**Report on MS 2209 SPANISH PUBLIC HOSPITAL WAITING LISTS: A THEORETICAL AND EMPIRICAL APPROACH**

## Reviewer 2: Reply

We thank the referee for his/her valuable comments. The paper has changed and benefited substantially from these insightful suggestions, for which we are grateful. We have made every attempt to accommodate the referee's comments, and we have hopefully addressed all of them satisfactorily. Below, please find a brief summary of the key issues raised by the referee as well as our responses.

**The paper studies the effects that supply and demand factors have on waiting lists (WL). The first part of the model defines a theoretical approach to waiting list, defined as the excess of demand in an equilibrium function between supply and demand of healthcare. In the second part of the paper the authors apply their theoretical model in an empirical analysis of Spanish data. In general, the authors should extend the description of Spanish Healthcare System, in order to allow the reader in understanding the implication of the theoretical part to the applied part of the paper.**
**In particular, the role of the private hospitals in the healthcare system has to be more explained. The difference in terms of penetration of the private hospitals in the market areas, it implies an impact of the WL for public hospitals. But in order to understand this impact in Spanish healthcare System the reader needs more details to understand how do the private providers act in the hospital market.**

Thank you for your suggestion. We have included the following information about the role of the private sector in the Spanish health system:

(Page 2): *It was designed to give universal coverage characterised by being a free service at the point of delivery. Concretely, healthcare provision is free except for several services, namely, dental, optical, over-the counter medication and prescription pharmaceuticals (in the latter case they are subject to co-payments). In line with the findings of the OECD (2014), private healthcare provision tends to play a much smaller role than public health care. For example in 2010, 75% of total admissions were performed in public hospitals with only 24.5% taking place in the private sector. All citizens have the right to public healthcare and cannot choose private healthcare in lieu of the former except for civil servants who have this choice available to them. Private healthcare insurance systems are independent of the public system and are of a complementary nature (principally in order to access services with long waiting lists in the public system, such as specialist attention, or dental services not provided by the public system). According to data from INE (2006) 85.1% of the population has healthcare which is exclusively public; 1.4 % is exclusively private and 13% complement public healthcare with some form of private insurance (García-Armesto et al., 2010).*

**Page 10: what do the authors mean exactly with "protected population"? It seems that there is no way for patient to choose an hospital regardless his clinical condition. It seems also that hospitals or the GPs can not move patients to another hospital in case when they consider this hospital as a better solution for the patient's health status.**

The Spanish healthcare model is organized into different health areas (comprising a population between 200,000 and 250,000 inhabitants and which constitutes its so-called protected population). Regarding patient choice, the possibility to choose a specialist and hospital is relatively less developed (with some differences across Autonomous Communities), compared to primary health care. In any case, access to specialist care requires referral from a general practitioner (GP) (García-Armesto et al., 2010). Nevertheless, as pointed out by the referee, the GP or paediatrician can assign a different hospital if the reference hospital does not provide the treatment required by the patient.

In order to clarify this point, we have extended the paragraph on page 10 as follows:

*The State has a direct influence on the supply of the public hospital services via regulation of the market: public hospitals each have a "protected population" assigned to them and as such no direct competition exists with other hospitals. This means that public hospitals supply specialized assistance to patients belonging to their zone of influence, this depending on individual place of residence (although the GP can assign a different hospital if the patient´s reference hospital does not provide the required treatment).*

Page 10/11 in case of budget constrain, like the authors describe in the paper, it could be accept to exclude the objective of profit maximisation, but the authors should more discuss this budget constraint in particular with the aim to study WL. In fact, in a context of cost containment and budget reduction, as in all the western countries, it could happen that for some hospitals the budget is not enough to provide the same services' supply and this has a direct impact on WL. The authors say something about this in the comment of figures but this point need to be extended in the first part of the paper.

As suggested by the referee we have extended our comments on this issue in the first part of the paper as follows (please, see page 10):

*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. Spanish hospitals operate in a context of cost containment and budget reduction and it is therefore possible that some hospitals have insufficient funds to provide similar services to other hospitals, this having a direct impact on WL. With this situation, it is more cohesive to assume….*

**I do not understand whether the authors refer their model only to the inpatients services or this can be applied for both outpatient and inpatient services. Maybe in the case of inclusion of outpatients the theoretical model should be extended?**

The WL model is for both inpatients and outpatient services. In line with the referee's comments we realized that the construction of the variable was not clearly explained in the text. Hence, we have revised the text as follows:

*The dependent variable obtained directly from the EESRI will be the waiting list data representing an aggregate variable unit composed of the waiting lists for: a) the waiting list for the first outpatient consultation; b) the waiting list for hospitalisation (number of*

*patients pending hospitalisation for diagnosis or treatment) and c) the waiting list for outpatient surgery (number of patients awaiting outpatient surgery). The aggregation of these three types of waiting list has been weighted in accordance with the classification criteria of the Weighted Healthcare Unit or WCU (Unidad Ponderada Asistencial (UPA).)* [1]

**Fig 1: I think that "O" should be substituted with "S"**

The typo has already been corrected. Thank you for this.

**Most in general some of the points shortly discussed in the comment at figure 1 and figure 2, should be more detailed in the first part of the paper where the authors present their theoretical approach to WL.**

Following your suggestion, we have explained in more detail under the introduction of the theoretical model (Section 2), the model and its implications. More precisely we have included the following:

(Page 5, just before Section 2.1):

*Therefore, the demand for health services can be understood as a derived demand from the demand for health. This analysis will allow us to explain from a microeconomic viewpoint what waiting lists depend upon and how factors such as supply (for example, increases or decreases in budget) or in demand (variations in income, employment, morbidity etc) can affect said function. What follows is an analysis of the healthcare market, its particular conditions as well as the fundamental components of supply and demand.*

**The application does not help to support the theoretical part of the paper. First of all, the data collected by this survey can be limited in terms of quality. For example, the respondents can reduce the real value of their WL. Secondly, I have some concern in considering medical and surgical WL together as well as I think that an application about WL should be detailed in single procedures. For example, in some healthcare systems there are procedures that must be delivered within a time fixed by law. Furthermore, the model considers the WL of a region. I think that hospital data can help to improve the quality of the applied part of the paper. A regional WL is a weak measure of quality, is a kind of regional average of all the WL related to all the procedures delivered in a hospital.**

As pointed out by the referee, the use of hospital data can help to improve the quality of the empirical application. We agree with this affirmation and as such perform an analysis using data obtained directly from hospitals. Thus, our main variable (WL) is obtained directly from the EESRI which is an official statistic undertaken by the Ministry directly with the hospitals. We consider it as being the most direct and therefore most trustworthy way of obtaining information on this variable. Other sources,

[1] WCU weighs hospital activities according to the consumption of resources per unit, where the unit is a medical stay (a medical stay = 1 UPA; a first outpatient visit =0.25 and a surgery stay=1.5). The elaboration of the WCU measure unit is explained in Bestard et al. (1993).

for example at state or Autonomous Community level supply data but in a mixed way (aggregated, disaggregated, for some activities only etc).

We have followed the same argument when taking into account the other supply variables considered (BUDGET, CAPITAL) again obtaining this information from the EESRI. However, in order to implement our theoretical model we also had to take into account demand variables (UNEMPLOYMENT, GDP, POPULATION or LIFE EXPECTANCY) and this is only possible at an aggregated level, given that it would be impossible to obtain said information from the patients of each hospital).

With respect to considering WL detailed in single procedures, we have to take into account that the supply variables are not separable (that is, it is impossible to identify the amount of capital and labour specifically employed in medical activities nor for that matter the capital and labour used separately in surgical activities). Namely, both inputs act together in producing overall hospital activities and it is not possible to identify which portion of these inputs can help to reduce the different types of waiting lists. Therefore in this model we use a weighted aggregated variable from the WL.

**The results of the applications as well, are not convincing me. It seems that there is only two regions different form the others and there are significant effects only at 10% after 2005. Maybe in 2005 there have been some exogenous shock that decrease the WL? The result about limited regional differences over time maybe can be a direct consequence of the analysis at regional level, as explained in my previous comment. In conclusion, I would like to encourage the authors to deeply revise the paper including more detailed explanation of all the elements that contribute to WL, and moreover to find more interesting data in order to support the theory with a strong application. For all these considerations, I do not consider this version of the paper suitable for publication in this journal.**

In order to perform the empirical analysis, we use a panel data model. With this we can capture the unobserved and time invariant heterogeneity of the different individuals in our sample (in this case regions). The fact that the fixed effects per region are not statistically significant implies that they are fairly homogeneous (which is understandable given that we are considering public hospitals belonging to the same NHS) and as such this does not suppose an econometric problem.

The exceptions, as highlighted by the referee, are the regions of Cataluña and Madrid. Neither is this result surprising if we take into account that in each of them are situated the most important and populated cities of the country (Barcelona and Madrid) characterised by higher population densities. This, without doubt contributes to increasing the complexity of the health system in these regions and therefore, the unobservable and time invariant heterogeneity. We believe that our results are capturing these special characteristics.

With respect to the time variables, although these are significant only from 2005 onwards we have included a test statistic to confirm the relevance of including time effects in our empirical analysis. More precisely, applying a Wald test, 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 ($\chi^2$ (13)=38.26) allows

us to strongly reject the hypothesis that the joint effect of time effect has not affected waiting lists.

In view of the foregoing, we conclude that the results obtained regarding the evolution of WL over time are statistically relevant indicating that from 2005 onwards a significant increase in waiting lists can be observed (also inferred from figure 4). Behind this increase, as highlighted in results and conclusions there may exist factors both of supply (budget cuts) as well as demand (an ageing population, income….etc.).

Also, we have performed the same analysis to contrast the validity of the individual dummies. Here, 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 $\chi^2(16)=114.34$).

These results are described in the paper (please, see footnote 7):

*Applying a Wald test, we have checked whether the time effects, taken as a whole, are significant by testing whether the coefficients of $D_t$ are simultaneously zero. The value of the test ($\chi^2$ (13) =37.87) allows 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).*

In sum, the empirical model estimated is coherent with the theory and bears the expected signs. Hence, we consider it applicable for the purpose of validating empirically the theoretical model presented.

Again, thank you very much for your constructive and insightful comments. We have taken all your comments/suggestions very seriously and have made every attempt to resolve them in our revised version. We strongly believe that the current version has improved substantially, for which we thank you. We hope that the present version addresses your concerns satisfactorily.

**References:**

García-Armesto S, Abadía-Taira MB, Durán A, Hernández-Quevedo C, Bernal-Delgado E. (2010), Spain: Health system review. *Health Systems in Transition*, 2010, 12(4):1–295. WHO Regional Office for Europe, Denmark.

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