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ABSTRACT

This paper analyzes environmental expenditures in Indonesia – a significant newly industrializing economy – reported at the plant level comprising all 23 thousand manufacturing establishments with more than 20 employees. Since compliance is barely enforced, pollution abatement expenditures are effectively voluntary in nature. This allows us to test whether foreign owned firms expend more due to a technology that adheres to stricter Western standards or whether the predominant effect is that both foreign and domestic exporting companies are more environmentally conscious due to better technology transfer or green consumerism in the Western countries. If so, this would contradict conventional wisdom that environmental expenditures reduce competitiveness and that increased levels of foreign direct investment or export-orientation in manufacturing will necessarily pre-empt firms from behaving in a "greener" fashion.

JEL Classification: F1, Q1

Key words: Environmental regulation, competitiveness, multinational enterprises, green consumerism, export performance, Indonesia

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1. Introduction

Industrialization in developing countries has often been associated with increasing levels of environmental degradation.[1] While developing countries often do not lack environmental laws and regulations, they more often lack effective enforcement. Insufficient enforcement can result from a shortage of skilled monitoring personnel, but also from a lack of public participation, information disclosure, and wholesale evasion due to lobbying, cronyism, and corruption.[2] Recently, many have claimed that globalization is a main driving force behind developing countries' environmental problems. Forced to compete in internationally and attract foreign direct investment, many developing countries it is suggested keep environmental standards at deliberately low levels. While openness and FDI foster economic growth (Edwards, S. 1998) they may come at the cost of deteriorated environmental quality.

Does industrialization through foreign direct investment and export led growth even in the absence of effective enforcement necessarily conflict with the environmental abatement efforts on the part of industry? This is still a moot point. Whereas many theoretical papers suggest the "globalization cum environmental degradation" view, some evidence suggests that firm level expenditures on environmental abatement are too small to affect the competitive position of a firm or a country (cf. sect. 2). They argue that it is more economical for multinational enterprises to develop a "one-fits-all" technology that adheres to strict environmental standards of the developed countries – thus there is no role for environmental policy to attract FDI. Reliable estimates of industrial environmental costs – in particular for developing countries – are notoriously hard to come by, the most notable exception being the US.[3]

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[1] See Grossman, G. M., and Krueger, A. B. 1995. "Economic Growth and the Environment."*Quarterly Journal of Economics*, 110., pp. 353-77. for an empirical analysis of the "Environmental Kusznet- curve", an inverted U shape function linking pollution levels to GDP per capita. See Panayotou, Theodore. 2000. "Economic Growth and the Environment." *Center for International Development Working Paper*: 116: Harvard University. for a comprehensive review of the literature.

[2] Cf. http://www.transparency.org/pressreleases_archive/2001/2001.01.26.davos-esi.html

[3] Another exception in China for which recently some evidence on pollution abatement has emerged cf. for instance Wang, Hua. 2002. "Pollution Charges, Community Pressure, and Abatement Cost of Industrial Pollution

Pollution abatement expenditure levels may actually differ across jurisdictions/countries, sectors, and specific firms according to their characteristics and production processes. The limited availability of more widespread international empirical evidence for developing countries, has led many existing studies had to assume that the sectoral structure of environmental expenditures and thus the relative pollution-intensity of sectoral production is equal internationally in order to assess the pollution intensity of trade flows.[4] Obviously, this assumption need not hold as regulations and technologies might be very different across countries in levels and in structure. Moreover, existing studies mostly refer to sectoral data and do not take into account firm-specific variables.[5] In particular, they cannot distinguish between firms that are exposed to foreign competition and those that are not. Also they cannot control for the influence of foreign ownership and thus for potentially more advanced technology through technology transfer within hierarchies.

The case of Indonesia represents a unique case study. Its manufacturing industry varies across location and type of industry and outward orientation. Moreover, until recently environmental regulations were so weak that environmental abatement expenditure on the part of firms was effectively voluntary. If environmental expenditures were indeed anticompetitive, we should expect in the absence of regulation that firms that are active on foreign markets incur less environmental expenditures than those that are not. Likewise, if foreign firms are attracted by low environmental standards as a major location factor they should have environmental expenditures no higher than their domestically owned counterparts. If environmental expenditures deteriorated the international competitiveness significantly we should expect exporting firms to have lower environmental expenditures. Alternatively, if a technology effect of international trade or green consumerism was the overriding issue we should expect

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in China." *World Bank Development Research Group Discussion Paper*: 27: Washington, D.C. and Wang, Hua and Jin, Yanhong. 2002. "Industrial Ownership and Environmental Performance: Evidence from China." *World Bank Policy Research Working Paper*: 28: Washington, D.C.

[4] See Schulze and Ursprung (2001, ch. 3) on this.

[5] Notable exceptions include Wang, Hua. 2002. "Pollution Charges, Community Pressure, and Abatement Cost of Industrial Pollution in China." *World Bank Development Research Group Discussion Paper*: 27: Washington, D.C.and Wang, Hua; Mamingi, Nlandu; Laplante, Benoit and Dasgupta, Susmita. 2002. "Incomplete

export-oriented firms to expend more for environmental control than their domestically oriented counterparts.[6] Likewise, if we found a significantly different pattern of environmental expenditures for domestically owned and foreign owned firms this would prove the second hypothesis and indirectly also the first hypothesis – environmental control costs (ECC) would be too small to warrant redesigning the technology used in developed countries.

To directly address these questions, we are able to draw of reported environmental abatement expenditures for individual manufacturing establishments, while controlling for export behavior and ownership, as well as a host of other characteristics. We are able to do this through a unique dataset providing such a combination of information for a population of 22 thousand large and medium scale manufacturing establishments wide variety of plant level and regional characteristics as control variables for 1994 to 1996.[7]

The paper is organized as follows. Section 2 provides a critical assessment of the theoretical and empirical literature on international competitiveness and environmental protection and derives testable hypotheses. Section 3 describes the state of environmental regulation and its enforcement in Indonesia. Section 4 presents the empirical model and the data. Section 5 provides the results. Section 6 summarizes and concludes.

2. Do Environmental Abatement Costs Reduce International Competitiveness?

The impact of enforced environmental regulation on international competitiveness remains subject to considerable disagreement. While some fear a loss of competitiveness from higher

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Enforcement of Pollution Regulation: Bargaining Power of Chinese Factories." *World Bank Development Research Group Working Paper*: 21: Washington, D.C.

[6] Thus we cannot strictly discriminate between motivations for adopting cleaner technologies – green consumerism or efficiency gains from more modern technologies with better environmental protection as a byproduct – but the implication for the issue at hand would be the same: Environmental expenditures would not reduce international competitiveness but rather international competition would lead to higher environmental protection at least in developing countries.

[7] Other studies on developing countries differ considerably in focus and method. There are studies on the influence of environmental regulation on location decision within a country, see e.g. Mani et al. (1996) and sector-specific studies for developing countries, cf. Schulze and Ursprung (2001), ch.3.

standards and consequently a race to the bottom, others discard these fears as empirical irrelevant. Yet others regard well designed environmental regulation even as pro-competitive (Porter, M. 1991;Porter, M. E., and Linde, C. van der 1995).

Theoretical work has largely supported the first position: McGuire (1982) for instance portrays stricter environmental control in a Heckscher-Ohlin model as negative technical progress which makes the dirtier sector contract. A trade distortion results unless the difference in regulations reflects a different degree of externality. Copeland and Taylor (1994;1995) show that if different environmental regulations in the developed and the developing world reflect different relative preferences for environmental quality free trade will result in specialization of the South in the production of dirtier products. This leads to a reduction of North's welfare if pollution is transboundary. The literature on strategic environmental policy shows how governments may use environmental standards as instrument to secure domestic firms a competitive edge or to attract foreign investment (e.g., Barrett, S. 1994; Markusen, J., E. Morey, and N. Olewiler 1995; Ulph, A. 1996). This strategic interaction may then lead to a welfare-deteriorating erosion of environmental standards ('race to the bottom argument') and a relocation of pollution-intensive industries in countries with low standards ('pollution haven hypothesis').[8]

Empirical analyses, however, have largely failed to find any significant effect of environmental policy on trade patterns or the direction of foreign direct investment (inter alia Ferrantino, M. 1997; Levinson, A. 1996; Low, P. 1992; Tobey, J. 1990).[9] How is this finding to be explained? Three lines of arguments have been put forward.

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[8] Note, however, that the opposite might hold under certain circumstances: If the disutility from environmental damages are too high countries might raise their standards competitively ("not-in-my-backyard" policies), see Pflüger, Michael. 2001. "Ecological Dumping under Monopolistic Competition." *Scandinavian Journal of Economics*, 103:4, pp. 689-706.. For a survey of the theoretical literature on trade and environmental policy see Schulze, G. and H. Ursprung eds. 2001. *International Environmental Economics: A Survey of the Issues*. Oxford: Oxford University Press., ch. 2.

[9] For a survey of the empirical evidence on the influence of environmental policy on international trade and investment patterns see Schulze, G. and H. Ursprung eds. 2001. *International Environmental Economics: A Survey of the Issues*. Oxford: Oxford University Press., ch. 3.

First, additional costs associated with environmental regulations or abatement are too small to affect location choice relative to other factors such as labor costs and taxes. Existing data refer to environmental control costs (ECC) which are the costs of compliance with environmental regulation on say emission or effluent levels, including capital costs for abatement equipment, operating costs of environmental management, and R&D costs for abatement technology. ECC hardly exceed two percent of overall production costs indicating little significance for investment decisions (Jaffe, A., Peterson, S., Rotney, P., and Stavins, R. 1995). Increasingly firms in developed markets have "mainstreamed" environmental expenditures in their basic capital expenditures, obviating to a certain extent the use of previously prevalent and discernable 'end-of-pipe' expenditures (Low, P. 1992). As more comprehensive data on "true" costs of meeting pollution abatement regulations is only available for a limited number of countries (e.g., the US) is hard to test the impact of environmental abatement costs in any direct fashion.[10]

Second and closely related to the first hypothesis, international capital flows may not respond to lower environmental regulations because it is not profitable for multinationals to adjust their technology to specific countries' environmental regulations and to save ECC (Levinson, A. 1995;Low, P. and A. Yeats 1992). Rather they develop a one-fits-all technology that adheres to the strictest, i.e. Western standards. Lower standards in developing countries are thus inconsequential for internationally operating firms, but may matter to domestic firms. If this 'technology effect' is indeed important environmental policy will not serve as a strategic instrument to attract FDI. A race to the bottom is not to be expected.

Third, both domestic and foreign firms exporting to foreign markets may have better access to more modern and cleaner technology, also if they are not part of a multinational enterprise, as they have better knowledge of the technologies used by their international competitors and are

[10] For want of international data many existing studies assume that other countries have sectoral ECC structures and levels similar to the US. They use these sectoral ECCs as one explanatory variable for trade and FDI patterns. Taking the theoretical literature seriously that describes environmental policy as a factor that – at least potentially – affects trade and investment patterns, similarity of ECCs seems a very strong assumption.

able to adopt them more easily.[11] Using modern and cleaner Western technology may not only be motivated by realized cost-savings but also by demand considerations: firms exporting to developed countries' markets may be concerned that consumers in these markets care for environmentally friendly production processes and therefore firms located in countries with lenient regulations but exporting to Western markets would still engage in production that meets Western standards unlike their counterparts producing for the domestic market (cf Wheeler, D. and P. Martin 1992). This effect caused by 'green consumerism' is irrespective of ownership; it is demand driven as opposed to the above 'technology effect' which is supply driven.

3. Environmental Regulation in Indonesia

As many developing countries, Indonesia has established a legal framework to regulate industrial - pollution (e.g., water, air, and other ambient pollution levels).[12] Although these regulations often codify standards that are equivalent or even exceed developed country standards, the actual enforcement of these remains notoriously weak to non-existent.[13] The capacity to actively enforce environmental amelioration on the part of industrial plants is curtailed by lack of capacity, resources, a lack of effective monitoring or sanctioning of plants

[11] Many firms in developing countries produce intermediate products for Western firms that supply them with modern technology. In Indonesia, many domestically owned firms in the textile, garment and shoe industries produce for European and American firms which have outsourced the core production process.

[12] The Environmental Management Act of 1982 and revised in 1997 provides the legal basis for monitoring and enforcement of environmental regulations in Indonesia. Since 1986, the Environmental Impact Analysis (AMDAL, *analisis mengenai dampak lingkungan*) has been the means of detecting environmental impacts and formulating mitigating measures in Indonesia. An Environmental Impact Management Agency (BAPEDAL, *badan pengendalian dampak lingkungan*) was established by Presidential Decree in 1990. The aim of this agency was to coordinate various ministries and agencies to monitor and promote environmental policies, although it was recently abolished.

13 Legal instruments include Government Regulation 20/1990 on water pollution control and 1995 for stationary air pollution standards ADB. 2000b. "Indonesia: Country Environmental Policy Integrative Studies." Asian Development Bank: Manila.. In the course of decentralization process which started in 2001, environmental protection agencies have undergone a major reorganization and continue to do so.

(cf Afsah, Shakeb, Allen Blackman, and Damayanti Ratunanda 2000; Pargal, Sheoli, Hemamala Hettige, Manjula Singh, and David Wheeler 1998).[14]

In the face of pervasive problems to enforcement during the nineties, the Indonesian government focused on essentially voluntary programs to encourage environmental behavior on the part of industry (Afsah, Shakeb, Allen Blackman, and Damayanti Ratunanda 2000). Pioneering efforts included the Clean Rivers Program (PROKASIH) (1989ff), which focused on the discharge of industrial pollution in waterways. Under the PROPER extension in the mid-1990s, the government resorted to a mechanism of the voluntary disclosure of a rating system for water pollution compliance.[15] Formal coverage of firms amounted to only about 5 percent of manufacturing establishments in eleven river basins across Java, Sumatra, and Kalimantan, and was based on the recognition that formal regulations and sections were proving largely ineffective (Pargal, Sheoli, Hemamala Hettige, Manjula Singh, and David Wheeler 1998, Section 2.2). In the meantime also this program has been discontinued as it has proven to be also ineffective and plagued by corruption and pervasive bureaucratic inefficiency.

Starting from the recognition that formal environmental control is de facto non-existent in Indonesia, (Pargal, Sheoli and David Wheeler 1996) and (Pargal, Sheoli, Hemamala Hettige, Manjula Singh, and David Wheeler 1998) have argued that public participation/ civic protest partly substitutes for the lack of effective enforcement of regulation: in the absence of

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[14] Not only are responsibilities undefined across varies sectoral agencies, but environmental protection agencies suffer from a severe lack of skilled staff and from corruption. There is broad consensus that BAPEDAL ultimately lacks the legal basis to monitor and enforce emissions standards and is not allowed to sue polluters ADB. 2000a. "Assessment of Poverty In Indonesia." 77 + Statistical Appendix. Asian Development Bank: Manila, Waddel, Sarah. 2001. "Environmental Law in Indonesia - An Overview." BAPEDAL/GTZ (Pro-LH: Program Pengelolaan Lingkungan Hidup Indonesia): Jakarta, Zwahlen, Robert and Bedjo Soewardi. 2000. "Sustainable Development, Environmental Impacts, and the Land Development Process - Indonesian Context." 115. BAPENAS/BPN: Jakarta..

[15] The full PROKASIH extended to 778 firms in 1990/91. For PROPER, BAPEDAL sent letters to 350 facilities requesting participation, and 176 were selected for rating Afsah, Shakeb and Jeffrey Vincent. 1997. "Putting Pressure on Polluters in Indonesia: Indonesia's Proper Program." 16. Harvard Institute for International Development: Cambrige, MA.. PROKASIH was extended to 77 rivers in 17 provinces in the fiscal year 1996/97 Global Environmental Forum. 1997. "Overseas Environmental Measures of Japanese Companies (Indonesia): Research Report on Trends in Environmental Considerations related to Overseas Activities of Japanese Companies." 170 + 4 Appendixes. Ministry of Environment, Japan: Tokyo..

effective formal regulation plants' abatement activities are influenced by *informal regulation* brought about by local community pressure to reduce pollution levels. The ability to organize opposition and exert pressure on local plants in turn is argued to depend on socioeconomic characteristics of the community such as population density, income level, and educational profile of the local population. In a small sample (N=243) for 1989-90 they find that one major water pollutant, i.e. biological oxygen demand, varies significantly with these local community characteristics. They conclude that informal regulation is effective. However, the program included only a small fraction of establishments, only about 1 percent of those establishments in our current manufacturing census. Moreover, our emphasis is on reported spending on environmental abatement as a cost factor that may compromise competitiveness. We use total environmental expenses as endogenous variable rather than pollution levels of a specific type of pollutant. Most importantly, we look at export activity as determining factor since the relationship between international competitiveness and environmental control is at heart of our analysis. However, since informal regulation may also exert influence on the level of environmental spending, we control for local socio-economic characteristics in a way very similar to Pargal and Wheeler.

4. Empirical Model and Data

We seek to analyze the nature of the relationship between environmental expenditures and international competitiveness. To this end we want to establish whether export-oriented firms tend to have lower or higher environmental expenditures and whether this pattern is different for foreign-owned firms as compared to domestically owned firms. Thus we include ownership and export orientation in our regression and control for other relevant establishment-specific, sectoral, and regional characteristics. We account also for the presence of regional effects of informal regulation along the lines of Pargal and Wheeler (1996).

Since 1975 Indonesian Central Bureau of Statistics (*Badan Pusat Statisk,* BPS) has compiled an extensive establishment level data set in its annual Survey of Large and Medium Scale

Industries (*Statistik Industri*, SI) (cf Kaiser, Kai and Jack Molyneaux 2000).[16] The SI is designed as a census of all establishments with more than 20 employees. In 1996, the SI covered over 22 thousand establishments. Establishment level characteristics also include the levels of export intensity (share of total output) and foreign ownership shares. Starting in 1994, the SI also asks establishments about preventative environmental expenses (*biaya pencegahan pencemaran linkungan*), along various other expenditures. For 1994-1996 we are therefore able to link environmental expenditures at the plant level with plant level characteristics. We are also able to derive regional characteristics for income, education, and urbanization levels at the level of 303 administrative districts from the annual National Socio-Economic Household Surveys (SUSENAS).

As only about fifteen percent of all establishments report positive environmental expenditures simple OLS regressions generally result in biased estimates. To address this sample selection bias we use the two-stage Heckman procedure: The first stage provides a probit estimate of the selection process, i.e. it determines the factors that make reporting of environmental expenditures likely (selection stage). The second stage (outcome stage) provides an OLS regression of the level of environmental expenditures on its determinants *conditional* on the selection, i.e. that the observation is an element of the sub-sample of positive environmental spending ((Heckman, J.J. 1979) (Greene, William 1990)).[17]

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[16] For those establishments that are only "discovered" after being in operation for a number of years, BPS creates a supplementary "backcast" dataset with a limited number a variables to achieve better estimates of the total LME manufacturing population output, value added, and employment, cf. Hill, Hall and Kai-Alexander Kaiser. 2001. "Indonesian's Industrial Transformation, Revisited.".

[17] The regression equation for the outcome stage is then $E(y_i | z=1, x_i) = x_i'\beta + \theta\hat{\lambda}_i$ where y_i is the observed level of environmental expenditures for establishment i, x_i is the vector of exogenous parameters, z is a dichotomous realization of a latent variable z* which takes on the value 1 if a positive environmental spending is observable (i.e., iff z*>0) and zero otherwise and β is the vector of regression parameters. $\hat{\lambda}_i$ is the estimate of the inverse Mill's ratio, θ is the covariance ($\theta = \sigma_{ue}$.) between the error term of the regression of z_i* on its exogenous variables $(z_i^* = w_i'\alpha + e_i)$ and the regression of y_i* on its exogenous variables x_i. $(y_i^* = x_i'\beta + u_i)$. (Note that σ_e has been normalized to one.)

As endogenous variable for the selection stage we use a dummy variable ENVSPENDER which is one if the establishment spends on environmental protection at all and zero otherwise. The endogenous variable for the outcome stage is the log of environmental expenditures, ENVEXPENDITURES. As we are interested in the influence of export activity and foreign ownership on environmental expenditures (cf. Sect 2) we construct the dummy variables FOREIGN and EXPORTER which are one if the establishment is (partly) foreign owned and engages in export activity, respectively, regardless their actual shares, and zero otherwise. We also used the actual shares and redefined the dummy variables to become one if the share of foreign ownership and output exported exceeded 30 percent. Both alterations only mildly affected results.

The control variables are intended to capture all other effects on environmental expenses. We assume that plants with high pollution levels are more likely to engage in environmental protection and/or tend to spend more. Thus we use the following proxies for pollution emission:

Sector: Of course the level of pollution is sector-specific. For both regressions we use sectoral dummies as exogenous variables on the two digit SITC levels.

Size: Larger firms will tend to be more polluting, other things being equal. We thus expect a higher likelihood to incur environmental expenditures and, if so, a higher level. There may be economies of scale in environmental protection or abatement activities leading to lower environmental expenditures per unit of output. We therefore control for size by using the natural logarithm of output [LN(OUTPUT)] as explanatory variable.[18]

Energy intensity: Energy intensive plants tend to be more polluting and therefore should have a higher probability to report environmental expenditures and should tend to report higher

[18] One could argue that output may in turn be a function of environmental expenditures as high environmental expenditures may tend to reduce competitiveness and thus output thereby leading to a simultaneity problem. Although this might be a potential problem it would not be as severe as in other regressions of this kind: Because environmental expenditures are voluntary, we can expect firms to determine their optimal output and decide independently on their optimal environmental expenditures rather than being forced to determine their output under the constraint of environmental regulations.

environmental expenditures. We constructed energy intensity as the share of fuel costs in total output.

Age: This variable proxies the plant's level of technology – older firms should tend to have higher pollution intensities and therefore higher end-of-pipe expenditures. Note that the environmental expenditures used as endogenous variable in this study do not include investment expenditures. Therefore cleaner but also more expensive technology would reduce environmental expenditures.

Furthermore we have included *year dummies* to capture any time specific effects such as business cycle effects. In one set of regressions we included 13 *regional dummies* to capture any possible effects of 'informal regulations' as studied by Pargal and Wheeler (1996) and other region-specific effects. In a different set of regressions we addressed the 'informal regulations' more directly the way Pargal and Wheeler did by including socioeconomic characteristics of the districts that are conjectured to proxy the pressure which the local population exerts on polluting plants. They are share of urban population, share of population with secondary education, and per capita expenditure, all at the district level (*kabupaten/kota*).

Table 1 gives an overview of the sample size and the number of establishments reporting positive environmental expenses. Just under 15 percent of establishments reported environmental expenditures during the period 1994-1996.[19]

[19] The SI does not allow us to distinguish between instances of non-response (i.e., missing values) and the actual absence of environmental expenditures, although the assumption is that only establishments that consciously report expenditures are also engaged in environment measures.

Table 1: Sample size and number of firms reporting environmental expenses

Year	Total Establishments	Environmental Spenders	Share of Total
1994	19,017	2,556	13.44 %
1995	21,551	3,158	14.65 %
1996	22,997	3,504	15.24 %
Total/Average	63,565	9,218	14.50%

Source: Statistik Industri and own calculations

Table 2 provides average establishment characteristics for environmental spenders in comparison to total manufacturing establishments. Export shares are somewhat higher (17.3 versus 12.51 percent), as is foreign ownership (6.97 versus 4.05 percent). Environmental spender establishments are also somewhat larger (296 versus 192 employees).

Table 3 reports location characteristics which will be used to proxy for possible informal regulation as per Pargal and Wheeler (1996) through pressures of affected citizens at the local level (see above). We use a local indicator of prosperity/income (per capita household expenditures), education (share of the total population with secondary education), and share of urbanization as defined at the level of the more than three hundred local administrative areas (*kabupaten* and *kota).* These are drawn from the National Socio-Economic Household Survey (SUSENAS) annual cores, which provide statistical significance to that level.

Table 2: Summary Statistics: LME Establishments and Location Characteristics

	Mean	Spender Mean	Standard Deviation	Spender Standard Deviation	Minimum	Spender Minimum	Maximum	Spender Maximum
Environmental Expenditures	3,967	27,353	63,006	163,508	0	3	7,789,663	7,789,663
Employees	192	296	770	731	20	20	116,052	20,262
Output (000 Rps/Year)	9,353,776		78,527,975		687		7,553,379,840	
Wage (Rps/Year)	630,034	1,138,903	3,321,053		0		224,188,336	
Value Added per Worker (Rps/Year)	981,453	1,349,033	11,291,247	3,853,647		499		
Age (Years)	11.1	11.93	11.1	12.18	0	0	95.0	94
Foreign Ownership (%)	4.05	6.97	17.34	22.05	0	0	100.00	100.00
State Ownership (%)	2.73	4.09	15.78	19.12	0.00	0	100.00	100.00
Export Share (%)	12.51	17.32	30.23	33.90	0.00	0	100.00	100.00

Source: *Statistik Industri, and refer to pooled values for 1994-1996.*

Table 3: District Level Informal Regulation Variables

Local Government Level Variables	Mean	Standard Deviation	Minimum	Maximum
Income Per Capita (000s Rps/year)	52,848.02	19,817.52	25,684.37	158,905.09
Share Urban (%)	19.59	32.35	0	100
Percentage Education Greater Primary (%)	40.11	10.37	21.30	68.42

Source Notes: Local government statistics are from the National Socio-Economic Survey (SUSENAS) annuals cores. Reported local government characteristics are for 1995. Income figures refer to per capita private household expenditures. Figures refer to N= 303 regions.

5. Results

We pooled our three years of data on environmental expenditures. Using a larger sample tends to wash out business cycle effects and enhances reliability of results; at the same time a three year period is too short to run a meaningful panel regression.[20] We have excluded 1997 because of the disruptions caused by the Asian crisis and missing data problems on exports. Results are presented below.

Table 4 presents the results of the outcome and selection stages of our estimates with ENVSPENDER and ENVEXPENDITURES as endogenous variables. We suppress the sectoral and year dummies. Regression model (1) looks at firm-specific characteristics only and disregards local factor such as a possible informal regulation.

The most striking result is that establishments that engage in export activities – i.e., the selection stage of our regression --- are significantly more likely to report environmental expenses. However, at the outcome stage of those who do report, environmental expenditures are lower in terms of Rupiah levels, naturally controlling for size and other plant level chateracteristics.

There are two lines of reasoning for this observation. Since exporting establishments are more likely to incur environmental expenditures, also those establishments report at least some expenses that would not do so if they were domestically oriented, thus leading to a lower average expenditure for the exporting plants. In other words, lower environmental expenses for exporting plants are due to a different selection bias and not to lower environmental expenses for otherwise comparable establishments.

[20] Pooling gives newly established firms and those which went out of business less weight than the other firms which enter twice or three times. We do not consider that as a problem as newly established firms may not yet have found their optimal level of environmental expenditures and firms that go out of business may not have optimal expenditures anyways. Since environmental expenditures are voluntary, they cannot be responsible for the bankruptcy either, therefore a discrimination against such firms does not blur a causal link. Alternatively we would have to pick a specific year at random. Still, we have run all regressions separately for each year which did not alter the results significantly.

Table 4: Regression Results for Heckman selection model

Variable	*Coefficient*	*z*	*P>|z|*	*Coefficient*	*z*	*P>|z|*
	(1) Regression without regional characteristics			(2) Regression with informal regulation		
2. Outcome stage: Endogenous variable ENVEXPENDITURES						
FOREIGN	. 27190	3.90	0.000	.27381	3.92	0.000
EXPORTER	-.09695	-1.97	0.048	-.09459	-1.92	0.055
LN(OUTPUT)	.60924	48.70	0.000	.60644	48.36	0.000
ENERGY INTENSITY	.02063	6.60	0.000	.02077	6.57	0.000
AGE	-.00293	-1.87	0.061	-.00304	-1.93	0.053
Principal component	–	–	–	.00950	0.80	0.423
Year dummies	Yes (2)			Yes (2)		
Sectoral dummies	Yes (8)			Yes (8)		
Constant	1.22622	4.74	0.000	1.28829	4.99	0.000
1. Selection stage: Endogenous variable ENVSPENDER (probit)						
FOREIGN	.01057	0.41	0.683	.00979	0.38	0.705
EXPORTER	.04135	2.36	0.018	.03851	2.20	0.028
LN(OUTPUT)	.14644	41.51	0.000	.14759	41.76	0.000
ENERGY INTENSITY	.00882	8.46	0.000	.00828	7.88	0.000
AGE	.00295	5.35	0.000	.00312	5.65	0.000
Principal component	–	–	–	-.01748	-4.23	0.000
Year dummies	Yes (2)			Yes (2)		
Sectoral dummies	Yes (8)			Yes (8)		
Constant	-3.17912	-63.28	0.000	-3.19196	-63.45	0.000
	Censored obs.		54341	Censored obs.		54270
	Uncensored obs.		9218	Uncensored obs.		9212

Wald	$\chi^2(15)$ =3166.7; Prob > χ^2= 0.0000		$\chi^2(16)$ =3148.17; ; Prob > χ^2= 0.0000	
ρ	-.82942	Std. err.: .01302	-.83265	Std. err.: .012711
σ_u	2.24107	Std. err.: .04861	2.25100	Std. err.: .04845
λ	-1.85879	Std. err.: .06843	-1.87430	Std. err.: .06788
LR test of independent eqns. (ρ=0)	$\chi^2(1)$= 155.88, Prob > χ^2= 0.0000		$\chi^2(1)$= 162.00, Prob > χ^2= 0.0000	

Note: Parameters are explained in fn. 17. The Wald test is a test of all regression coefficients (except the constant) being zero, the likelihood ratio test is a test on ρ being zero, i.e. a test on the joint likelihood of an independent probit model for the selection equation and the regression of the observed environmental expenditures on the explanatory variables β against the Heckman model likelihood.

Alternatively, it is conceivable that exporting firms engage in some sort of environmental protection activity in order to satisfy consumers in export markets, but that the exposure to international competition leads them to reduce these expenditures However, if environmental costs indeed would reduce competitiveness in any significant manner, the variable EXPORTER should have turned out significantly negative also in the selection stage since environmental expenditures are basically voluntary. Our result contradicts this notion.

Foreign-owned firms are not significantly more likely to report environmental expenditures but if they do their environmental expenditures are significantly higher than for the other firms. This positive differential effect is much stronger than the negative effect for exporter indicating that ownership matters much more than export orientation. These observations lend support for our technology-hypothesis advanced earlier. It also implies that differences in environmental standards may not be an appropriate instrument to attract foreign direct investment.

Control variables are also highly significant and have the expected signs: Larger firms tend to report more often positive environmental expenses as do more energy intensive plants. Interestingly, older firms are more likely to engage in environmental protection, but tend to spend less, possibly because they can achieve a higher improvement at a lower/minimal investment).

Our measure of environmental abatement naturally has some limitations in terms of disentangling actual abatement levels as related to the choice of technology. Foreign firms through their choice of technology may have already mainstreamed environmental costs, hence see less need to itemize end of pipe environmental expenditures (i.e., report them in our selection stage). However, if additional end of pipe abatement efforts are needed (i.e., at the outcome stage), foreign firms will engage in higher expenditures for a variety of reasons.

Abatement activities may respond to local community pressure and thus may depend on local characteristics in addition to firm-specific variables. To account for such a possibility we have included in a second set of regressions regional dummies that could capture informal regulation along with other location factors. That did not alter our results in any significant way. Moreover, we tried to include variables similar to those employed by Pargal and Wheeler: the share of urban population, share of population with secondary education, and per capita expenditure, all at the local level (*kabupaten/kota*). Informal regulation should increase with any of those variables. It turned out that these variables were highly correlated with each other (partial correlation coefficients ranging from .66 to .78) leading to a severe multicollinearity problem. To address this problem we used the principal component analysis. The first component accounts already for almost two thirds of the variance in the three variables, so that we included it as additional regressor representing the influence of informal regulation on the decision to incur environmental costs. Results are reported in regression model (2) in Table 4. In our large sample including more than 60 thousand observations it turns out that informal regulation has no effect on the level of environmental expenditures and makes it even less likely that plants invest in environmental expenditures at all. All other results are unaffected by the inclusion of this variable.

6. Concluding Remarks

In this paper we have studied the decision of Indonesian manufacturing firms to engage in reported environmental abatement expenditures. We find that exporting firms are significantly more likely to incur environmental expenses (and spend no less) after controlling for relevant plant level characteristics. This finding contradicts the notion that firms exposed to

international competition will be less likely to engage in environmental abatement expenditures relatively to domestically oriented firms.

As a second major result, we find that foreign owned firms spend significantly more on environmental protection activities than domestically owned firms, once we have controlled for those actually reporting. Although foreign firms may already be using "cleaner" home country technology thereby mainstreaming part of their environmental expenditures, competitive pressure does not appear to limit their environmental expenditures relative to other firms. We find no evidence that lenient or non-existing environmental regulations establish an effective incentive to attract foreign capital.

Our ability to disentangle why foreign oriented firms do not appear to limit environmental expenditures relative to other firms is still somewhat limited. This finding may be due to reputation effects as much as Green Consumerism in exports markets, or to a different technology. The resolve this uncertainty it would be very insightful to differentiate exporting firms according to their export markets. In some case, FDI if finalized to production for international markets has to be standard-proof anyway. Our current data set does not permit a differentiation according to export markets. However, we may be able to extend our analysis to differentiate by countries ("green" or "brown" owners) of the source of foreign investment.

International best practice is increasingly moving to mainstreaming environmental abatement. This for example has been the approach of German Technical Assistance (GTZ) in Indonesia in this area. They argue that greener production is incidental to cost-gains of more efficient production processes, and it is this incentive that is mainly used to promote the improved environmental performance of establishments in Indonesia. This approach conforms to our findings that firms may mainly engage in environmental expenditures because they are part of efficient production processes, rather than additional costs. As our results show, however, the mainstreaming of environmental abatement may also make it *less* likely that firms actual would report expenditures. The SI has stopped collecting data on environmental expenditures in the context of streamlining the survey in the context of the Asian economic crisis. Although we currently do not have necessary data, future research may wish to look in more detail into

the relationship between reporting and actual mainstreaming/outcomes for pollution abatement.

Our paper suggests that the voluntary approach of “eco-grading” of plants (i.e., PROPER etc.) leverages our demand channel (i.e., green consumerism) in a context where the capacity for formal regulation and monitoring remains limited. Of course, improved regulations and enforcement can bring about improved environmental quality. Done well, and in the context of mainstreamed abatement, we argue that these regulations do not necessarily erode competitiveness.

However, a major problem in Indonesia remains corruption and bureaucratic efficiency. As a further line of research it would be interesting to examine how corruption and environmental expenditures interact with each other and whether and to what extent informal payments may substitute for environmental expenditures. This again suggests that the most effective forms of pollution abatement may not be through bureaucratic enforcement (which may be abused), but through our channels that encourage “voluntary” good practice.

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