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Globalization and the Environment

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Abstract

We study the effects of economic globalization (liberalization of international trade and investment flows) on the environment in the context of a model that integrates standard factor endowment theory (FET) with the pollution haven hypothesis (PHH). Both FET and PHH imply that inward investment burdens the environment while outward investment is favorable for environmental quality. The model suggests that FET and PHH can be discriminated on the basis of the effects of the interaction between trade in goods and inward FDI on the environment. In particular, the interaction is positive under the former and negative under the latter theory. We examine the effects of FDI for SO_2 concentrations in a large set of countries during the last two decades. We find that inward FDI is associated with higher concentrations while outward FDI is associated with lower concentrations. And that increased FDI amplifies the effects of increased trade. The last result constitutes prima facie evidence in favor of the PHH over the FET.

Keywords: FDI, trade, environment, pollution haven, factor endowments, SO_2

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Introduction

A key economic development of the last couple of decades has been the significant increase in the degree of economic globalization. Globalization has operated mostly through three channels: Trade in goods and services; capital mobility; and international policy cooperation. Reductions in trade barriers and the relaxation or elimination of capital controls have led to increases in trade and capital flows that have outpaced the rate of economic growth. The degree of trade (the share of international trade in GDP) and asset (the share of foreign assets in GDP) openness are much higher now in comparison to 25 years ago. Similarly, participation in international organizations (such as the WTO or the EU) has expanded.

Globalization has implications for many important issues, ranging from living standards to the distribution of economic and political power. One such issue that occupies center stage at present in both the research and political agendas is the environment. All three channels described above are thought to matter for environmental quality.

According to standard trade theory, trade in goods worsens environmental quality in countries that have a comparative advantage in the production of "polluting" goods. The comparative advantage may derive either from the distribution of the world endowments of the factors of production (the factor endowments theory, FET), in which case the *developed* countries become dirtier with free trade due to their capital abundance. Or, from policy related differences in tolerance of pollution (the pollution haven hypothesis, PHH), in which case the *less* developed countries are expected to become dirtier with international trade due to pollution haven effects. Nevertheless, static

trade theory abstracts from an important determinant of environmental quality that is affected by international trade, namely income. In a careful study that includes both the direct and indirect effects of trade, Antweiler et al., 2001, establish that in the long run such income (the so called technique) effects are sufficiently large as to overcome the negative effects arising from the scale and the composition of economic activity. They find that trade has had a positive effect on environmental quality as captured by SO_2 concentrations.

The relationship between international capital mobility, in particular Foreign Direct Investment (FDI), and the environment has also received recently considerable attention, but almost exclusively at the empirical front (Barbieri, 2002; Christmann and Taylor, 2001; Eskeland and Harrison, 2003; Javorsik and Wei, 2004; Keller and Levinson, 2002; Mani and Wheeler, 1998; Millimet and List, 2004; Xing and Kolstad, 2002). The theory underlying this body of work is the pollution haven hypothesis. In a nutshell, this theory postulates that polluting firms will find it profitable to relocate to countries with "lax" environmental standards. Consequently, FDI will worsen the environment in the receiving while improving it in the originating country.

The empirical evidence on the relationship between FDI and environmental quality has so far been rather mixed. For instance, Keller and Levinson (2002) and Xing and Kolstad (2002) report –rather weak- support for the pollution haven hypothesis. Javorsik and Wei (2004), Xing and Kolstad (2002) and others report the absence of any link, or sometimes a positive association. The latter association could be accounted by findings such as that by Eskeland and Harrison (2003), that foreign owned plants are significantly more energy efficient and use cleaner types of energy than domestically

owned plans. Nonetheless, it should be noted that, to the best of our knowledge, there exists no theory predicting that FDI will involve more efficient and cleaner plants than domestic investment in countries with low environmental standards.

The third channel regards international policy cooperation. Its influence on the quality of the environment is expected to be positive. International policy cooperation can produce a globally cleaner environment by limiting free riding/externalities problems in the production of pollution. That is, by reducing the cross-country spillover effects of poor, national environmental policies. This channel has not yet received as much scrutiny[1] as the other two and no reliable evidence has been presented so far regarding the sign and size of its impact.

The objective of this paper is twofold. First, to present a theoretical framework that contains an analysis of both international trade and FDI and it also encompasses pollution haven and standard trade theory (composition) effects. We do so in the context of the so called specific factors (Viner) trade model, adapted to also include differences in environmental standards. And second, to examine the empirical evidence on the effects of trade and FDI –for the latter, using a comprehensive data set constructed recently at the IMF- on various indicators of environmental quality.

The model predicts that inward FDI will have a negative effect and outward FDI a positive effect on the environment independent of which theory, the FET or the PHH, is the relevant one. But is also gives rise to a prediction that can be used to discriminate between these two theories. If the pollution haven hypothesis plays the dominant role in

[1] Ruoff (2006) is a notable exception but the focus of her study is on Less Developed Countries (LDCs).

production and trade patterns, then one should expect that FDI will *amplify* the effects of free trade. That is, the less developed countries will become even dirties and the developed ones even cleaner as a result of international capital movements. If on the other hand, differences in factor endowments play the key role in the determination of trade patterns, then one should expect that the effect of FDI will be to *mitigate* the effect of free trade[2]. Hence, the interaction between growth in trade with growth in inward FDI is expected to be positive under the PHH and negative under the FET.

We investigate the effects of international trade and FDI for SO_2 concentrations in a large set of countries during the last 25 years. We find that inward FDI is associated with higher concentrations while outward FDI is associated with lower concentrations. Inward FDI in the rich countries does not worsen the environment. We also find that the interaction between growth in trade with growth in inward FDI results in worse environmental quality. The last finding provides support for the pollution haven hypothesis over the factor endowments theory.

The model

The study of the effects of trade on the environment has relied on the workhorse of trade theory, the H-O model (see Antweiler et al., 2001). This model, however, is not useful for studying trade and capital movements together, because of its implication that these

[2] This is the case under the standard view that the developed countries are polluting capital abundant and the less developed countries are capital poor. That manufacturing is polluting capital intensive. And that manufacturing is more polluting than non-manufacturing.

two are perfect substitutes (Mundell, 1964). In particular, free trade brings about the international equalization of the rate of return on each factor of production, making international factor movements completely redundant. In order to be able to examine trade and FDI flows jointly we will rely on the specific, factor model (see Caves, Frankel and Jones, 2001). The key difference between this and the H-O model is that it also contains factors that are industry specific.

Let an economy produce two goods, x_1 and x_2. Production of good x_1 utilizes capital (k_1) and labor (h), while that of x_2 utilizes a *different* type of capital (k_2) and labor (h). In particular, the production functions in the two sectors take the form:

(1) $x_1 = Z_1(k_1)^b(h_1)^{1-b}$

(2) $x_2 = z_2(k_2)^c(h_2)^{1-c}$

with $h_1 + h_2 = h$. "z" is a measure of the efficiency of production. It can also be used to capture the stringency of environmental regulations. For instance, a high value may represent low stringency in environmental standards. We will assume that k_1 and k_2 cannot be substituted for one another, at least in the short-medium term. k_1 and k_2 are called the specific factors while h is the mobile –across sectors- factor.

We assume that markets are competitive and that producers maximize profits, Π. In particular, producers in sector 1 choose k_1 and h_1 in order to maximize

(3) $\Pi_1 = x_1 - wh_1 - r_1k_1$

where w is the wage rate (common across sectors due to labor mobility) and r_1 is the rental rate on capital in sector 1. The input demands are then given by

(4) $bx_1 = r_1k_1$ $\qquad$ $(1-b)x_1 = wh_1$

Similarly, in sector 2, profits are $\Pi_2 = px_2 - wh_2 - r_2k_2$. Maximization leads to input demands

(5) $pcx_2 = r_2k_2$ $\quad\quad$ $(1-c)x_2 = wh_2$

Note that p is the relative price of good 2 in terms of good 1. We have set the price of good 1 (the numeraire) equal to unity.

Most of the countries in the world represent small open economies, which means that they cannot influence p (the terms of trade). Without loss of generality we will set b = c and $z_2=1$, $z_1=z$. Using the second equations in (4)-(5) and the production functions allows us to solve for the allocation of labor across the two sectors and thus the levels of production x_1 and x_2 as a function of the aggregate endowments of the factors of production and the relative price. In particular,

(6) $h_1 = h[1+ z^{(-1/b)}p^{(1/b)}(k_2/k_1)]^{-1} = h*G^{-1}$ $\quad\quad$ $h_2 = ((G-1)/G)*h$

(7) $x_1 = z(k_1)^b h^{1-b} G^{b-1}$

(8) $x_2 = (k_2)^b h^{1-b}((G-1)/G)^{b-1}$

where $G = 1+ z^{(-1/b)}p^{(1/b)}(k_2/k_1)$.

2.1. Trade and the environment

How does free trade affect the environment? In order to answer this question we need to know two things. First, which of the two activities is more polluting? And second, what is the trade pattern of the country under consideration?

Concerning the sectoral contribution to pollution we will arbitrarily assume that sector 1 is the more polluting sector. For simplicity, we will also assume that the second sector does not create any pollution.

The trade pattern depends on the comparison of the price that would have prevailed in the absence of trade, p^a, to the world price, p. If $p^a > p$ then the country will export good 1 and import good 2 (it will have a comparative advantage in 1). The reverse pattern will obtain if $p^a < p$. In general, the difference between p^a and p will be determined by three factors involving a comparison across this country and the rest of the world: a) differences in consumption preferences over goods 1 and 2; b) differences in relative factor supplies, k_1/k_2; and c) differences in the stringency of environmental regulation as captured by differences in z. The first factor is usually ignored in the literature because it is hard to justify cross country variation in the utility function. The second factor implies that countries that are relatively abundant in capital k_1 will have a lower rental rate r_1. This in turn implies that the cost of production and hence the price of good 1 will be lower in those countries, making it more likely that they will be exporters of this good. Finally, the third factor implies that countries with less stringent environmental regulations will have a higher z and thus a lower cost of production in sector 1. These countries will tend to become exporters of that good. This corresponds to the pollution haven hypothesis.

Implications of free trade for environmental quality

Proposition 1: With similar environmental standards across countries, a country that is abundant in the capital that is used in the polluting activities (it has a k_1/k_2 that exceeds that in the rest of the world) will expand the scale of the polluting activity under free trade. Such a country will experience a deterioration in environmental quality as a result of greater international trade.

Proposition 2: With similar environmental standards across countries, a country that is abundant in the capital that is used in the non-polluting activities (it has a k_1/k_2 that falls short of that in the rest of the world) will contract production of the polluting activity under free trade. Such a country will experience an improvement in environmental quality as a result of greater international trade.

Proposition 3: With similar ratios of factor endowments across countries, a country with less stringent environmental regulations (a higher z) will expand production of the polluting activity under free trade (the pollution haven hypothesis).

When both the ratios of the factors of production and environmental standards differ across countries, one needs to compare the relative strength of the effects described in Propositions (1)-(3) in order to arrive at the net effect of international trade on the quality of the environment. Laxer environmental standards are not sufficient per se to induce a pollution heaven behavior as they may be dominated by the countervailing effects arising from differences in factor endowments across countries.

2.2 FDI and the environment

In order to determine the flows of FDI and their implications for environmental quality we need to determine factor prices in this country relative to the rest of the world under free trade. Under perfect competition in factor markets, input prices are equal to the value of the corresponding marginal products (VMP). In particular, the wage rate, w is

(9) $w = VMP_{h1} = VMP_{h2} = (1-b)x_1/h = p(1-b)x_2/h = (1-b)z(k_1/h)^b G^{b-1}$

(10) $r_1 = bz(k_1/h)^{b-1} G^{b-1}$

(11) $r_2 = b(k_2/h)^{b-1}(G/(G-1))^{b-1}$

It can be shown that $dr_1/dk_1 < 0$ and that $dr_1/dz > 0$. Consequently, a country with a higher capital 1 (capital 2) to labor ratio will have a lower r_1 (r_2). And a country with laxer environmental standards will, ceteris paribus, have a higher rate of return in the capital employed in the polluting industry.

When capital is allowed to move across countries, it will move from countries with a low rate of return to countries with a high rate of return. How will this behavior affect environmental quality? In order to answer this question we need to distinguish between FDI driven by differences in factor endowments –for given environmental standards- and FDI driven by differences in environmental regulation –for given factor endowments.

Implications of FDI flows for environmental quality

Proposition 4: With similar environmental standards across countries, a country that is abundant in the capital that is used in the polluting activities (it has a k_1/k_2 that exceeds that in the rest of the world) will witness an outflow of "polluting" capital and an inflow of "non-polluting" capital under free international capital mobility. Such a country will experience a decrease in the scale of activity in the polluting sector[3] and hence an improvement in environmental quality as a result of FDI.

[3] Note that the effect on outputs is magnified because the outflow of k_1 (inflow of k_2) will depress (increase) the marginal product of labor and thus wages in sector 1 (sector 2) drawing additional labor towards sector 2 at the expense of sector 1.

Proposition 5: With similar environmental standards across countries, a country that is abundant in the capital that is used in the non-polluting activities (it has a k_1/k_2 that falls short of that in the rest of the world) will witness an outflow of "non-polluting" capital and an inflow of "polluting" capital under free international capital mobility. Such a country will experience an increase in the scale of activity in the polluting sector and hence a deterioration in environmental quality as a result of FDI.

Proposition 6: With similar ratios of factor endowments across countries, a country with less stringent environmental regulations (a higher z) will attract polluting capital and witness an expansion of production in the polluting activity under free capital mobility (the pollution haven hypothesis).

Propositions (1)-(6) give rise to diverse patterns, not only with regard to how international trade and FDI impact on environmental quality but also regarding their combined effects. The implication that can be used to discriminate between the two theories (factor endowments vs pollution haven) as an explanation of the effects of globalization on the environment is then as follows. If the pollution haven hypothesis plays the dominant role in production and trade patterns, then one should expect that an increase in *inward FDI* will amplify the effects of growth in international trade. If, on the other hand, differences in factor endowments play the main role in the determination of trade patterns, then one should expect that the effects of inward FDI will go in the direction opposite from that of free trade. That is, there would be a negative effect of the interaction of these two aspects of globalization on the environment.

Before concluding this section it is worth mentioning that there may be a third possibility, which could perhaps account for a positive effect of FDI on environmental quality in the receiving less developed countries. To the extent that capital flows from the developed to the less developed countries are directed mainly to the relatively low pollution activities, FDI could improve environmental prospects in the latter set of countries. This would take place if k_1/k_2 were low in the *developed* relative to the less developed countries. In such a case, both free trade and free capital movements would contribute to higher environmental quality in the less developed countries[4].

3. The empirical analysis

The data set is an unbalanced panel consisting of 153 countries and covering the period 1990-2004 (annual data). Motivated by the theory developed in the previous section, we will estimate the following equation

(1) $$Q_{it} = a_0 + a_1 T_{it} + a_2 I_{it} + a_3 X_{it} + u_{it}$$

where the index *it* refers to country *i* in year *t*. *Q* is the environmental indicator. We rely mostly on SO_2 because of its greater availability (more countries and years) and also because its measurement does not involve any judgment. But we also consider CO_2 as well as environmental sustainability.

[4] The finding of Eskeland and Harrison (2003) that foreign owned plants are significantly more energy efficient and use cleaner types of energy than the domestically owned ones seems consistent with this scenario.

The dependent variable is the total level of SO_2 multiplied by the density of the country (population divided by surface). This formulation takes into account the fact that the environmental effect of air pollutants depends on the number of people that are exposed to it, which in turn depends on the density of the population. Lacking relevant information on exposure we use the country density as a proxy.

T represents the measure of trade. We use both a long and a short term measure. The former is given by the degree of openness (share of imports plus exports in GDP), while the latter by the *growth rate* of the trade share. The justification for the use of two distinct measures is that the former is more likely to capture the income (technique) effect documented by Antweiler et al., 2001. While the latter may capture the short run effects of trade liberalization as well as the indirect effect that fluctuations in FDI have on the environment through the resulting fluctuations in international trade in goods. In order to capture the interaction between growth in FDI and growth in trade we use the product of these two growth rates[5]

I is the measure of FDI. We will use two variables, FDI assets (outward FDI) and FDI liabilities (inward FDI) as the theory suggests that the effect of these two variables should go in opposite directions in each country. The data come from Lane and Milesi-Ferretti who have recently constructed a comprehensive data set on the foreign assets and liabilities for all countries in the world. For international positions in equity, they distinguish between portfolio investment and foreign direct investment. The latter

[5] While we report results with the product of the contemporaneous growth rates, that is, $\Delta(\text{Trade}(t))*\Delta(\text{FDI}(t))$ it should be noted that the same results obtain when we use lagged values for the FDI. Namely, $\Delta(\text{Trade}(t))*\Delta(\text{FDI}(t-1))$.

involves domestic acquisitions of foreign equity that exceeds 10% of the firm in which the investment takes place.

X contains a set of additional explanatory variables. It includes standard economic (GDP per capita and the scale of economic activity) and political variables (the degree of democracy, corruption). The scale of economic activity is measured by the product of GDP per capita and the country density. The degree of democracy is measured by the POLITY variable. Finally, X includes some other related variables such as participation in international organizations, the number of treaties a country has signed and/or ratified. Below we provide a more detailed justification for the variables employed.

Control variables

Economic variables

A large body of theoretical and empirical literature focuses on economic determinants of environmental quality. It has led to the identification of an important empirical pattern (e.g., Grossman and Kruger, 1995; Selden and Song, 1994). In particular, some forms of environmental degradation, e.g., SO_2 air pollution, follow a Kuznets curve pattern. That is, pollution first deteriorates and then improves as income per capita increases. The standard interpretation of this finding is that environmental quality is a luxury good in the initial stages of economic development. Poor countries facing a trade-off between protecting the environment and improving material living standards opt for the latter. Once significant gains have been made in living standards, the opportunity cost of stricter environmental policies becomes (relatively) smaller and voters are prepared to accept lower economic or personal income growth (the two may not be identical) in order to enjoy less pollution (the environment becomes a normal good). In order to text for the

existence of a Kuznets pattern we include the square of gdp alongside its level (to avoid very small numbers we have normalized the level of gdp by dividing it by its sample median).

Scale effect: Intensity of economic activity: **activity**

The larger the scale of economic activity per unit is, the higher the level of environmental degradation (i.e., pollution) is likely to be. That is, increased economic activity tends to result in more SO_2 emissions and thus higher levels of ambient SO_2 concentration. We measure the scale of economic activity by *GDP per square kilometer.* This measure reflects the concentration of economic activity within a given geographical area. It is constructed by multiplying per capita GDP by population density (population / square kilometers) – this, in effect, results in a coefficient measuring GDP per square kilometer. We expect a positive relationship between economic activity and environmental degradation.

Political variables

Political System: **Polity**

Many authors (Olson, 1993; McGuire and Olson, 1996; Niskanen, 1997; Lake and Baum, 2001; Bueno de Mesquita et al, 2003) have argued that non-democratic regimes are likely to underprovide public goods, including environmental quality. Hence we should expect a positive relationship between democracy and environmental quality. Others have claimed, however, that in democratic countries special interest groups enjoy disproportionate influence on policymaking (Olson, 1965, 1982; Midlarsky, 1998). This implies that public goods (environmental quality) may be underprovided in the presence of strong special interest groups opposing environmental policies. The same may be true

if elected politicians overweighed short-run benefits in the presence of long-term environmental degradation (Congelton, 1992).

Our measure for the political system variable is an index capturing the extent of democratic participation in government, *Polity*, from the POLITY IV data set. It is a composite index that includes the following elements: presence of competitive political participation, guarantee of openness and competitiveness of executive recruitment, and existence of institutionalized constraints on the exercise of executive power. Polity ranges from –10 (mostly autocratic) to 10 (mostly democratic) (Marshall and Jaggers (2002). With a view to the abovementioned theoretical arguments we expect the sign of the relationship between democratic political systems and environmental quality to be ambiguous.

Government quality: **corruption**

Bureaucratic inefficiency and corruption seems to contribute to environmental degradation too. According to the authors of the Environmental Sustainability Index (2005) that ranks nations by environmental performance, bureaucratic inefficiency and corruption are among the most highly correlated (among the 67 quality-of-life variables included in the index) with poor environmental quality. One possible explanation for this relationship might be that in highly corrupt societies, government officials accept bribes in return for not enacting environmental regulations and enforcing environmental laws. Moreover, Desai (1998) shows that corruption contributes significantly to environmental degradation in developing countries.

Participation in international environmental treaties: **signature and/or ratification**

International treaties oblige its member countries to cooperate on environmental

problems such as air or water pollution, climate change, trade in toxic waste and endangered species etc (Ward 2006).

In order to capture the strength of environmental protection in each country, we employ the degree of participation (signature and/or ratification) in international environmental protection treaties.

Estimation method

The data form an unbalanced panel. Following standard practice in the literature for this type of data we employ the Prais-Winsten model with panel-corrected standard errors (see Beck and Katz, 1995). We have also repeated the analysis using alternative estimation methods for panel data such as the Arellano-Bond linear, dynamic panel data estimator or fixed or random effects estimation. The main results are robust across estimation methods.

Results

Main results

Tables 1-3 report the estimation results. The following patterns obtain regarding the effects of FDI and trade:

1. FDI outflows improve the environment (the coefficient on FDIA is negative and statistically significant in Tables 1 and 3).

2. FDI inflows worsen the environment (the coefficient on FDIA is positive and statistically significant in Tables 1 and 3).

3. FDI inflows into the developed countries do not matter for the environment (Table 2)

4. The combined effect of an increase in the degree of openness and an increase in FDI inflows is positive (Table 3).

5. The effect of the *level* of international trade on pollution is negative. As Antweiler et al. 2001, argue, this is a reflection of the technique effect.

Findings (1)-(4) can be used to evaluate the two competing theories discussed in the paper, the FET and the PHH. (1), (2) are consistent with both the FET and the PHH. (3) is consistent with the PHH and the FET. Recall that according to the FET, inflows of capital into the developed countries must go into the non-polluting activities because the rate of return in those activities is higher than in the rest of the world. The PHH has the same implication: Clean capital will flow into the countries that have higher environmental standards, while dirty capital will go into the countries with the less stringent environmental regulation.

It is finding (4) that has discriminating power across the two theories as explained in the previous section. Recall that a positive coefficient on the interactive term favors the PHH while a negative one favors the FET.

What about the environmental effects of the other variables? There is a clear Kuznets effect present. The estimated coefficient of GDP on pollution is positive while that of the square of GDP is negative. The effect of the scale of economic activity is positive, that is more activity increases concentration of SO2. The contribution of democracy on the quality of the environment is negative. This seems paradoxical, and we do not have a good explanation for it. Finally, participation in international organization, either in terms of signing or ratifying international agreements does not make it more or less likely that a country will experience higher environmental quality.

3. Conclusions

We study the effects of economic globalization (liberalization of international trade and investment flows) on the environment in the context of a model that integrates standard factor endowment theory (FET) with the pollution haven hypothesis (PHH). Both FET and PHH imply that inward investment burdens the environment while outward investment is favorable for environmental quality. The model suggests that FET and PHH can be discriminated on the basis of the effects of the interaction between trade in goods and inward FDI on the environment. In particular, the interaction is positive under the former and negative under the latter theory. We examine the effects of FDI for SO_2 concentrations in a large set of countries during the last two decades. We find that inward FDI is associated with higher concentrations while outward FDI is associated with lower concentrations. And that increased FDI amplifies the effects of increased trade. The last result constitutes prima facie evidence in favor of the PHH over the FET.

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Table 1: *The effects of FDI Assets and Liabilities on SO_2 All countries*

Prais-Winsten regression, heteroskedastic panels corrected standard errors

	Coef.	Std. Err.	z	P>|z|
year	-3.728664	.595145	-6.27	0.000
trade	-.3427186	.0610113	-5.62	0.000
fdia	-5.392294	3.233076	-1.67	0.095
fdil	8.357891	2.12145	3.94	0.000
acti	.0000175	3.79e-06	4.62	0.000
polity	1.155314	.2583641	4.47	0.000
gdp	.0079894	.0019032	4.20	0.000
gdpsq	-.5793293	.1154191	-5.02	0.000
cumsign1	-.1323682	.4541033	-0.29	0.771
cons	7463.009	1175.531	6.35	0.000

Obs = 2934
R-squared = 0.2295
Wald chi2(9) = 135.89
Prob > chi2 = 0.0000

Table 2: *The effects of FDI Liabilities on SO_2 in the 50% richest countries*

Prais-Winsten regression, heteroskedastic panels corrected standard errors

	Coef.	Std.Err.	z	P>|z|
year	-6.301	0.915	-6.880	0.000
trade	-0.527	0.127	-4.150	0.000
tradegr	0.251	0.069	3.620	0.000
fdil	0.444	1.110	0.400	0.692
acti	0.000	4.130	3.480	0.001
polity	2.099	0.349	6.010	0.000
gdp	0.000	0.000	-0.340	0.735
cumsign1	0.072	0.479	0.150	0.880
_cons	126.270	18.140	6.960	0.000

Prob > chi2 = 0.000
R-squared = 0.1314
Wald chi2(8) = 111.58
Prob > chi2 = 0.0000

Table 3: *Discriminating between the PHH and the FET*

Prais-Winsten regression, heteroskedastic panels corrected standard errors

	Coef.	Std. Err.	z	P>|z|
year	-4.118715	.652437	-6.31	0.000
trade	-.4021671	.0770706	-5.22	0.000
tradegr-fdilgr	3.181579	.9709716	3.28	0.001
fdil	7.741333	2.160031	3.58	0.000
fdia	-6.051423	3.130561	-1.93	0.053
acti	.0000158	3.66e-06	4.31	0.000
polity	.7900307	.2394555	3.30	0.001
gdp	.006159	.0020623	2.99	0.003
gdpsq	-.4647869	.1132749	-4.10	0.000
cumrat1	.2872001	.2982913	0.96	0.336
cons	8234.036	1288.65	6.39	0.000

Obs = 2765
R-squared = 0.2105
Wald chi2(10) = 112.56
Prob > chi2 = 0.0000

Appendix

Data and sources

SO_2: Stern (1998) available under http://www.rpi.edu/~sternd/datasite.htm

Trade: Total trade in millions of current year US dollars according to the Gleditsch and Ward data set of Expanded Trade and GDP data version 4.1
http://weber.ucsd.edu/~kgledits/exptradegdp.html

FDI: Available from Milesi-Feretti (IMF).

GDP: Real GDP per capita in US-dollars according to the Expanded Trade and GDP dataset of Gleditsch version 4.1
http://weber.ucsd.edu/~kgledits/exptradegdp.html

Corruption: Corruption Perception Index from Transparency International
http://www.transparency.org/polity_research/surveys_ indices/cpi

Signature/ratification: ENTRI dataset by CIESIN http://sedac.ciesin.columbia.edu./entri

Population: Total population in thousands of a state according to the Expanded Trade and GDP dataset of Gleditsch version 4.1
http://weber.ucsd.edu/~kgledits/exptradegdp.html