**FULL RESEARCH PROPOSAL – CAFFERA**

**Title of the Project:** Testing the Effectiveness of Enforcing Industrial Pollution Regulations in Montevideo, Uruguay

**Project Leader**: Marcelo Caffera

**Institution**: Universidad de Montevideo

**Contact information**: Marcelo Caffera, Facultad de Ciencias Empresariales y Economía, Universidad de Montevideo, Prudencio de Pena 2440, CP 11600, Montevideo, Uruguay. Telephone: +598-2-7074461 extension 308. Fax: +598-2-7074461 extension 325. E-mail: [marcaffera@um.edu.uy](mailto:marcaffera@um.edu.uy)

**Date of submission: XXXX**

**Abstract:**

1. **RESEARCH PROBLEM**

**The Problem:** Non-compliance to industrial effluents standards has been ubiquitous in Montevideo, Uruguay. (See Caffera (2004)). But neither we know what characteristics of industrial plants are more correlated with higher levels of non-compliance, nor how effective have the enforcement measures taken by regulators been in increasing the levels of compliance. This is an important gap because we need to have this information in order to be able to develop good policy recommendations to regulators to use their scarce enforcement budgets more effectively.

**POLICY MAKERS ARE NOT ABLE TO DO IT. THEY LACK PERSONNEL WITH THE NECESSARY QUALIFICATIONS AND TIME.**

Enforcement of regulations controlling emissions is crucial. Environmental sustainability will not be achieved if the norms restricting agents’ actions towards the environment are not enforced. This may be particularly a determinant issue in Latin American countries. Several authors has pointed out that non-compliance with environmental regulations in less-developed countries is ubiquitous (see Eskeland and Jimenez, 1992; Tietenberg, 1996; Russell and Powell, 1996, O’Connor, 1998; Blackman and Harrington, 2000).[[1]](#footnote-2) Our region may not be the exception, according to what the empirical work done in Latin American countries entails. (see Blackman and Bannister (1998), Dasgupta, et al. (2000), Coronado (2001), Cruz and Uribe (2002), Ferraz, et al. (2003), Otero (2002), Gangadharan (2006) and Palacios and Chavez, (2005)). Certainly, Uruguay is not. (Caffera, 2004). In the specific case of compliance with industrial effluent standards in the capital city of Montevideo, noncompliance has been very frequent. Between the years 1997 and 2001, the number of reported violations of BOD5 emission standard as a percentage of the number of reports never decreased below 25% in a given month. (See Caffera, 2007). But since 2001, we do not know how effective have the enforcement measures been in increasing these low levels of compliance and what characteristics of the industrial plants are more correlated with non-compliance. The proposed research aims to fill this gap. This is important for two reasons. One, because the period studied by me previously was a very special one, and we may not be able to draw useful conclusions from it. … Second, Unluckily, the same lack of resources that the literature suggest are the causes of poor enforcement of environmental regulations prevent may there is not sufficient sound empirical work done on the effectiveness of regulators’ enforcement measures in the region. Consequently, neither we can measure how effectively we Latin-Americans are using our scarce resources, nor can we compare alternative enforcement mechanisms (formal vs. informal, for example) or instruments (command and control vs. incentive- based, for example). One of the reasons that explains this situation is the lack of adequate data on emissions and enforcement measures (inspections and fines), which is probably the result of the same lack of resources. This is not the case in Montevideo, Uruguay. Here, the municipal and national governments keep good records on the level of emissions, production, inputs used, and enforcement measures.

**Scientific Relevance of this research is given by the use of a good instrument if I came out with one and by the racont of how enforcement is organizaed in a less developed country**

Viejo título que dejo par aver que hay abajo: 2. RELEVANCE FOR THE REGION

In spite that several authors have acknowledged the lack of institutional capacity in less developed countries to enforce environmental regulations (see Eskeland and Jimenez, 1992; Tietenberg, 1996; Russell and Powell, 1996, O’Connor, 1998; Blackman and Harrington, 2000)[[2]](#footnote-3), there is a large disparity in the number of comprehensive empirical studies analyzing the effectiveness of environmental regulators’ enforcement activity in developed and less developed countries. To my knowledge, the only examples of published papers for a less developed country that use a comprehensive database on emissions and enforcement actions are Dasgupta *et al.* (2001), Wang *et al.* (2003) and Wang and Wheeler (2005). The studies done on Latin America are cross-section studies without information on either emissions (Blackman and Bannister (1998), Dasgupta, et al. (2000), Coronado (2001), Cruz and Uribe (2002), Ferraz, et al. (2003), Otero (2002), Gangadharan (2006)) or enforcement activities (Palacios and Chavez, (2005)). To my knowledge, there is no published work that uses time series data on emissions, inspections and fines on a Latin American country. As said above, this gap constitutes an obstacle for the design of effective environmental policy in Latin America.

The proposed research is a continuation a previous one (Caffera, 2007). The conclusions reached in this work were negative: Uruguayan regulators´ inspections and fines were ineffective in increasing compliance of industries with emissions standards. Nevertheless, the study period was a very special one. During this period, the Municipal Government of Montevideo implemented the Industrial Pollution Reduction Plan with funds from the Inter-American Development Bank to increase compliance. As part of this plan, emissions standards were relaxed to give plants time to invest in abatement technology. Also, during the Plan period the Uruguayan industrial sector experienced one of its more severe crises in history. Because of these facts, the results obtained from my past work cannot be generalized to different situations, possibly more common or “normal”. This is the reason why this new proposed research in Montevideo, Uruguay, is worth pursuing. The availability of data makes it a unique opportunity to do empirical research on this issue that can be used to extract helpful conclusions for the region (valid not only for a specific period and place) regarding the relationship between institutional capacity and the design of environmental policy.

**2. RESEARCH OBJECTIVES**

The purpose of this research project is to use these data to test the effectiveness of the enforcement measures on the compliance status of industries in the city with emissions standards.

Is the enforcers’ activity sufficient to make industrial firms comply with effluent standards? How effective are the regulators’ enforcement actions in decreasing industrial organic pollution?

**3. RESEARCH METHODS**

**Data set description:**

Every four months, industrial plants report to the Industrial Effluents Unit of the municipal government monthly levels of (1) production, (2) water consumed, (3) energy consumed, (4) number of employees and days worked, and (5) volume of effluents and concentrations of different pollutants in these effluents. From all the pollutants reported I chose BOD5 because it is one of the most important industrial pollutants in the city and it is one that every plant has to report, regardless of its branch. At the same time, regulators conduct inspections to assess compliance. Two types of regular inspections exist: sampling and non-sampling inspections.

The data set consists of the monthly levels of the variables (1) to (5) above for each industrial plant, and the number of inspections performed and the number and amount of fines applied on each industrial plant by the municipal and the national government. The sample period for all variables is July 1996 – October 2001, except for fines, which is May 1997 – October 2001. MENDEZ CPONSEGUIR.!!!

DECIR QUE TENGO HASTA 2001. ME FALTA 2001 – 2008.

The second source of information is NAT. It provides the same type of information on inspections and fines, plus the total number of compliance orders (a note communicating a potential fine) issued by NAT. The sample period for all NAT variables is July 1996 – October 2001.

The third source of information is the private consulting partnership SEINCO, in charge of the Monitoring Program that the MUN implemented between April 1999 and September 2001. Information from this source consists of the number and result of sampling inspections conducted by SEINCO during this period.

Overall, the data set includes 74 privately owned industrial plants in Montevideo. [[3]](#footnote-4) These plants are responsible for more than 90% of the total industrial organic pollution in the city. SEINCO inspected a total of 87 plants at least once. From these, I excluded one steel-plant because it declared it was not emitting BOD5. The rest (12) were plants inspected by SEINCO during a short period. One of the objectives of SEINCO was to design a monitoring routine for the MUN, so SEINCO inspected some small plants in the city to evaluate the worthiness of including them in the list of plants that the MUN should inspect with some frequency. Nevertheless, the MUN had already made a decision with respect to these plants. The MUN did not consider them relevant in terms of pollution load, and therefore did not follow closely.[[4]](#footnote-5) For both reasons, I did not include the scarce information on these 12 plants in the data set.

Table 1 presents the descriptive statistics for the reported input and pollution variables.[[5]](#footnote-6) There are a couple of things to notice from Table 1. First, the mean value of mg/l of BOD5 emitted is larger than the emission standards. These are: 60 mg/l for plants emitting directly into a water body, and 700 mg/l for plants emitting into the city sewage system. The median is 370 mg/l, almost 1/3 of the mean. This indicates that the distribution of emissions in the sample is skewed, with some plants driving the mean upward. The same can be said for most of the variables in Table 1. Second, all variables have missing values. I refer to this problem in the next section.

Table 1 here

Table 2 here

Table 2 shows the descriptive statistics for the monitoring and enforcement variables. The information is presented separately for the MUN, the NAT and SEINCO. The first thing to notice in Table 2 is that the NAT inspected fewer plants than the MUN: 61 plants the NAT vs. 74 the MUN. The MUN inspections were quite often. According to the frequency of inspections in this period, a plant had an 11.6% chance of being inspected by the MUN in a given month. Unluckily, the IMM did not have comprehensive data on compliance orders, postponements and fine threats, as the NAT did. “Compliance orders” are letters of warning sent to firms when a violation is discovered indicating that it has a period of time to correct the situation (usually a treatment plant operation failure) or it may be fined. “Postponements” are communications to firms giving them more time than the one originally given in the compliance order. “Fine threats” are notes sent to firms as a second warning, after the compliance order. Table 2 also shows that the MUN imposed eleven fines during the months of July 1997 and October 2001, while the NAT imposed 4. The fines imposed by the NAT were larger, though, as measured by October 2001 US dollars.

Finally, the descriptive statistics for reported violations are presented in Table 3. Two variables were constructed. First, “Reported Extent of Violation”, defined as reported emissions of BOD5 (mg/l) minus the concentration standard, censored at zero; i.e., over-compliance results in a value of zero. Table 3 also includes descriptive statistics for “Compliance Status”, a variable equal to one if the plant reported a violation and zero otherwise. The calculations are done using the original standards during the entire period and also using the laxer standards of the Industrial Reduction Plan during July 1997 – December 1999.

Table 3 here

Reported violations were frequent, even when measured as emissions in excess of the laxer Plan´s standards. Forty-one percent of the reported BOD5 levels were out of compliance with these emission standards. The number of reported violations as a percentage of the number of reports never decreased below 25% in a given month in the case of the Plan’s laxer standards and 41% in terms of the original standard. The mean extent of a violation was large (338.8 mg/l), although the median was zero. Again, the data says that some heavy polluters drive the mean of emissions and extent of the violations up.

#### 3.2 Missing Values

**Econometrics:**

With the assumption that the level of emissions of an industrial firm is the result of a balance between marginal benefits and marginal costs of pollution EN LUGAR DE ESTO PONER MODELO TEÓRICO. SACAR DE LOS APUNTES DE MIS CLASES. OJO QUE NO HAYA NADA NUEVO DINÁMICO APARTE DEL MODELO ESTÁTICO SOBRE ESTÁNDARES.

The hypothesis will be tested running a dynamic panel data model with pollution as the dependent variable. COPIAR LINE-OUT DE PROPOSAL DE ANA ACA: Pollution will be measured as mg/l of Biological Oxygen Demand (BOD5) in the firm´s effluents. BOD5 is a measure of organic pollution, one of the most important forms of pollution of the city streams. This information is taken from the monthly reports that the industrial plants send to the Municipal Government of Montevideo. This report includes not only information on BOD emissions but also on other types of pollution, as well as level of production, employment, energy used and water consumed. These variables, along with the product price, will be the right-hand side variables representing the value of the marginal product (the marginal benefit of pollution). This is the approach of pollution as an input of production. There is another approach to specify the pollution equation to estimate. This is the abatement cost approach. In this approach the cost of pollution is the difference in (maximum) benefits with different levels of pollution. Following this approach requires estimating the pollution equation with the relevant prices of inputs and outputs as explanatory variables. This approach will be pursued also. The other important explanatory variables will be inspections and fines from regulations. These will represent the expected penalty of pollution (marginal cost). This information is taken from the municipal and national governments’ records.

The data set covers the period July 1997 – February 2008 and between 70 and 80 industrial plants in the city of Montevideo, Uruguay. The panel is unbalanced due to missing data (non – reports) and attrition is present since new firms appear and other close. All information is monthly.

**Methodological problem: published literature has not done a good job in controlling endogeneity. Several strategies to solve this problem have been tried: review papers to see strategies.**

**Endogeneity** of inspections is an obvious potential and important problem in this type of empirical research. I will treat the data as a system of equations, with inspections and emissions jointly determined, to tackle this problem.

**4. EXPECTED RESULTS AND DISSEMINATION**

**5. INSTITUTION AND PERSONNEL**

The proposed research would be a continuation of my dissertation research. The dissertation gave me experience (PONER QUE EXPERIENCIA: DONDE ESTAN LOS DATOS, LA LEGISLACIÓN QUE LA SE, EL CONTACTO CON LOS REGULADORES, LA ECONOMETRÍA, ETC.)

I am attaching my CV as an annex.

**6. TIMETABLE**

**7. BUDGET**

**8. ANNEXES**

Caffera, M. (2007). “Financial assistance of multilateral aid agencies to enforce environmental regulations: is it effective?”. Unpublished working paper.

1. See Caffera (2007) for the references mentioned in this proposal. [↑](#footnote-ref-2)
2. See Caffera (2007) for the references mentioned in this proposal. [↑](#footnote-ref-3)
3. Publicly owned industrial plants did not report emissions during the period. [↑](#footnote-ref-4)
4. Notwithstanding, some them sporadically report to the MUN. [↑](#footnote-ref-5)
5. Descriptive statistics for levels of production are not presented for space reasons. [↑](#footnote-ref-6)