Spanish public hospital waiting lists: a theoretical and empirical approach

Ana Rodríguez-Álvarez and Mayte Rosete-Rivero

Abstract
The main objective of this work is to study the effects that supply and demand factors have on waiting lists. With this aim, the authors discuss a model which explains the factors that can affect the production of healthcare, demand for healthcare, and finally, the inequalities between health supply and demand. This analysis proves that, due to imbalances between supply and demand, there is an excess of demand that is equal to the waiting lists. This demand excess is called the waiting list function. Hence, the second part of this paper develops an empirical analysis which estimates the function for the waiting lists of Spanish public hospitals for the period 1996 to 2009. As a result of the estimation, the supply and demand factors influencing waiting lists, as well as their evolution, are determined and studied. An imbalance between supply and demand reduces the supply and increases demand resulting in the amount traded by the market being less than potential demand.

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1. INTRODUCTION

The National Health System (NHS) constitutes an important pillar in the Welfare State. In the case of Spain, there have been significant achievements since its implementation such as the equity of and accessibility to healthcare, the supply of a wide-ranging, high-quality and controlled healthcare, a wider system of primary healthcare and the integration and coordination of the different public structures and health services managed by the NHS. The Health Care General Act (LGS 1986) established the National Health System with many features which still exist today. It was designed to give universal coverage characterised by being a free service at the point of delivery. Additionally, it was agreed to be financed by general taxation and to integrate the service network under its structure. Furthermore, it established an agreement to transfer political competences to the Autonomous Communities with the commitment to provide services in basic health areas with a new model of primary health care. The process through which the competences at the sub-national level were reallocated culminated in 2002.

However, despite these gains and strengths, Spanish NHS suffers weaknesses in the form of bureaucratic inefficiencies, a high number of doctor per person appointments (above the average of the OECD countries), an ageing population, and long waiting lists/times for some specializations (Peiró and Ridau 2004; Rodríguez and Lovell, 2004; Prior and Solà, 2007).

The concern with waiting lists/times has spread to all healthcare units regardless of the region, and as such, healthcare status is subject to improvement by either increasing inputs to produce the service or a better allocation of said inputs. In fact, waiting lists are considered one of the major challenges faced by the NHS in Spain and in many other OECD countries. This problem presents a social cost to patients, hospital

managers and politicians. Moreover, waiting lists/time may affect health outcomes and result in an unequal access to the health care system. However, from an economic viewpoint, these waiting lists/times do not necessarily need to be zero. Namely, given that Spanish healthcare faces uncertainty in terms of demand (Lovell *et al*., 2009; Rodríguez *et al*., 2012), if for example a hospital has sufficient capacity to meet patient needs in periods of high demand, this can produce excess capacity in periods of low demand (Worthington, 1987; Propper, 1990; Street and Duckett, 1995 or Iversen and Luras, 2002). This in turn translates itself, from the point of view of productivity analysis, into a certain degree of technical inefficiency. Hence, determining the optimum size of waiting lists requires a comparison of the social marginal cost related to the prolongation of a precarious health status with the marginal cost associated with a reduction in waiting lists/times (see Globerman, 1991; Cullis *et al.* 2000 or Siciliani *et al*., 2013 for a review).

Waiting lists/times can be altered essentially by patient demand and by the capacity of supply. Policies implemented by health managers to reduce waiting lists and times include, for example, guaranteeing a maximum waiting time and sub-contracting private services or increasing hospital capacity. All the policies require both additional funds and a change in operational behaviour. However, over recent years and due to the budget cuts suffered by the healthcare systems, reducing the waiting lists/times remains one of the biggest challenges of the Spanish Health System.

The problem of how to address the subject of waiting lists/times has already been considered in the literature. In this context, many authors define waiting lists as a system of rationing healthcare generated from an excess of demand (Lindsay and Feigenbaum, 1984; Worthington, 1987; Street and Duckett, 1996 or Cullis *et al*., 2000 among others). It is in this regard that the present paper undertakes both a theoretical

and empirical analysis of the characteristics for waiting lists generated by the Spanish National Health Care System, and more specifically the public healthcare system. Within the framework of a healthcare market, and taking into account the supply and demand for healthcare, Martin and Smith (1999) develop an elegant theoretical model with empirical implementation, where both demand and supply are a function of waiting times. This assumption is also considered in posterior models such as Gravelle *et al*. (2003); Windmeijer *et al*. (2005) and Martin *et al*. (2007).

In our paper, we tackle the problem from a different perspective. Specifically, we start with traditional microeconomic theory in order to present both a potential demand for healthcare as well as a potential supply. Given that we assume that said healthcare occurs within a NHS, prices are subsidized meaning that the market price of healthcare will be below the equilibrium level occasioning an excess of demand (Worthington, 1987; Street and Duckett, 1996). Based on this idea, we develop a theoretical excess demand function (that is, a function of waiting lists) and we propose the estimation of an empirical example. In this sense, we present a waiting lists versus waiting times perspective. Several papers have revealed that although both concepts might be correlated, this correlation is imperfect. However, for the Spanish case, an advantage of using waiting lists versus waiting times could be that the waiting times are regulated in Spain, which means that, with the objective of not surpassing timelines, various autonomous communities have detected and reported several practices aimed at either concealing and/ or manipulating the real statistics of waiting times. This implies that the data for waiting times, when existent, should be treated with considerable caution.

After performing the theoretical analysis, an empirical model is developed using panel data where we estimate a function for waiting lists. From an empirical standpoint, our model shares with previous ones the simultaneity problems associated with a joint

estimation of supply and demand. Nevertheless, given the use of panel data techniques, this problem is tackled in the empirical model.

Finally, the main contribution of the paper is, to the best of our knowledge, that it constitutes the first study in the literature which analyzes both from a theoretical and empirical standpoint a waiting list function in the context of a National Health System (NHS).

2. MODELING HEALTHCARE WAITING LIST

The model proposed in this section is developed using a microeconomic framework and ultimately serves to evaluate the excess demand for healthcare services. Considering the complexities of measuring health, from a conceptual point of view as well as an instrumental one, we approach it using healthcare provision as a proxy.[1] Healthcare provision will include all those services performed by healthcare professionals aimed towards an individual or a group of individuals with the main objective of facilitating the recovery of the biological, psychological and social functions. The demand for healthcare services is not a goal in itself but instead the demand for a sought-after good: health. Therefore, the demand for health services can be understood as a derived demand from the demand for health. What follows is an analysis of the healthcare market, its particular conditions as well as the fundamental components of supply and demand.

2.1. HEALTHCARE DEMAND

To obtain healthcare demand we apply the principles of classical consumer theory, which studies the preferences of a utility-maximizing consumer restricted by

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[1] It is important to differentiate between two types of goods: healthcare and health. In this paper we focus on the demand for healthcare instead of investment in health (Grossman, 1972).

their budget. Concretely, we assume that a consumer has to choose between two goods (healthcare and a second item). For this specific consumer, the ordinary utility function can be constructed as follows:

$$U = U(M, X, \bar{H}) \tag{1}$$

Where we define; M =Healthcare consumption; X =Other goods; $\bar{H}$ =individual state of health (assumed to be short- term). The utility maximization process has to be restricted through monetary limitations. The real budgetary constraint is viewed as the combination of consumption possibilities given a set of market prices and initial wealth. These constraints were developed by Acton (1975) who incorporated the cost of time into the price vector for the model, expressed as follows:

$$Y = (p + wt)M + (q + ws)X \tag{2}$$

$$Y = P \cdot M + Q \cdot X \tag{3}$$

Defining: Y =Total income; p =Unit Price for healthcare services; w =Hourly wage; t =Time spent on the consumption of healthcare goods; q =Unit Price for the alternative goods; s =Time spent on the consumption of other goods; P =Total price of healthcare; Q =Total price for other goods.

The consumer is granted an amount of income Y which they have to distribute between the consumption of both goods. The chosen combination will depend on the price of the goods but in the case of healthcare we have to add to the unit price (p) the indirect costs (wt) defined as the opportunity costs of time spent on acquiring healthcare. In the same way, the price of other goods (besides the direct unit price q) carries an indirect opportunity cost materialized in the time spent on acquiring other goods. The budgetary constraint will be subject to variations based on changes in prices, wages, income or the time allocated by each individual to the consumption of both goods.

The consumer's equilibrium is the combination of goods that solves the following optimization process:

$$Max \ U_{M,X} = U(M, X, \bar{H}) \tag{4}$$

$$s.a. \quad Y = (P \cdot M + Q \cdot X) \tag{5}$$

Once the optimization problem defined in the equations (4) and (5) is solved, we can deduce the individual's demand function (M^d) defined as follows:

$$M^d = M^d(P, Q, Y, \bar{H}) \tag{6}$$

The quantity demanded is positively related to the price of the alternative goods and personal income (if we assume that healthcare is a normal good) and negatively related (if healthcare is an inferior good). Nonetheless, healthcare demand is negatively related to its own price and the individual's level of health leading to a diminished demand when either of the latter variables increases.

Finally, we define the market demand (in this case, society) as the sum of all individual demands at every price level. With this definition, the form adopted by the aggregated curve will depend on the form of the individual curves for each consumer. Consequently individual health status will be the main factor for defining the aggregate demand function. We have to assume that all individuals in this particular society enjoy the same level of health. The slope for the aggregated demand curve in a society that endures worse levels of health will be steeper in contrast to healthier societies where it will be much flatter.

The aggregate demand function (M^D) for the entire society depends on a large number of factors, the following being the most influential:

$$M^D = M^D(P, Q, Y, H, POP) \tag{7}$$

Where we define: $M^D =$ Quantity of the demanded Healthcare; $P =$ Total Healhcare Price; $Q =$ Total Price of other goods; $Y =$ aggregate income; $H =$ Health Status; $POB =$ Total population.

Variations in the previous factors will result in changes in aggregate demand. Under the aforementioned assumptions, the price of other goods, aggregate income (in the case of a normal good), mean age and population will positively affect the quantity demanded. Meanwhile health status and healthcare price will affect it negatively.

2.2. HEALTHCARE SUPPLY

State intervention in the healthcare system is justified by the numerous market failures. The healthcare system currently enacted in Spain is NHS regulated on a national scale. This service is granted by way of public financing and provision, staffed by State employees and offers free and universal access to all its services. The NHS leaves the private sector as an alternative for those citizens whose utility is not maximized by the public provision of healthcare and who are able to affront the cost of a private healthcare scheme in monetary terms One of the main reasons why some individuals opt for private healthcare services is precisely to avoid the long waiting lists of the public service which are due in part to the latter's free and universal nature.

The production agent in our model are hospitals. As explained by Cullis and West (1979) hospitals are suitable for comparison as a firm since both entities are faced with the task of choosing between a series of factors to produce a number of healthcare services (i.e. a multi-output firm). Also, it is important to mention that, judging by the total healthcare expenditure incurred, hospitals are the dominant institutions in the production of health. From the point of view of the Spanish healthcare sector we can

differentiate between private and public hospitals. The former allows for the pursuit of different objectives: from profit maximization, cost minimization or others such as quantity or quality maximization (see for example Sloan (1998), Dranove (1988) or Frank and Salkever (1991)). With regards to the latter, several authors have analyzed hospital activity, i.e. Newhouse (1970) developed a model where the main optimization objective was both service quantity and quality. Lee (1971) assumes that hospital managers compete for their "status" or reputation. Finally, there exist several papers which analyze the hospital sector within the framework of a bureaucratic organization (Lindsay, (1980), Spicer (1982) or Ortún (1990); Rodríguez-Álvarez and Lovell (2004) and Lovell *et al*. (2009). These works predict sacrifices, in terms of efficiency, when hospitals fall within the framework of a bureaucratic institution.

2.2.1. Hospital production

It is difficult to measure or quantify hospital production since being subjected to health assistance does not guarantee a full recovery. Therefore it seems reasonable to define hospital output as a combination of the quantity and quality of the service.

A two-factor (labour and capital) production function for a hospital is developed below. We run a short-term analysis, with the assumption of constant capital (K) - buildings, machinery and medical equipment-. Labour (L) will be studied as the number of working hours offered by personnel, including their human capital (level of knowledge and education).[2] The production function indicates the highest output levels achieveable by each hospital using possible factor combinations, that is to say, it reflects

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[2] The variable factor Labour does not suffer any drastic changes taking into account the high degree of specialization of healthcare professionals and the high entry barriers into this Spanish labour market. That is, in the short-term it is difficult to modify the number of workers substantially.

the best possible way to use factors in order to achieve the highest degree of efficiency. This is expressed as:

$$M = M(L, K) \tag{8}$$

Where M (healthcare) is the maximum output achieved with a given input vector. Regarding firm-specific costs, and with reference to the function explained in (8), hospital cost is formulated as follows:

$$B = W \cdot L + rK \tag{9}$$

Where we define: B =Total hospital budget; W =labor price and r is the capital price.

An understanding of hospital objectives is essential for determining the supply of healthcare, also taking into account that the economic analysis performed in this paper is limited to public hospitals, namely, those belonging to the NHS. The State has a direct influence on the supply of the public hospital services by regulating the market: first, public hospitals each have a "protected population" assigned to them and as such no direct competition exists with other hospitals; second, the hospitals have a public budget assigned to them (B). Therefore, objectives for profit or income maximization prove unsustainable if we consider healthcare institutions belonging to the NHS as in the case of the Spanish public hospital network. In these establishments it is more cohesive to assume that management maintains other goals such as the maximization of service quantity or quality subject to a public budget (see for example, Rodriguez-Álvarez and Lovell, 2004). That is to say:

$$\text{Max } M_L = M(L, K) \tag{10}$$

$$\text{s.t.} \quad B = W \cdot L + rK \tag{11}$$

The first-order conditions of the output maximization problem subject to a given level of budget, provide demand functions for a level of K (we present a short-term capital model) as follows:

$$L=L(W, B,K) \tag{12}$$

and also generates indirect supply functions as a function of input prices, capital and budget as follows:

$$M^s=M^s(L(W,B,K), K)=M(W,B,K) \tag{13}$$

2.3. MODEL EQUILIBRIUM. ANALYSIS OF WAITING LISTS IN SPANISH PUBLIC HOSPITALS

Once the supply and demand of the healthcare market have been analysed, we are in a position to establish the market equilibrium conditions. What follows is a description of the current healthcare hospital services available in the market, something that will help us to explain the evolution of waiting lists. We start by representing the equilibrium between supply and demand where the supply is provided by public hospitals at a price inferior to that offered in the private sector. In fact, given that the service is subsidized the price of the service is zero and patients only have to face an indirect cost.

Figure 1 shows the supply (S) –note that in Equation (13) supply is price inelastic- and potential demand (D) –defining it as the amount of healthcare services that individuals are willing to purchase at every price level- for Spanish public hospital services with the equilibrium point E depicting where the market would be in a non-regulated context. However, since the service is subsidized, the price that an individual pays for one unit of service is P (which corresponds to the time waiting for the service and with a price

substantially lower than that set by the market). Hence, for price level P, the amount supplied will be M* which does not meet the potential citizen demand (M_D), thereby generating an excess demand. This excess is the cause of the waiting lists, which are the differences between the potentially demanded quantity and the supplied one (M_D – M^*).

(INSERT FIGURE 1 AROUND HERE)

Having explored the theoretical healthcare supply and demand framework, we now study how changes in these driving forces affect the model. Regarding supply-side variations, a reduction of the hospital's budget, for example, will shift the supply curve to the left. The newly exchanged amount has decreased to M', the exchanged price is still P and the demanded quantity remains unchanged. On the other hand, the excess demand, that is to say, waiting lists, has steadily increased (M_D – M').

(INSERT FIGURE 2 AROUND HERE)

Waiting lists also suffer variations in response to a shift in healthcare demand. For example, an increase in the individual's morbidity generates an increase in the healthcare services demanded (Figure 3). As shown by the graph, the result of an increase in the demand for healthcare services is a shift of the demand curve to the right. After this change the new point of equilibrium is established at a traded quantity M_D' and price P, leading to an excess of demand and therefore waiting lists (M_D' – M^*).

(INSERT FIGURE 3 AROUND HERE)

As shown by the graph, the result of an increase in the demand for healthcare services is a shift of the demand curve to the right. The new point of equilibrium is established at a traded quantity M_D' and price P, leading to an excess of demand and therefore waiting lists (M_D' – M^*).

In essence, the excess demand generated in the Spanish Public Hospital Sector is caused by reductions in supply and spikes in demand. The potential demand is higher than the observed demand, which is equivalent to the supplied quantity (M^S), that is, the healthcare assistance exchanged in the market. The difference between both quantities is expressed through waiting lists (WL). Mathematically speaking we can define waiting lists (WL) as a function of supply and demand factors:

$$WL = M^D - M^s = M(P,Q,Y,H,POP) - M(W,B,K) = f(P,Q,Y,H,POP,W,B,K)$$

(14)

The WL function in (14) is, similar to the demand function defined in (7) homogeneous of degree zero for prices and income. The formulation above will be used to develop the econometric estimation of the waiting list function.

3. DATA

To estimate equation (14) we require information on both healthcare supply and demand factors. The structure of our database will be a data panel for 17 Spanish regions (autonomous communities –CCAA) observed over the 1996-2009 time-frame.

The data referring to hospitals has been obtained from the *Estadística de Establecimiento Sanitarios en Regimen de Internado*–EESRI (the Spanish acronym for Survey of Sanitary Establishments with Internal Regimes), which is basically a survey conducted by the Spanish Health Ministry by way of interviews to Spanish hospitals. The study covers all the Spanish Public hospitals and the latest one available relates to the 2009 survey.

The dependent variable obtained directly from the EESRI will be the waiting list data respresenting an aggregate variable unit composed of the waiting lists for internal

medicine hospitalization and surgery (number of patients waiting for an operation). The concatenation of both types of waiting lists has been achieved using Weighted Care Units (WCU) which equates the severity of the procedure to be performed to a unified unit of measure.[3]

The EESRI also provided the supply factors. We proxy budget (BUDGET) by using the sum of purchases and currents assets and services per hospital per year (in constant 2005 euros).[4] The capital variable (CAP) measures the official and accounted depreciation and the investment per hospital per year (in constant 2005 euros). As regards labor price (W in equation 14), given that public hospitals have centralized procurement services, and the salaries of employees are established by law at the beginning of the year and they are the same in each CCAA, these prices will be captured by the dummies of the CCAA and time included in the empirical model.

The demand factors included in our estimation are the GDP (as a proxy of income); number of hospital visits and life expectancy (as a proxy of morbidity of the population); population and the regional unemployment rate. We have included unemployment since it is one of the key issues for the Spanish economy and as such, its analysis is important because of its potential effect on population health.

With respect to pricing, the price of hospital assistance is, as we have explained before, approximately zero-assuming that the time spent on bureaucracy is a residual price. In any case, if we consider that the bureaucratic process leading up to being attended by a public hospital is constant for all autonomous communities, this price (the bureaucratic time spent) is captured by the individual and time effects included in the estimation. The

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[3] WCU weighs hospital activities according to its consumption of resources per unit, where the unit is a medical stay (a medical stay = 1 UPA and a surgery stay=1.5). The elaboration of the WCU measure unit is explained in Bestard et al. (1993).

[4] Budget is state-regulated at the start of each year, therefore we consider it as a pre-determined variable.

same occurs with the price of other goods, if we consider an average price for each year and autonomous community.

The GDP variable has been taken from the Spanish Statistics Institute (INE, its acronym in Spanish) and is expressed as the gross domestic product per year in millions of euros. The variable of hospital outpatient visits (VISIT) is a proxy of morbidity and has been collected from the EESRI survey. We define it as the number of outpatient visits from patients to healthcare services, involving a medical diagnosis on an outpatient basis. Life expectancy (LIFEXP) has been estimated using data from the INE and we define it as the number of years people are expected to live per autonomous community. The population variable (POP) comes from the population data generated by the INE, which includes all residents in each Autonomous Community per year. Finally, the unemployment variable (UNEMPLOY) has been obtained from the Spanish Labour Force Survey and it is defined as the yearly unemployment rate: the number of people that want to find work and are actively searching for it. Table 1 briefly describes the variables used in the study.

(INSERT TABLE 1 AROUND HERE)

4. EMPIRICAL MODEL

We propose a panel model where the error term is not assumed to be independent and identically distributed (iid). Instead, it is assumed that the disturbance could be heteroskedastic and contemporaneously correlated across panels. We have also tested for a first-order autocorrelation issue (in our example it is likely that the waiting lists in t are associated with those of t-1). That is to say, we control for heterocedasticity; cross-panel correlation and first order autocorrelation.

$$\ln WL_{it} = \sum \alpha_i D_i + \sum \alpha_t D_t + \beta_1 \ln BUDGET_{it} + \beta_2 \ln CAP_{it}$$
$$+ \beta_3 \ln UNEMPLOY_{it} + \beta_4 \ln GDP_{it} + \beta_5 \ln VISIT_{it}$$
$$+ \beta_6 \ln POP_{it} + \beta_7 \ln LIFEXP_{it} + e_{it}$$

(15)

where i = 1; …;m is the number of regions (or panels); and t = 1;…; T; is the number of periods in panel i.

The parameters of equation (15) are defined as follows: α, β are parameter vectors to be estimated; D_i and D_t are vectors of firm and time-specific dummies respectively; and e_{it}, is a disturbance that may not be iid. In fact, we have already tested the existence of heteroskedasticity, contemporaneous correlation of the errors; and serial-correlated errors.[5] Because of this, we use a panel corrected standard errors model (PCSE).

5. RESULTS

The results obtained from the estimation of equation (15) are in Table 2. Before discussing our results, we wish to point out that the variables used in the estimation are defined in logarithms and these variables have been divided by the geometric mean. Therefore, the coefficients in Table 2 can be interpreted as elasticities.

The budget variable (BUDGET) shows a negative and significant elasticity meaning that larger budgets would generate a reduction of waiting lists, specifically; keeping constant the rest of the variables, if the budget were increased by 1%, the waiting list

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[5] To test the existence of correlation we have applied the Wooldridge test for autocorrelation in panel data. The value of this test was 5.179, higher than the critical value of the F distribution at the 5% level of significance, which means that we can reject the null hypothesis of absence of first-order autocorrelation. To test the existence of heterocedasticity, we have applied a Wald test. The value of this test was 787.57, higher than the critical value of the *chi*-square distribution for 17 degrees of freedom at the usual levels of significance, which indicates that we can also reject the null hypothesis of absence of heterocedasticity. Finally, we have used the Pesaran test of cross sectional independence with the null hypothesis being rejected at the 1% level.

would decrease by aproximately 0.04%. This result logically indicates that an increase in budget translates itself into more resources and, therefore, in a greater probability of attending more patients, reducing in turn, waiting lists. Similarly, the capital variable (CAP) shows a negative and significant coefficient indicating that increases in the capital of hospitals also reduce waiting lists. More specifically, a potential increase in the fixed capital of hospitals would imply and improvement in the form of a decline in waiting lists of 0.08%. Therefore, both results seem to indicate as the theoretical model predicted, that increases in supply –either via an increased budget in current costs or capital- could reduce hospital waiting lists.

With respect to the demand variables, these present higher coefficients than those for supply variables, which would appear to indicate that demand variables are the ones which most influence variations in waiting lists. Hence, for example, the GDP variable, which is our income proxy, presents a negative elasticity indicating an inverse relationship between income and waiting lists. Concretely, if the GDP were increased by 1%, the waiting list would decrease by aproximately 0.91%, ceteris paribus. Although several authors have found a positive relationship between income and waiting times (Laudicella et al,, 2010 or Siciliani and Verzulli, 2009), these results may indicate a positive relationship between more income and better health which has been amply discussed in the literature. For example, Marmot *et al* (1978), Lantz *et al*. (2007,2010), Moss and Krieger (1995), Rose (2001), Case and Deaton (2005), Galama and Kipperluis (2010) amongst others, find that income and social class in general are a good predictors of morbidity and mortality given that lower social classes tend to lead less healthy lifestyles and behaviours than superior social classes. Moreover, this result could indicate that public hospital healthcare is an inferior good compared to its private counterpart. If patients experience an increase in income, they cease to wait for services

from the NHS and switch to the private hospital system where waiting lists are non-existant or if they exist they are minimal in terms of time. Both reasons, may explain why GDP gains generate a reduction in the NHS patient waiting list

On the other hand, the value of the coefficient of population (POP) is positive and signifcant indicating that more populated regions are those with the longer waiting lists. Concretely, the results indicate that if the population increases by 1%, the waiting list would rise by 0.65%.

As regards morbidity, the variable for healthcare visits (VISIT) shows a positive and significant elasticity. A larger number of outpatient visits are indicative of a slightly more deteriorated population health, leading to an increase in the length of the waiting list. With these results we can say that if hospital visits increase by 1%, waiting lists would rise by aproximately 0.17%. In a similar way, an increase of a year in life expectancy (LIFEXP) significantly reduces waiting lists by 0.005%.

The unemployment variable (UNEMPLOY) presents a negative but not significant elasticity.[6] Numerous studies have documented a positive association between employment and health (Moser *et al*. (1987); Mathers and Schofiels (1998) or Roelfs et al. (2011)), whilst others find an inverse relationship (Boone and van Ours (2006); Ruhm (2000) or Stuckler *et al*. (2009)). We have therefore included this variable in the study in order to contrast the relationship. However, the result is not significant and thus we are unable to determine whether a clear relationship exists between unemployment and health and in consequence between unemployment and waiting lists.

In order to control for the differences between the various CCAA, a regional dummy variable (D_{CCAA}) has been included. The results seem to indicate, that except for a few exceptions, no significant differences exist between CCAA. With respect to time, the

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[6] The coefficient is significant by 10.2% which is at the limit of standard significance levels.

dichotomic time variables captured events common to all the autonomous communities during a period, such as for example the effects of the crisis or political changes which could have affected health policies. Whilst the results for the initial years (from 1996 to2005) are not significant, from 2005 onwards the relationship is significant and positive. This result can have two readings, one with its origin in supply and the other in demand. With respect to supply, this negative impact is visible at the commencement of the economic crisis as a reflection of the start of the budgetary problems and restrictive policies. On the demand side, the effects of determined factors on population health similar to those for all the CCAA and which vary in time (for example, the ageing population or the chronification of several illnesses previously terminal thanks to the technical advances in medical research) may have influenced an increase in the number of waiting lists. Figure 4 shows the evolution of waiting lists, assigning 1996 as the baseline year.[7]

(INSERT FIGURE 4 AROUND HERE)

6. CONCLUSIONS AND DISCUSSION

This paper has performed both a theoretical as well as an empirical analysis of Spanish NHS waiting lists. First, we have applied a theoretical model that explains both the supply and demand of Spanish NHS hospitals. In Spain, public healthcare is subsidized so that patients do not have to pay for the service received. The theoretical framework justifies this waiting list increasing as a result of changes in demand (for example,

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[7]Applying a Wald tests, we have checked whether the time effects, taken as a whole, are significant by testing whether the coefficients on D_t are simultaneously zero. The value of the test (χ^2 (13) =37.87) allowing us to strongly reject the hypothesis that the joint effect of time effect has not affected waiting lists. In the same way, for the case of the regional individual dummies (CCAA) we find that the significance level of the test is very close to 0 (the value obtained with the Wald test was $\chi^2(16)=114.34$).

population or morbidity) as well as supply (budgetary cuts and capital) factors. As a consequence of these possible increases in demand and reductions in supply, excess demand has broadened, in other words, waiting lists have increased.

Once the waiting list function was defined in the theoretical model, the next stage involved developing an empirical panel data model to estimate the former function. Thus, the main objective of the second part was to contrast the effects that both supply and demand factors have on waiting lists. We have used a data panel for the 17 Spanish Autonomous Communities observed over the 1996-2009 time-frame.

The main contribution of this paper is that it combines a dual approach represented by a theoretical and empirical model in order to analyse the waiting list function in a rigorous way, shedding some light on what is, without doubt, a social and economic problem of enormous magnitude. The results obtained confirm the model presented: the waiting lists of Spanish public hospitals are affected by supply and demand variables. Concretely, an increase in the budget for the current costs of hospitals as well as capital diminishes waiting lists significantly. With respect to demand variables, results seem to indicate that these have a bigger impact than supply variables. Specifically, variables which approximate income, morbility (number of outpatient visits or life expectancy) and population, influence waiting lists significatively. In contrast, unemployment does not appear to have a significant effect on said waiting lists.

Finally, we have observed that time has influenced an increase in waiting lists (the effect proving statistically significant from 2005 onwards). This result may be due either to restrictive supply budgets or demand factors such as population ageing or the chronification of certain illnesses thanks to technological advancements.

Nowadays, the Spanish National Health System suffers from the austerity measures resulting from the impacts of the economic crisis. These measures include cutbacks in

the budget dedicated to public health. The model proposed predicts that this, together with an increase in citizen demand for health services, will result in a reduction in supply and an increase in demand and with it an excess of demand that translates itself into longer waiting times. During the period of study, we gain a glimpse of the future evolution of waiting lists.These results motivate a greater reflection on the barriers currently being generated by the NHS in terms of more restrictive services as a consequence of the cutbacks in production factors. Since one of the objectives of an NHS is equality, it is important to consider how austerity-fueled cutbacks will compromise service redistribution based on the most basic principles of social justice. Moreover as revealed by the study, the most affected citizens will be those with fewer resources, who have to resort to public services because of their inability to afford private treatment. Namely, those citizens who, already suffering from a reduction in their economic power because of the crisis, have to endure rising indirect costs (in the form of longer waiting lists) for public healthcare.
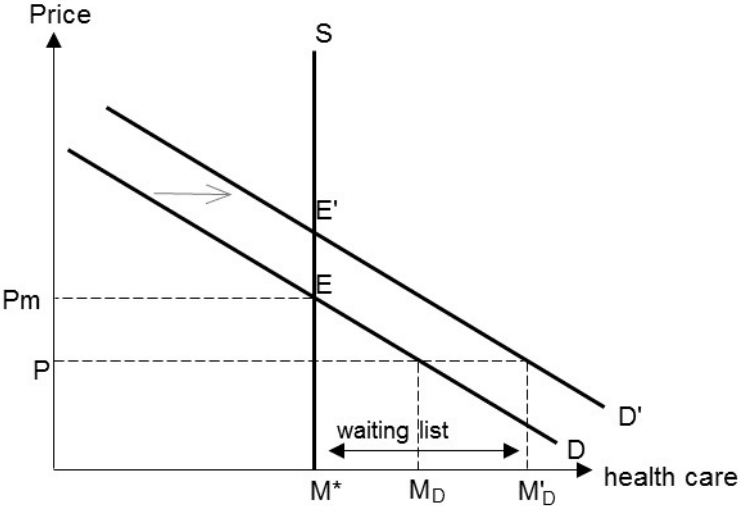
FIGURE 1.

**The Waiting List
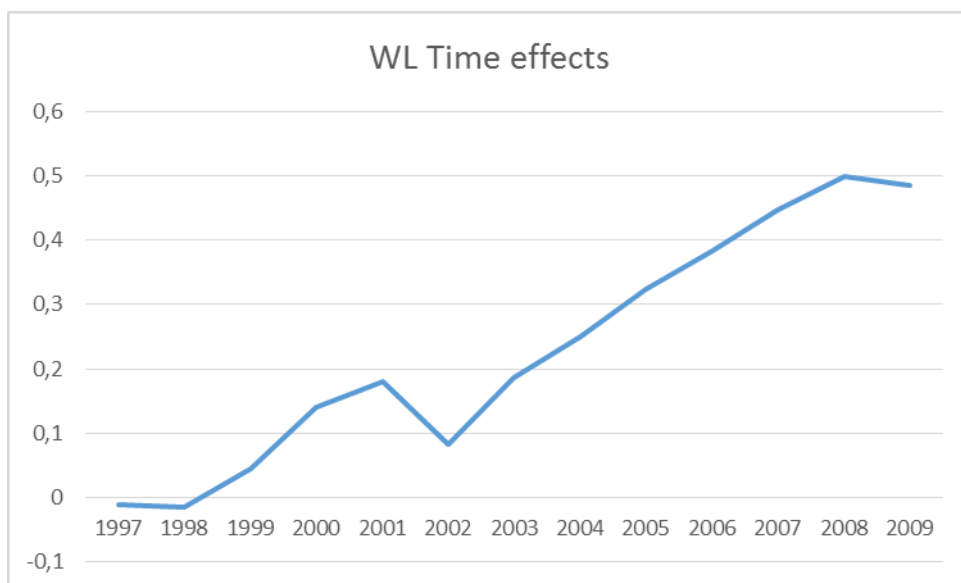Model**
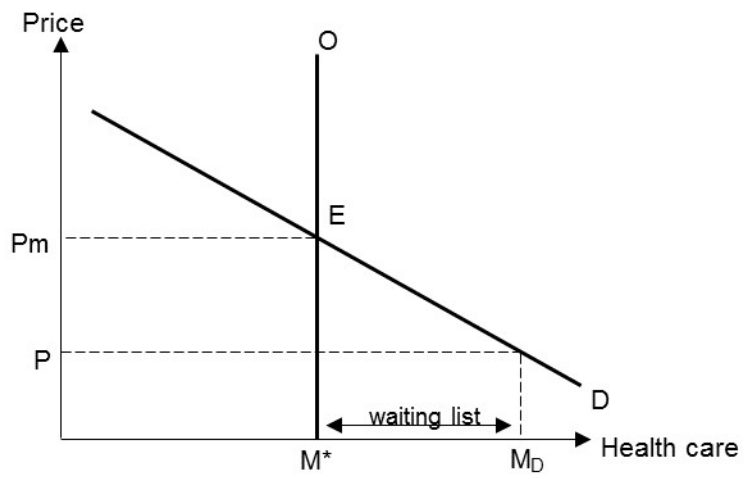
FIGURE 2.
Waiting List & Changes in Supply
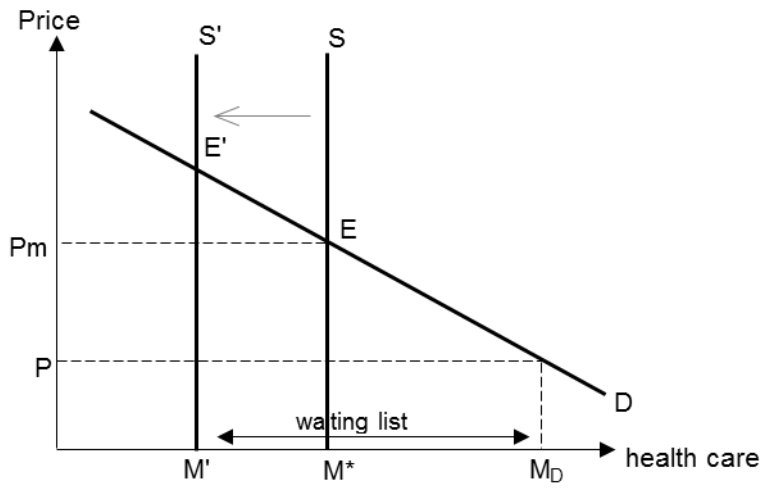
FIGURE 3.
Waiting List & Changes in Demand

FIGURE 4.
Evolution of WL Time Effects

WL Time effects

TABLE 1.
Descriptive Data Analysis

	Mean	S.D.	Minimum	Maximum
WL (patients)	1024.439	168.28	583.6	1655.82
Supply Variables				
BUDGET *(thousands of euro 2005)*	1.32e+07	7130626	4568961	6.00e+07
CAP *(thousands of euro 2005))*	108.58	99.23	18.64	453.63
Demand Variables				
UNEMPLOY *(individuals)*	12.53	5.74	4.27	31.8
GDP *(thousands of euro 2005)*	45468.9	45982.5	3729	200808
VISIT *(individuals)*	87049.8	28900.7	33811.3	177705.4
POP *(individuals)*	2495142	2191308	263644	8302923
LIFEXP *(years)*	79.99	1.29	77.16	82.97
Nº observacions	238			
CCAA (regions)	17			
Period	1996-2009			

Source: EESRI, INE

TABLE 2.

Results of the Estimation of Equation 15[(*)]

Variable	Coefficient	t-statist	P-value
Ln(BUDGET)	-0.0396	-1.67	0.096
Ln(CAPITAL)	-0.0784	-3.01	0.003
Ln(GDP)	-0.9079	-2.74	0.006
Ln(POP)	0.6586	2.44	0.015
Ln(VISIT)	0.1676	1.98	0.048
LIFEXP	-0.0055	-2.44	0.015
Ln(UNEMPLOY)	-0.0717	-1.64	0.102
Constant	-0.0447	-0.19	0.852
Aragón	0.2017	0.33	0.660
Asturias	-0.4192	-1.18	0.240
Baleares	-0.3142	-0.89	0.372
Canarias	-0.1726	-0.67	0.501
Cantabria	-0.3607	-0.74	0.462
Castilla León	0.0153	0.08	0.939
Castilla La Mancha	-0.2861	-1.03	0.304
Cataluña	0.6036	4.59	0.000
Valencia	0.0738	0.76	0.448
Extremadura	-0.5856	-1.39	0.163
Galicia	-0.1955	-0.93	0.351
Madrid	0.4107	2.09	0.037
Murcia	-0.4463	-1.33	0.184
Navarra	-0.2332	-0.54	0.590
País Vasco	-0.2146	-0.99	0.323
La Rioja	-0.6423	-1.12	0.264
D_{1997}	-0.0140	-0.57	0.569
D_{1998}	-0.0142	-0.34	0.732
D_{1999}	0.0407	0.66	0.511
D_{2000}	0.1349	1.51	0.131
D_{2001}	0.1754	1.52	0.128
D_{2002}	0.0972	0.70	0.485
D_{2003}	0.2009	1.26	0.207
D_{2004}	0.2643	1.43	0.151
D_{2005}	0.3367	1.63	0.102
D_{2006}	0.3965	1.69	0.090
D_{2007}	0.4616	1.82	0.069
D_{2008}	0.5143	1.90	0.057
D_{2009}	0.5004	1.90	0.057

*The reference variable deleted was Andalucía

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