1.744967	1.845662	3.306947935	0
ACES_Lisboa VI - Loures	2.432309	2.642897	2.740593716	0
ACES_Lisboa VII - Amadora	2.284467	2.368222	3.202949806	0
ACES_Lisboa VIII - Sintra-Mafra	2.125694	2.263912	2.95604706	0
ACES_Lisboa IX - Algueirão - Rio de Mouro	1.81685	2.012212	3.378790583	0
ACES_Lisboa X - Cacém-Queluz	1.652823	1.895166	3.670517919	0
ACES_Lisboa XI - Cascais	2.235277	2.344553	3.506170944	0
ACES_Lisboa XII - Vila Franca de Xira	2.104619	2.128432	3.287709717	0
ACES_Setúbal I - Almada	3.139459	2.751584	3.202075786	0
ACES_Setúbal II - Seixal - Sesimbra	2.525116	2.248858	3.391539872	0
ACES_Setúbal III - Arco Ribeirinho	2.541005	3.023467	3.039939622	0
ACES_Setúbal IV - Setúbal-Palmela	2.428608	2.680946	3.01360566	0
ACES_Oeste I - Oeste Norte	2.870529	2.981924	3.094031691	0
ACES_Oeste II - Oeste Sul	2.459432	2.840478	3.09268124	0
ACES_Médio Tejo I - Serra d'Aire	2.654446	2.930797	3.43813752	0
ACES_Médio Tejo II - Zêzere	3.147637	3.338531	3.182308589	0

ACES_Lezíria I - Ribatejo	3.428332	2.791273	2.824680124	0
ACES_Lezíria II	3.098489	3.106843	3.151445049	0
ACES Alentejo Litoral	3.068553	2.418287	3.50949607	1
ACES Alentejo Central I	4.284499	3.300348	3.703282123	1
ACES Alentejo Central II	3.894444	2.652448	3.627047229	1
Algarve I - Central	2.411115	2.299051	2.859331229	0
Algarve II - Barlavento	2.372283	2.174469	2.708087131	0
Algarve III - Sotavento	2.729423	2.413621	3.107560082	1
ACES_ULS Matosinhos	3.425663	0.9909232	3.133943059	1
ACES_ULS Alto Minho	4.09627	3.775848	3.809345153	1
ACES_ULS Guarda	2.92522	3.235492	3.958166906	1
ACES Baixo Alentejo	3.664025	2.360594	3.785245344	1
ACES Caia	5.05668	2.554698	4.005962345	1
ACES S. Mamede	5.018028	2.770318	4.109349013	1
ACES_Beira Interior Sul	3.180307	3.150373	3.693450495	1
ACES_Pinhal Interior Sul	3.776536	3.425212	3.965862707	1
Total ACES	**3.10704423**	**2.83069657**	**3.311262879**	

Annex 4

Diário da República, 1.ª série — N.º 21 — 30 de Janeiro de 2009

Artigo 16.º
Urgência
1 — O preço do episódio de urgência para os hospitais do SNS é de:
a) Serviço de urgência polivalente — 147 €;
b) Serviço de urgência médico -cirúrgica — 108 €;
c) Serviço de urgência básica — 51 €.
2 — A classificação por tipo de urgência é a presente no despacho n.º 5414/2008, de 28 de Janeiro.
3 — O preço do episódio de urgência inclui todos os procedimentos e meios auxiliares de diagnóstico e terapêutica realizados durante aquele episódio.
4 — Não há lugar à facturação dos atendimentos urgentes que tenham dado lugar a internamento do doente.
5 — Serviço de atendimento permanente — 36 €.
6 — Aos valores dos números anteriores acresce o valor do transporte nos termos previstos no anexo III.

Annex 5

Average price of urgencies:

Urgências Hospitalares	Preço em €	Percentagem de Utilização	Número de Urgências Hospitalares
Serviço de Urgências Médico-Cirúrgica	147.0	0.5	3154138.7
Serviço de Urgências Polivalente	108.0	0.4	2391247.4
Serviço de Urgência Básica	51.0	0.1	865464.9
Total		1.0	6410851.0

	Preço em €	Número de Consultas
Serviço de Atendimento Permanente	36.0	3911267.0

Total de Urgências	Preço em €	Número de Consultas	Percentagem de Utilização	Preço ponderado
Serviço de Urgências Médico-Cirúrgica	147.0	3154138.7	0.3	33.0
Serviço de Urgências Polivalente	108.0	2391247.4	0.2	34.1
Serviço de Urgência Básica	51.0	865464.9	0.1	4.3
Serviço de Atendimento Permanente	36.0	3911267.0	0.4	13.6
Total		10322118.0	1.0	**85.0**