1. ***Para alcanzar un determinado nivel agregado de emisiones minimizando los costos totales de un programa basado en estándares, un regulador que no puede observar los costos de abatimiento de las empresas, ¿debe diseñar el programa de forma de permitir cierto nivel de transgresiones o debe diseñarlo de tal forma que haya cumplimiento perfecto?***

**I.1. Full information on abatement costs**

We start by trying to answer the question in the case the regulator can observe the abatement costs of the firms. In this case, the regulator has two possible penalty schemes: increasing or constant marginal penalties. We start by assuming the marginal penalty is increasing.

***Individual choices under increasing marginal penalty***

Penalty:

Given all the relevant parameters, a firm *i* solves the following problem:

The Lagrangean of this problem is:

And the Kuhn – Tucker conditions:

From these, we know that the firm complies with the standard . If this is not the case, the firm violates the standard, in which case , and from KT condition 2), = 0 and

If we assume that (we give a functional form to ), then, the above conditions is:

From this expression we can get the firm´s reaction function:

Which gives the level of violation that the firm is going to respond with () as a function of the abatement costs parameters, the enforcement parameters, and the level of the standard:

The regulator jointly determines and to induce the desired level of emissions (and violations) to minimize expected costs of achieving *E*. It can be seen from this equation that the regulator has two instruments to induce a certain level of violation for the firm *i*, the monitoring probability and the standard. Moreover, the regulator faces a sort of trade off between these instruments, since a lower level of one of the instruments implies a larger level of the other in order to induce a certain level of violation for plant *i*.

***The regulatory choice of violations under increasing marginal penalty***

**General Characterization**

Where μ is the dollar cost of an inspection and β is the per dollar cost of collecting penalties.

Assuming positive standards and inspections probabilities, the necessary and sufficient conditions are given by:

From where

From where

QUEDÉ ACÁ

Using

From the firm’s optimal choice of emissions, we know that

From where,

**Given the assumption of increasing marginal penalty, this expression cannot be signed. The first term inside de parenthesis of the right hand side is negative and the second term**  **is positive. This means the the cost-effective levels of violations could be positive or zero.**

**Nevertheless, it is interesting to note that the total enforcement costs minimizing level of violations that the regulator is going to choose does not depend on the level of the standard. INTUITION!!!!!**

**Closed solution**

Assuming a penalty function of the form:

Which gives and increasing marginal penalty function of the form:

and

Gives

???¿?¿?¿?¿?¿?¿?¿?¿

**PENSAR POR QUÉ ME DA CERO Y LUEGO PENSAR SI LLEGO A ALGO IGUALANDO LAS DOS FOC A LAS EXPRESIONES DE CARLOS.**

stoy intentando llegar a una expresión de la violación minimizadora de costos que el regulador induce con su elección de la probabilidad y el estándar, pero sin hallar una expresión para estos dos. (No pude, son muchas cuentas, no probé con el scientific workplace que puede ser la solución).