**“The Cost-Effective Choice of Policy Instruments to Cap Aggregate Emissions with Costly Enforcement” Revised EARE1343 Response to Reviewers**

**Reviewer 1 Comments**

*1. The paper is an addition to the growing literature on the analysis and comparison of environmental policy instruments with costly monitoring and enforcement and, possibly, imperfect compliance by firms. In particular, the paper studies two ways of capping aggregate emissions of a pollutant: tradable pollution permits and firm-specific standards (in effect, non-tradable permits).

The paper builds, inter alia, on two recent related papers, viz. those of Stranlund (2007), who studies the question of whether to allow for some noncompliance in tradable permit systems, and Arguedas (2008), who studies a standards system with one firm. In essence this paper tries to extend Arguedas' analysis to a system with many firms.

There are three important results announced:
1. That standards should be firm-specific and perfectly enforced.
2. That total expected costs of an optimally designed tradable permit system are larger than corresponding costs of an optimal standards system, except when monitoring costs are identical across firms.
3. That when it is cost effective to induce violations, tradable permits minimize costs under "even more special conditions".

These claimed results are indeed important and interesting. Of particular interest is (2), e.g. when compared to the results of Chavez, Villena and Stranlund (2009) in a very similar setting where the result is derived that "under incomplete information, regulation based on each firm-specific emissions standards [sic] cannot be less costly than a transferable emissions permit system" (abstract of Chavez et al.). The two results appear to contradict each other, which would seem to call for some discussion and explanation of the intuitive reason for the contradiction. Unfortunately the author(s) do not offer such a discussion.*A discussion on this should be included….the Reviewer 1 builds almost all his comments on this point….

Creo que lo hacemos, como dice más adelante, pero deberíamos aclararlo con mayor destaque.

 *2. I suspect the crucial difference lies in assumptions about information: whereas information on abatement costs is asymmetric in Chavez et al. (2009), there seems to be an implicit assumption in this paper about the regulator having perfect information about firms. However, I must confess to being quite confused about what the information assumptions really are. On page 7 the author(s) say that the regulator can only observe the "type" of a firm, having a "subjective probability distribution over the possible abatement cost functions of every type of firm". In the regulator's optimization problem, the side-conditions are imposed that actual emissions from each individual firm are equal to the subjective expected best response function of the firm (page 8); furthermore, that these actual emissions sum up to the emissions cap, E. It seems to me that the upshot of this is that the regulator really does have perfect information about each firm. Otherwise, how can he guarantee that each individual firm emits exactly what he expects it to emit?* Tenemos que ser más claros con la notación. Es cierto lo que dice. Se puede leer de este modo. Propongo poner $\overbar{e}=\overbar{e}(…)$ en las restricciones si vamos a trabajar con las emisiones y los costos “esperados” como hasta ahora, o dejar e = e(…) si vamos a hacer explicito el supuesto de información perfecta primero y luego incorporar información asimétrica. *And then it is not surprising - it is actually fairly obvious - that a standards system is going to be superior to a tradable permit system.* I do not think it is obvious that under perfect information a system of emissions standards is superior to a TDP. In fact the literature builds on the superiority of TDP on standards because a uniform policy (the price) allow for different responses from regulated firms according to their abatement costs. It is the consideration of enforcement costs (monitoring and sanctioning) which turn the question relevant….What do you think Marcelo. Pero nadie se había dado cuenta… si sos tan crack por qué no lo habías escrito ..la c..(Esto mejor no lo ponemos). . *I have already confessed to being confused about the modelling of information in the paper, but at a minimum that shows that the author(s) really need to present their analysis in a much better way.* Okay, we need to clarify our information assumptions, maybe first, complete information, and then incomplete information as an extension….I think we should talk about complete vs. incomplete information, instead of perfect vs. imperfect, the literature on perfect vs. imperfect ends most of the time on mechanism design (asymmetric information)…we should not go that way, I think. Si vamos a trabajar con “expected emissions” y “expected costs” deberíamos poner algo como lo que dije en el congreso: el regulador tiene una “subjective probability” y trabaja con un momento de la distribución, la media.

*3. Provided the author(s) are able to model information in a lucid and convincing way* de aquí es que me parece se basó el editor para pedirnos modelar información asimétrica. Yo creo que deberíamos hacer lo que tu planteas (no lo vi todavía pero por lo que me mostraste) y eso debería ser suficiente. Deberíamos empezar con información simétrica y decir que en este caso los estándares son más baratos y continuar con información asimétrica y decir que en ese caso, dependiendo de x, y y z, los permisos podrían ser más baratos, o no. No lo sé. Si te parece posible sin que arruine nuestras posibilidades, deberíamos poner también en la carta al editor un mensaje BAJO ALGUN ESTILO POLITE que diga: lo que nos estas pidiendo es otro paper y es 100 mil veces más difícil. (Si lo hiciéramos mandaríamos el paper al AER y no al ERE). *intuitive explanation needs to be given for the contradicting results of this paper and Chavez et al.* Of course, we will need to address perhaps in more details these issues. I am sure that it is already somehow discussed into the paper…It would be good if we can rise the point that sanctioning cost also matter here, which is not in JAE’s paper…(Marcelo: I am pretty sure that I know who is our Referee 1)

*4. In general the writing and presentation can, and should, be improved substantially.* Le hacemos una nueva edición cuando terminamos y lo mandamos a un editor de inglés.

*Also, there are many typos and language errors* Ya corregí todos los errores ortográficos.*and the reference list should be cleaned up.* Hay que hacerlo.*These are of course easy to fix once the major question of how exactly information is modelled has been resolved.*

The response here should include the following items:

-We have cleaned and checked the references…..qué se nos pasó?

-As part of our efforts to improve our revised version, the manuscript was subject to an English grammar and spelling check revision by a professional English editor. We send a new revised version of the manuscript.

**Reviewer 2 Comments**

The paper is nicely motivated and the extensions of previous work in the field are clean and relevant. The main point that the authors make, as I see it, is that previous comparative studies of standards vs. tradable permits have Marcelo: falta un “no” aquí? paid adequate attention to monitoring and sanctioning costs of the instruments. If this is done, according to the authors, the support for tradable permits based on cost-effectiveness arguments, is weakened and instead emission standard seem to minimise costs.  Important criteria are that the standards are firm specific, as are efforts by the regulator to induce compliance and sanctions.

*1. The math seems correct, so in that sense the authors succeed in convincing me that emission standards may be more cost effective than tradable permits. However,* ***I have one main problem*** *with the argument that the authors make, and* ***that is the very brief discussion of the possibilities for a regulator of setting correct firm specific emission standards and to tailor enforcement efforts based on firm specific characteristics****. Both of these factors will depend crucially on the specific marginal abatement costs of the firm, which are notoriously difficult to know. If at all possible, it is sure to be costly to obtain this information. As the authors note in passing, one of the primary arguments in favour of tradable permits is that the regulator does not have to know the marginal abatement costs of firms in order to design the policy.*

In principle, I got the impression that we can extend the discussion and acknowledge the information problem…the complaint thus far is “the very brief discussion”….OK. Debemos poner más énfasis en esto. Cosa que me parece surgirá naturalmente en la nueva versión del papel: información simétrica + información asimétrica.

*2. The authors do discuss this briefly in relation to their findings (for example on page 20, second paragraph) and they recognise that this point makes it difficult to make clear policy recommendations. Hence they seem aware of this challenge.* ***I think the paper would become stronger if this discussion was made deeper and, even better, formalised****.* De nuevo, acá nos están pidiendo modelar. *For instance, it would be possible, I think, to introduce a variable capturing the costs to the regulator of obtaining information of marginal abatement costs into the several of the expressions in the paper. This may make results more ambiguous in some cases, but it would also make the conclusions more convincing to me.*I am having difficulties to understand what the referee is suggesting when says: “introduce a variable capturing the costs to the regulator of obtaining information of marginal abatement costs into the several of the expressions”. This surely is too ad-hoc, and I can not see how this interact with the design we study (monitoring, standards)…If we are going to introduce information problems, a more straight way should be to consider that the regulator does not observe exactly the marginal abatement cost of each firm, but have some expectation about it. I have started to explore this, my impression is that what matter for our model and result is that in a situation like the one already described in the paper, but not explicitly considered in our analysis: the regulator does not know how the firm will respond exactly when facing an adjustment in the emissions standard and/or monitoring effort. (See my notes attached in the PDF).

Me falta ver tus notas. Como te dije, creo que es la manera de hacerlo y creo que será suficiente. Aquí nos está pidiendo modelizar nuevamente. Y adelanta correctamente que el resultado va a ser ambiguo en este caso. Me parece que debemos discutir si queremos llegar hasta aquí o si queremos decir algo más. Como por ejemplo: “los estándares son más baratos que los permisos si la varianza (de la distribución de segundo orden???) ….” No tengo idea como hacerlo y soy partidario de hacer solo lo primero si lo segundo resulta muy difícil o justifica hacer otro paper (2 es mejor 1!!).

*3. Another point, which the authors only discuss briefly in relation to monitoring costs, is dynamic effects of allowing non-compliance. Even if non-compliance may be cost-effective in a static setting, it may be that if firms learn that a certain level of non-compliance is tolerated based on for example expected litigation costs as the authors mention, firms could start to act strategically. Further, the credibility and political support of the program may erode. Perhaps this point is not central in the paper, but it could be worth a few sentences of acknowledgement.*Okay, we should acknowledge this, perhaps at the end in the conclusion section, leaving this topic as an important one for future research.

Puede ser que tenga un punto aquí. Se me ocurre que legalmente puede ser ilegal dejar que unas violen y ponerle multas a otras cuando violan para que cumplan. Pienso que debemos pensar una respuesta.

*4. A general comment is that the paper would benefit from a more direct language, with shorter sentences and a more accessible language. If the authors have time to let a professional editor go through it with those eyes it may be a good investment.*As part of our efforts to improve our revised version, the manuscript was subject to an English grammar and spelling check revision by a professional English editor. We send a new revised version of the manuscript.

Ciertas ambas. Ya puse que haremos las dos.

*5. Other, more minor comments:
a) The paper would benefit from a clearer definition of the terms "enforcement", and "sanctioning", and I recommend another read through in order to ensure the language is consistent throughout the paper. In most cases it is clear what the authors mean, but not always.*We can do this right upfront, in a brief footnote.

OK. Puede ser. Prestémosle atención.

 *b) It would help the reader if the definitions of some variables in the expressions were repeated.*Ok, but it is not clear which one we should repeat. Maybe re-reading everything at the end can gives us a clue about which definitions of variables need to be repeated.

Correcto. Hagámoslo.

 *c) Choice of words; I react to the expression "induce non-compliance". English is my second language so perhaps this is a correct choice of words, but to me "allow non-compliance" makes more sense.*I do not have problem with any of these alternative “wordering”. It seems to me that, as suggested by the Reviewer, “allow non-compliance” might be more appropriate.

A mí me parece induce está bien, pero no me molesta cambiarlo.

 *6. Spelling and grammar:*

*p. 2 Introduction, second paragraph, first sentence "...costs of capPing emissions."*We have changed this in the XXX row of the ZZZ paragraph in p. RR of the revised version of the paper.

*p 4, first sentence: two "with"*We have changed this in the XXX row of the ZZZ paragraph in p. RR of the revised version of the paper.

*p 5, second paragraph remove TO in "We then let the regulator TO..."*We have changed this in the XXX row of the ZZZ paragraph in p. RR of the revised version of the paper.

*p. 5, section 2, first sentence. Order of words: "...when IS IT cost effective..."*We have changed this in the XXX row of the ZZZ paragraph in p. RR of the revised version of the paper.

*p. 11, section 3.1, last paragraph "...complete abAtement costs..."
section 4.2, last sentence "...optimally designED..."*

We have changed this in the XXX row of the ZZZ paragraph in p. RR of the revised version of the paper.