LEGAL FAMILIES AND ENVIRONMENTAL PROTECTION: IS THERE A CAUSAL RELATIONSHIP?

by

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Abstract. In this paper we build on the analysis of La Porta *et al*. (1998), to investigate the importance of legal families in explaining the dissimilar levels of environmental quality indicators among countries with different legal systems. The main intuition behind our analysis is that the nations in which the rights of shareholders are more protected promote real and financial investment; this increases the speed at which the per-capita income corresponding to the declining branch of the Environmental Kutznets Curve (EKC) is achieved. In econometrics different regressions analyses were performed, using as dependent variables three different kinds of pollutants (CO_2, fine suspended particulates and waste), and including as an explanation some financial variables never before considered in this kind of study.

JEL classification: K4; Q0.

Keywords: Dummy variables; Environmental Kutznets Curve; Legal Families; Panel data; Pollution emissions.

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1. Introduction. Since the seminal paper of La Porta *et al*. (1998), increasing attention has been paid to the differences in the economic performance of countries as a result of their legal systems (i.e. *civil-law* or *common-law*) (Glaeser *et al*., 2002, Djankov *et al.*, 2003). In particular, it has been shown that common-law countries offer greater protection to shareholders and creditors (Djankov *et al.*, 2007, La Porta *et al*. 1998, Roe, 2006), thus promoting investment in the capital market, reducing both interest and discount rates. Despite the growing interest in this topic, the effects of the differences in legal families with regard to the levels of environmental protection and pollution have not so far been investigated. This may be due to the fact that the income-pollution relationship has usually been explained by factors more closely related to technological choices or other institutional factors (see Di Vita, 2008a, for a short survey).

Recently a few scholars (Chavas, 2004, Di Vita, 2008a, 2008b) have emphasized the differences among countries in capital cost and rate of inter-temporal preferences, as a device to shed light on the relationship between per capita income and pollution emissions (the so-called Environmental Kuznets Curve, EKC for short). In particular, theoretical analyses have shown that there is a negative relationship in developing countries between the interest rate and pollution, while this relationship is reversed in wealthy nations.

The main contribution of this paper is to develop both streams of the economic literature previously mentioned and thence to account for the effects of differences in legal families and financial market development on pollution emissions, thus contributing to a better understanding of the EKC dynamics.

This study is based on the intuition that a more effective protection of investors and creditors may reduce the time taken in developing countries to achieve the per

capita income level at which the pollution level starts to decline with growth in income, through the channels of both interest and discount rates, as a result of well-developed financial markets. In wealthy nations, the availability of capital reduces the cost of implementation of more environmental-friendly technologies. The question that we want to address in this paper is: do the differences in legal families, among groups of countries, have any effect on the environment? If the answer is yes, the subsequent question is: through which channel?

Ex ante we expect capital markets to be more developed in countries where shareholders' rights are better protected. Thus we may predict that the interest rate will be lower, and capital accumulation higher, in these economies than in countries where investors are not so well protected (as in nations that fall within the legal family of civil law) (La Porta *et al.*, 1997, 2000).

The emphasis in this analysis is placed equally on the importance of differences between legal families, on the financial market capitalization level and on the protection of creditors, to explain the differences in pollution levels.

In the empirical analysis we use data covering the period from 1995 to 2002, for forty-eight countries, the same used by La Porta *et al.* (1998), with the exception of Taiwan, because these data are not available in the World Development Indicator (WDI) data-set (World Bank, 2006). We take into account the data for eight years because the statistics for the three indicators of pollution are not available for all the countries studied for a longer period than this. Eighteen nations belong to the common law system, equally divided within the sample between industrialized and developing countries. Twenty-five countries are classified as developed, while the rest are considered developing, following a criteria supplied by Esty (2001), that assumes the turning point of the EKC for a per capita income greater than eight thousand dollars, thus we assume the per capita income to be higher than this in industrialized nations. In

this manner we expect there to be a direct relationship between per capita income and emissions pollution in less developed countries, while the relationship is reversed in industrialized nations.

The result of this research is expected to have an immediate spillover on economic policy, because an increase in the protection level for shareholders and creditors implies a greater development of the financial market but may also be useful to reduce the degradation of the environment.

The rest of the paper is organized as follows. Section two is devoted to giving a theoretical explanation of the choice of variables considered. Section three is dedicated to data overview; section four describes the econometric analysis. The economic policy implications of our analysis conclude the paper.

2. Theoretical background and choice of variables. Following the recent studies that show how the interest and discount rates may be useful to better understand the income-pollution pattern (Chavas, 2004, Di Vita, 2008a, 2008b), we foresee that in countries where the rights of both creditors and investors are more protected, as in economies belonging to the area of common law, the pollution level will be lower for developed economies and higher for poor countries.

The issue of the relevance of legal families in evaluating the performance of economies has been extensively explored in previous literature (see Siems, 2007, for an overview). Here the difference between countries of common law and civil law is tackled by means of two dummy variables.

Three different kinds of pollutants were used. The first, carbon dioxide emissions (CO2), is a type of pollutant that affects future generations more than the current one (Binder and Neumayer, 2005, Panayotou, 2000). The other two, particles suspended in air (PM10) and waste, are more offensive to current generations. The

choice of these three kinds of pollutant was limited by the availability of the data we drew from the World Development Indicators supplied by the World Bank (World Bank, 2008), for the same countries accounted for in La Porta *et al.* (1998).

We therefore expect the threshold of per capita income at which pollution starts to decline (Binder and Neumayer, 2005) to be higher for the first pollutant (CO2) than for the other two (Panayotou, 2000). We are aware that the first pollutant (CO2) may have a higher threshold level than the other pollutants, of per capita income at which pollution begins to fall with income growth. In particular, we report the results of previous empirical analyses on the EKC, to affirm that CO2 usually shows an inverse-U shaped curve, and that its turning point is included within a range of per capita income values from 10.000$ to 35.400$ (Cole *et al.*, 1997, Holtz-Eakin and Selden, 1995, Roberts and Grimes, 1997, Schmalensee *et al.*, 1998, Unruh and Moomaw, 1998). With regard to air particles emissions, a variety of dynamics were found (quadratic, linear downward and U-inverted quadratic), with a peak around a per capita income between 7.300$ and 9.800$ (Carson *et al.*, 1997, Cole *et al.*, 1997, Panayotou, 1993, Selden and Song, 1994, Shafik and Bandyopadhyay, 1997, Schmalensee *et al.*, 1998). Finally, waste still shows a mixed behaviour over time and with income growth (inverse-U shaped, linear increasing, quadratic), and it was not possible to determine the per capita income level at which the maximum of the EKC curve occurred (Cole *et al.*, 1997, Shafik and Bandyopadhyay, 1997, Shafik, 1994).

Our theoretical benchmark is that the decision to implement more environmental friendly devices is driven by the discount rate, which in cost-benefit analysis on expenses is the key factor to ameliorate and preserve the environment . Countries with a low per capita income show high levels of both pure intertemporal discount rates and returns of capital. On one hand, impatience about the future implies that developing nations have to postpone the moment in time when more ecological technologies are

implemented, because they have first to satisfy their present needs. On the other hand, scarcity of capital and high rates of interest are both an obstacle to growth for less wealthy nations, rendering more difficult the achievement of a per capita income level at which the EKC may show a declining behaviour. Shareholder protection and financial market development may also be useful in promoting savings accumulation and investments (domestic and foreign), thus boosting growth in developing countries and reducing the time necessary before it is possible to implement more clean technologies, creating an inverse relationship between per capita income and pollution. A more effective protection of creditors in common law countries (La Porta *et. al.*, 1998, Djankov, *et al.* 2007) may also stimulate foreign direct investment (FDI) and savings accrual, promoting growth in developing countries and the achievement of a per capita income level compatible with a decline in emissions.

The data of exports and imports was also included among the explanatory variables for two reasons: a) international trade has a strong effect on emissions levels (Antweiler *et al.*, 2001); b) different degrees of protection of creditors may drive exports and imports in such a way as to justify the non-homogenous performances in foreign exchange, between countries with dissimilar legal systems.

Although the per capita income is implicitly taken into consideration in the data, as a result of the division of the countries into developing or industrialized, according to their per capita income level, we follow the empirical literature on the EKC that usually includes it among the explanatory variables (Panayotou, 2000). Finally, the growth rate of the Gross Domestic Product (GDP) is also accounted for, because it was considered as one of the independent variables in some econometric analyses on the income-pollution pattern (Panayotou, 1997).

3. Data overview. To render the reader's task easier we have listed all the countries accounted for in Table 1.

TABLE 1

COUNTRY CLASSIFICATION BY PER CAPITA INCOME LEVEL.

WEALTHY COUNTRIES (a)	DEVELOPING COUNTRIES (b)
AUSTRALIA[θ], AUSTRIA, BELGIUM, CANADA[θ], DENMARK, FINLAND, FRANCE, GERMANY, GREECE, HONG KONG[θ], IRELAND[θ], ISRAEL[θ], ITALY, JAPAN, KOREA REPUBLIC, NETHERLANDS, NEW ZEALAND[θ], NORWAY, PORTUGAL, SINGAPORE[θ], SPAIN, SWEDEN, SWITZERLAND, UNITED KINGDOM[θ], UNITED STATES[θ].	ARGENTINA, BRAZIL, CHILE, COLOMBIA, ECUADOR, EGYPT, INDIA[θ], INDONESIA, JORDAN, KENIA[θ], MALAYSIA[θ], MEXICO, NIGERIA[θ], PAKISTAN[θ], PERU, PHILIPPINES, SOUTH AFRICA[θ], SRI LANKA[θ], TRINIDAD[θ], TURKEY, URUGUAY, VENEZUELA, ZIMBABWE[θ].

Note: θ denotes countries of *common law*, following the criteria of La Porta *et al.* (1998). Column (a) lists the twenty-five developed countries with a per capita income greater than 8.000 US $ (measured at 1995, expressed in US $ current prices in that year), while column (b) lists the twenty-three developing countries with a lower per capita income level [1].

In our opinion, the criteria used in order to split the countries into two subsets, according to their per capita income level, is correct because all the developing nations included in the sample showed a high level of external debt in the period under study.

Before performing the econometric analysis, it is worth having a look at the data reported in the following Table 2.

TABLE 2

DATA OVERVIEW (1995-2002)

	CIVIL LAW COUNTRIES			COMMON LAW COUNTRIES		
	All the sample	Rich	Developing	All the sample	Rich	Developing
CO2♥	5,62	8,22	2,66	8,42	12,64	4,20
PM10♦	49,56	30,77	71,04	55,49	29,23	81,77
Waste♠	9,29	5,91	13,16	20,95	2,30	39,61
Exports	31,58	36,82	25,58	51,76	64,41	39,11
FDI	2,63	4,61	0,38	3,47	6,40	0,54
GDS	21,85	24,59	18,71	24,13	26,02	22,24
Imports	31,27	34,49	27,59	49,75	61,37	38.14
Market capitalization	53,11	72,39	31,07	86,46	117,33	55,58
Real Interest rate	10,78	5,13	17,24	7,38	5,80	8,96
Per capita income♣	15.522	23.952	5.887	14.443	24.960	3.926
GDP growth	2,64	2,78	2,49	3,77	4,08	3,45

Note: The data report the average of the variables accounted for during the period under study. All the variables with their implications and their sources are fully explained in the World Development Indicator web site. ♥ Carbon dioxide emissions (CO2) are expressed in metric tons per capita. ♦ Particle matter concentrations (PM10), refer to the fine suspended particles of less than 10 microns of diameter (at a national level, measured in micrograms per cubic meter). ♠ Combustible renewables and waste comprise solid biomass, liquid biomass, biogas, industrial waste, and municipal waste, measured as a percentage of total energy use. ♣ per capita income is based on purchasing power parity (PPP, current international $). Real interest rates are expressed in ratios. Finally, the other variables, without prime are measured as a percentage of the GDP.

From the figures reported above, it is possible to affirm that, in general, all three indicators of the pollution level (CO2, PM10 and waste), are higher in common law

countries than in the others. Looking more closely at the single pollutants, we may observe that in developed countries, with a legal system of English origin, only the CO2 emissions are greater than in civil law nations, while the average levels for other pollutants are lower. This difference in values for carbon dioxide may be due to the fact that it is more harmful to future generations than the current one, so that an increase in the per capita income does not necessarily imply investment in devices to abate CO2 emission. Moreover, we may note that this kind of pollutant shows a peak level at a per capita income level higher than the other two (Panayotou, 2000).

It is true, for all the pollutants examined, that the emissions are higher in developing countries belonging to the legal family of common law than in nations with a civil law legal system. This may be due both to the higher GDP rate of growth and to the lower per capita income levels in less wealthy nations of common law.

This first empirical evidence confirms that an effective protection of creditors and investors in developing countries of common law boosts growth and also increases pollution, while the opposite is true for wealthy nations, with the exception of CO2.

Exports, imports, foreign direct investment (FDI), gross domestic savings (GDS), GDP growth rate (GDPgr) and market capitalization (MC) are greater in countries with a common law system, without any distinction between industrialized and developing ones. As we had supposed, the real interest rate (RIR) is almost always lower in nations with a legal system of English origin, with the exception of developed common law countries where it is a little higher than in developed countries of civil law. Finally, the per capita income (PCI) for all the countries included in the sample is greater in civil law countries, but it is higher in wealthy nations with a common law legal system.

[1] Esty (2001) estimates the per capita income level at which the EKC starts to decline at about 8.000 US $.

It is worth noting that in countries with a legal system of English origin the market capitalization level is in general almost one and half times as high as in civil law nations.

4. Econometric analysis. The differences that were noted in the data reported in Table 2 offer the information that, among the countries considered, and in the period under study, the performance of the economy varies according to which legal family the country belongs to, but this does not mean that these relationships also explain the differences in pollution levels or that they are statistically significant.

Based on the previous economic analysis, we expect *ex ante* the dummies introduced among the independent variables, in order to detect any systematic differences in pollution levels attributable to legal families, to be statistically significant. We also assume that the market capitalization level may be useful in explaining the differences in pollution levels, with, in general, negative effects on pollution and with some asymmetries between industrialized and developing countries. In the first case (industrialized countries) it is assumed to be negatively correlated with emissions, while in the less developed countries it may be positively related to pollution, through the channel of the capital cost.

The real rate of interest is another crucial variable to explain the income-pollution relationship: low rates, due to the abundance of capital, render easier the implementation of environmental friendly devices. Thus in general we expect there to be an inverse correlation between the pollution level and this variable, at the first stage of the development process, until the per capita income level is reached at which the pollution level starts to decline as the GDP grows. In wealthy nations the readier availability of capital simplifies the adoption of cleaner technologies and therefore the

preservation of the rights of future generations. This implies a direct relationship between emissions and the real rate of interest in developed countries (Di Vita, 2008b).

We expect gross domestic savings and foreign direct investments to have effects similar to the financial market capitalization level, because the accrual of savings and the stream of foreign capital reduce the real interest rate within the nation considered.

For obvious reasons of connection, the international trade components have to be taken into account together, despite the fact that exports increase income, and therefore we assume that they must reduce the pollution level in wealthy nations and increase emissions in developing countries, while imports reduce income inside the country considered and thus their effects should be the opposite. Finally, the per capita income and the growth rate of the economy in general raise the pollution level, but even in this hypothesis we foresee that there will be different effects for the two groups of countries considered, with regard to income, with a positive correlation in less wealthy nations and a negative relationship in industrialized countries. Moreover, some asymmetries may be present regarding the kind of pollution accounted for.

4.1 Variables. In the econometric analysis the three pollutant indicators explained in detail above were used as dependent variables, and three different sets of regressions were performed separately for each environment indicator. To make clear the asymmetric effects of the explanatory variables, econometric analyses were also performed on the two subsets of data, considering the industrialized and developing countries separately and using as a classification system the per capita income, as shown before in Table 1. The explanatory variables used were the same as in Table 2, for the period from 1995 to 2002. The entire panel data set of observations was employed in the empirical analysis.[2]

[2] Due to space constraint, preliminary statistics about data and correlation matrix are not reported here, but are available upon request from the author. Based on the correlation matrix we may exclude the presence of multicollinearity, because all the estimated coefficients are far from the value of unity.

Two dummy variables were considered in the analysis in order to determine the effects of differences in pollution indicators depending on the legal family belonged to by each country. The first dummy (dum1) was given the value of one for countries of English origin, and zero otherwise. The second dummy (dum 2) assumed the value of one for nations belonging to the civil law system, and zero for those belonging to the common law system. To make the statistical analysis more reliable, regressions were also made considering only dummy two, that in this case measured the differences in dependent variables (pollutant indicators), according to the different legal system (Baltagi, 2002). In the latter case a constant was also taken into account among the independent variables.

The econometric analysis was performed using the OLS technique,[3] by means of microfit software.

4.2 The regression model. To perform the econometric analysis the following very simple model was used:

[1] Pollutant indicator = α_1Exports + α_2FDI + α_3GDS + α_4Imports + α_5MC + α_6RIR + α_7PCI + α_8GDPgr + α_9Dum1 + α_{10}Dum2 + u_t.

Where:

u_t = is a stochastic term, which satisfies the standard assumptions;

α_i = are coefficient regressors, with i = 1, 2, … , 10.

Before performing the econometric analysis, it was necessary to verify the relevance of the dummies. To this aim we followed Brown (1975) who emphasizes that to avoid misinterpreting or overestimating the role of dummies it is useful to make regressions without these explanatory variables, to see if the differences in coefficient of determination are quantitatively relevant. To measure the lack of information in R^2 by

[3] Following La Porta *et al.* (2006) we also assume that the use of legal origins is a remedy to the problem of endogenity.

performing regressions without dummy variables, we report the differences in the coefficient of determination in Table 3.

TABLE 3

DIFFERENCES IN R^2 WITH AND WITHOUT DUMMY VARIABLES

Dependent variables	All	Rich	Developing
CO2	-9.670	-30.414	-12.378
PM10	-14.855	-3.92	-18.752
Waste	-32.928	-22.141	-43.947

Note: The differences reported above are obtained by performing regressions with the same explanatory variables and econometric model described in (1).

As we can see, the differences in the coefficient of determination obtained in the regressions, with and without the dummy variables and with no intercept terms, are large enough to justify the use of the dummy variables in our regressions.

To make the econometric analysis more reliable a regression was also performed for each explanatory variable using the following specification

[2] Pollution indicator = α_1Const + α_2Exports + α_3FDI + α_4GDS + α_5Imports + α_6MC + α_7RIR + α_8PCI + α_9GDPgr + α_{10}Dum2 + u_t.

where Const = is the intercept term. In this case we enclosed an intercept term, and excluded the first dummy (dum1).

4.3 Regressions results. The outcomes of empirical analysis are fully reported in Tables 1, 2 and 3.

[Tables 1 – 3, around here]

First of all we have to comment on the results of the regressions regarding dummy variables, which are always statistically significant. In particular, looking at the first row of Table 3, and column (IV) in Tables 1-3, it is possible to see that the second

dummy variable, that in this case measures the differences in the pollution levels between civil law and common law nations, is always negative and statistically significant at the 1% level for CO2 and waste. This is consistent with our preliminary data analysis, reported in Table 2, and confirms that the pollution of all the countries considered is greater in those within the common law system and may be explained by the legal family belonged to.

As the theory suggests, a well-developed financial market may be helpful in reducing the level of pollution. For all three pollutant indicators, in fact, this explanatory variable proved to have a negative sign for the sample as a whole, and in general it was statistically highly significant.

With regard to the real rate of interest, we may affirm that it possesses the expected negative algebraic sign in cases of CO2 and waste, while it is always positive for PM10. In general, this explanatory variable is of weak statistical significance. The results of the regressions for CO2 and waste fully confirmed that there is an asymmetric effect of the real interest rate between wealthy and developing economies. A negative relationship was found to exist in the first , while the opposite was obtained for the less wealthy nations. Finally, with regard to PM10, it is worth noting that, despite the fact that the coefficient of this regressor is always positive, its magnitude is greater in the case of developing countries and is also statistically significant.

In general a negative relationship exists between savings accumulation and the pollution indicator, with the exception of the case of carbon dioxide in developed countries. The weak statistical significance of the results does not make it possible to confirm fully that there are asymmetric effects between wealthy and developing countries.

Foreign direct investment reduces the emissions level in general, and is not very statistically significant. Despite this, it may be relevant, especially for developing

nations, , to explain the behaviour of CO2 and PM10. We observe that for CO2 and air particulates its algebraic sign is always negative and statistically highly significant. In other words, in less wealthy countries the FDI is useful to reduce the environmental impact of economic growth, in the same way as the financial market capitalization level.

For their undeniable connection we must comment on the result for exports and imports together. Although the two components of international trade have different effects on the emissions and income of the economy considered, it is possible to affirm that both are weakly statistically significant; exports however, for the sample as a whole, have a negative effect on the pollution level, and with some differences regarding the kind of pollutant considered. Imports in general reduce pollution in developing countries and increase emissions in wealthy nations, with the exception of CO2, where the regressor is statistically significant only for less industrialized countries. The pollution level in prevalence decreases with per capita income rises, but with mixed evidence when the countries are differentiated with regard to income. The growth rate of the economy is statistically significant with a prevalence of a positive algebraic sign.

5. Economic policy implications. Econometric analysis supports our initial hypothesis that legal families are relevant, among other factors, in explaining the differences in emissions rates among the nations observed. Economies with a legal system of English origin, that ensure a high level of protection for shareholders and creditors, show a lower level of pollution for industrialized countries than the nations of the civil law system, while the reverse happens for developing countries, with the exception of CO2 for wealthy common law economies. In developing countries with a legal system of English origin, per capita income and pollution grow together as in poor countries of civil law, but in the former the readier availability of capital, due to the

higher protection of shareholders and creditors, boosts economic activity, impoverishing the environment until the per capita income level, at which the emissions start to decline with income growth, is achieved.

On the basis of the outcomes of empirical analysis, it is possible to affirm that less wealthy economies show weak direct relationships between the per capita income and pollution emission, with the exception of PM10.

In the interpretation of the econometric results we have to bear in mind that the three kinds of pollutants considered in this paper possess different dynamics and show dissimilar per capita income levels at which the peak of the EKC occurs.

Our analysis has some implications for economic policy. Ensuring a high level of protection to investors and creditors boosts growth and allows developing countries to achieve the per capita income level at which pollution emissions show a declining behavior. In wealthy nations, the financial market development ensures low discount and interest rates, which render easier the implementation of more environmental friendly measures.

From our analysis we may draw some suggestions for policy makers, because increasing the degree of legal protection for both shareholders and creditors does not mean merely raising the level of the financial market capitalization level, but also in wealthy nations it is useful to reduce the levels of particulate air matter and waste, and render easier to implement environmental devices to diminish the emissions of CO2. In developing countries it reduces the time necessary to achieve the per capita income levels at which pollution starts to decline with an increase in income, thus diminishing the time for which the people are exposed to very high levels of emissions, typical of developing economies that during their transition phase experience a very high level of pollution.

From another point of view, we may observe that if common law is more efficient than civil law, it is probably because it is more simple to adapt to new needs or technological innovations, because a new law is not needed; this means that it would probably be better if civil law countries rendered their legal systems more simple, with fewer regulations and more room for efficiency.

These implications for economic policy are more relevant to the civil law countries belonging to the European Union, which should harmonize their legislation on shareholders and creditors protection, to avoid the movement of capital not justified by economic reasons, but through the differences in protection of investors and payees among countries, with the awareness that promoting financial development implies an improvement in environmental indicators, without any additional cost, but rather promoting growth.

Deeper analyses will probably be necessary in future to confirm our results, for example taking into consideration some other pollutants or lengthening the period of time considered. We find that this could be a good topic for future research.

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TABLE 1

RESULTS OF REGRESSIONS (OLS) – DEPENDENT VARIABLE CO2

Variables	(I)	(II)	(III)	(IV)
Constant term				147.6423 [83.4416] (1.7694)*
Dummy 1	147.6423 [83.4416] (1.7694)***	35.4423 [200.3961] (.17686)	-17.4863 [86.1032] (-.20308)	
Dummy 2	-220.4317 [84.8108] (-2.5991)*	-492.4388 [196.5541] (-2.5054.)**	-365.8377 [88.6789] (-4.1254)*	-368.0739 [36.3096] (-10.1371)*
Market capitalization companies	-0.00466 [0.0032] (-1.4695)	-.012935 [.003342] (-3.8705)*	.001181 [.005069] (.23300)	-0.00466 [0.0032] (-1.4695)
Real interest rate (%)	-.00013 [0.0296] (0.01004)	.20238 [.06849] (2.9550)*	-.03038 [.011655] (-2.6066)*	-.00013 [0.0296] (0.01004)
Gross domestic savings	0.13260 [.04150] (3.1950)*	.17253 [.06113] (2.8700)*	.002372 [.04653] (.05098)	0.13260 [.04150] (3.1950)*
Foreign direct investment	-.03711 [.02695] (-1.3766)	-.00121 [.024529] (-.04944)	-.09929 [.23600] (-.42072)*	-.03711 [.02695] (-1.3766)
Exports of goods and services	-.07373 [.04338] (-1.6995)***	-.09834 [.06272] (-1.5680)	-.03901 [.050026] (-.78161)	-.07373 [.04338] (-1.6995)***
Imports of goods and services	.04426 [.04165] (1.068)	.05140 [.061384] (.83738)	.042604 [.046082] (.92451)	.04426 [.04165] (1.068)
Per capita income PPP	.038681 [.00195] (19.7996)*	.04219 [.00505] (8.3503)*	.11075 [.00865] (12.811)*	.038681 [.00195] (19.7996)*
GDP growth	.08051 [.05388] (1.4944)	.19567 [.08838] (2.2140)**	.040866 [.054902] (.74434)	.08051 [.05388] (1.4944)
R^2	.6481	.56228	.62302	.6481
Log LH	-2743,3	-1398.8	-1274.3	-2743.3
Observations	384	200	184	384

(1) All the countries in the sample. (2) High per capita income countries. (3) Low per capita income countries (4) All the countries in the sample, with only one dummy variable and constant term. Standard errors in brackets and t-values in Parentheses. *, **, ***, indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

TABLE 2

RESULTS OF REGRESSIONS (OLS) – DEPENDENT VARIABLE PM10

Variables	(I)	(II)	(III)	(IV)
Constant term				8355.1 [900.63] (9.2770)*
Dummy 1	8355.1 [900.63] (9.2770)*	953.6044 [613.4121] (1.5546)	10696.4 [1525.9] (7.0100)*	
Dummy 2	7766.5 [915.40] (8.4842)*	1398.6 [601.6518] (2.3245)**	8749.8 [1571.5] (5.5677)*	-588.6491 [391.9069] (-1.502)
Market capitalization companies	-.09787 [.03419] (-2.8621)*	-015769 [.010229] (-1.5416)	-.31976 [.089842] (-3.5592)*	-.09787 [.03419] (-2.8621)*
Real interest rate (%)	.50248 [.13993] (3.5910)*	.26038 [.20964] (1.2421)	.39607 [.20654] (1.9176)**	.50248 [.13993] (3.5910)*
Gross domestic savings	-.30054 [.44796] (-.67090)	.93560 [.18401] (5.0846)*	-.68050 [.82454] (-.82531)	-.30054 [.44796] (-.67090)
Foreign direct investment	-.013632 [.29094] (-.04857)	-.13971 [.075084] (-1.8607)***	-6.1343 [4.1823] (-1.4667)	-.013632 [.29094] (-.04857)
Exports of goods and services	.31662 [.46827] (.67615)	-1. 5182 [.19197] (-7.9083)*	.73692 [.88654] (.83123)	.31662 [.46827] (.67615)
Imports of goods and services	-.19451 [.44952] (-.4327)	1.6594 [.18790] (8.8313)*	-.68644 [.81665] (-.84056)	-.19451 [.44952] (-.4327)
Per capita income PPP	-.18007 [.021087] (-8.5394)*	-.029321 [.015465] (-1.8959)***	-85.2311 [143.5752] (-.59363)	-.18007 [.021087] (-8.5394)*
GDP growth	.87549 [.58150] (1.5056)	-.033005 [.27053] (-1220)	2.0372 [.97295] (2.0939)**	.87549 [.58150] (1.5056)
R^2	.35469	.48915	.18707	.35469
Log LH	-3656.8	-1622.6	-1803.3	-3656.8
Observations	384	200	184	384

(1) All the countries in the sample. (2) High per capita income countries. (3) Low per capita income countries (4) All the countries in the sample, with only one dummy variable and constant term. Standard errors in brackets and t-values in Parentheses. *, **, ***, indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

TABLE 3

RESULTS OF REGRESSIONS (OLS) – DEPENDENT VARIABLE WASTE

Variables	(I)	(II)	(III)	(IV)
Constant term				5396.4 [375.5458] 14.3694)*
Dummy 1	5396.4 [375.5458] (14.3694)*	1133.3 [304.8911] (3.7171)*	6671.6 [437.8744] (15.2362)*	
Dummy 2	4183.9 [381.7079] (10.9611)*	1535.3 [299.0457] (5.1339)*	4603.9 [450.9727] (10.2088)*	-1212.4 [163.4187] (-7.4192)*
Market capitalization companies	-.044347 [.014259] (-3.1102)*	.0069219 [.005084] (1.3614)	-.11675 [.025781] (-4.5283)*	-.044347 [.014259] (-3.1102)*
Real interest rate (%)	-.11992 [.058347] (-2.0554)**	-.099605 [.10420] (-.95591)	.046314 [.059271] (.78140)	-.11992 [.058347] (-2.0554)**
Gross domestic savings	-.66263 [.18679] (-3.5474)*	-.38047 [.091459] (-4.1600)*	-36.4549 [25.5810] (-1.425)***	-.66263 [.18679] (-3.5474)*
Foreign direct investment	.15507 [.12132] (1.2782)	-.044991 [.037320] (-1.2056)	2.2231 [1.202] (1.8523)***	.15507 [.12132] (1.2782)
Exports of goods and services	.70219 [.19526] (3.5962)*	.44356 [.095419] (4.6485)*	.45299 [.25441] (1.7806)***	.70219 [.19526] (3.5962)*
Imports of goods and services	-.70585 (.18744) [-3.7657]*	-.43432 [.093392] (-4.6505)*	-.4960 [.23435] (-2.1165)**	-.70585 (.18744) [-3.7657]*
Per capita income PPP	-.093951 [.008793] (-10.6850)*	-.007747 [.0076869] (-1.0078)	.43119 [.043964] (-9.8080)*	-.093951 [.008793] (-10.6850)*
GDP growth	-.13276 [.24248] (-.54751)	.22798 [.13446] (1.6954)***	-.08193 [.2792] (-.29344)	-.13276 [.24248] (-.54751)
R^2	.46613	.25289	.70626	.46613
Log LH	-3320.9	-1482.8	-1573.6	-3320.9
Observations	384	200	184	384

(1) All the countries in the sample. (2) High per capita income countries. (3) Low per capita income countries (4) All the countries in the sample, with only one dummy variable and constant term. Standard errors in brackets and t-values in Parentheses. *, **, ***, indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

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