Ownership and Pollution in Vietnam's Manufacturing Firms

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Abstract

This paper has examined emission propensities by industry for MNCs, SOEs, and private firms in Vietnam in 2002 and 2004. Simple descriptive statistics suggest that MNCs tended to have relatively low propensities in a few industries while SOEs tended to have relatively high ratios in a few more industries. More rigorous analysis then asked if these propensities differed among ownership groups after accounting for the influences of other factor demands and technology intensity. These results suggested SOEs tended to have relatively high emission propensities in a number of cases and that MNCs also had relatively high emission propensities in a few cases. However, in most industry-year combinations, it was difficult to find statistically significant differences in emission propensities among ownership groups.

Keywords: ownership, multinational corporations, state-owned enterprises, pollution, abatement, Vietnam, manufacturing
JEL Categories: F23, K32, L32, L33, L60, O53, Q40

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1. Introduction

Critics of multinational corporations (MNCs) have sometimes accused them of exploiting so-called pollution havens by transferring polluting activities from home economies where environmental regulations are relatively strict to developing economies where corresponding regulations tend to be less stringent. Most known studies suggest evidence supporting this pollution-haven hypothesis is weak (Dean et al. 2009; Eskeland and Harrison 2003; Kirkpatrick and Shimamoto 2008; Smarzynska and Wei 2001), but others (He 2006; Wagner and Timmons 2008) provide some evidence consistent with the hypothesis. However, even if the pollution-haven hypothesis is true, and foreign direct investment (FDI) or other MNC activities (e.g., employment, sales) tend to be concentrated in pollution-intensive industries and countries with relatively lax environmental regulation, it is also possible that MNC affiliates in developing economies may be less pollution- or energy-intensive compared to local firms or plants. In other words, even if MNCs exploit pollution havens, they may contribute to more efficient use of energy or pollution reduction in host developing countries, especially if energy-efficient practices spillover from MNCs to local firms.

Eskeland and Harrison (2003) is one of the few, recent studies using micro-data to investigate the question of whether foreign MNCs are more energy efficient or have lower energy intensities than local counterparts in developing economies. One of their main findings (p. 21) was that "foreign plants are significantly more energy efficient and use cleaner types of energy" than their local peers in Coˆte d'Ivoire, Mexico, and Venezuela. In a

related study of provincial data, He (2006) provides evidence that FDI enterprises produce "with higher [SO2] pollution efficiency", but that stronger environmental regulation has simultaneously, though moderately, deterred FDI among Chinese provinces. Earnhart and Rizal (2006) focus on the effects of financial performance and privatization on environmental performance, but their results also indicate foreign ownership was usually an insignificant determinant of pollution in Czech firms. On the other hand, state-owned enterprises (SOEs) generally had lower pollution levels than private firms.

Distinctions among SOEs, MNCs, and private firms are also important in Vietnam. This paper thus investigates whether MNCs or SOEs polluted more or less than local, private firms in Vietnam's manufacturing industries in 2002 and 2004. To this end, emission levels, propensities to report emissions, and emission intensities of MNCs, state-owned enterprises (SOEs), and private firms are examined in manufacturing overall and industries with relatively large emissions (Section 3). The paper then proceeds to compare emission intensities among these three ownership groups, after other factors that may affect these intensities are accounted for (Section 4). A methodology similar to that described in Eskeland and Harrison (2003, pp. 16-18) is adopted for this purpose. Before turning to these comparisons, it is first helpful to briefly review why MNCs (or SOEs) might be expected to have different emission intensities than local, private firms (Section 2). The paper's final section (5) concludes.

2. Principles and Related Literature

As indicated above, there is a growing literature examining the pollution haven hypothesis, which suggests that MNCs tend to locate pollution-intensive activities in developing economies or regions with relatively lax environmental regulations. And as part of this examination, a few researchers have also been led to ask whether MNCs pollute relatively more or less than their local counterparts. However, these and other studies have not generally related their empirical work to the more general theory of the MNC, which emphasizes how MNCs can be expected to systematically differ from local plants. The first part of this section thus outlines how basic theory explains differences between MNCs and non-MNCs, and how those differences might lead MNCs to pollute less or more than their local counterparts. Similarly, the second part of the section applies a similar logic to the comparisons of SOEs and private, local firms in developing economies, emphasizing how the distinctive characteristics of SOEs might lead them to pollute more or less than private firms.

2a. Why Might MNCs Pollute Less than Non-MNCs (e.g., Vietnam's Local Firms)?

One important characteristic of the theoretical analysis of the multinational firm in recent years is the prominent role that knowledge-based, intangible assets (terminology from Markusen 1991) have come to play in the analysis. The key goals of the analysis are to explain why the MNC chooses to invest abroad when it (at least) initially has several cost disadvantages compared to local firms, and why the MNC chooses to spread out production

across countries rather than concentrate it in one location. Most observers agree that MNCs tend to possess relatively large amounts of technological knowledge and networks, marketing expertise and networks, especially international ones, and generally have relatively sophisticated and capable management.[1] The first two characteristics are evidenced by relatively high research and development (R&D) propensities (ratios to total sales), relatively large proportions of patent applications and approvals, relatively high advertising-sales ratios and relatively high dependence on international trade (generally on both exports and imports). Indeed, when asking what makes a firm decide to assume the extra costs of investing in a foreign country (compared to the costs of local firms in the host), Dunning (1988) asserted that a firm must first have "ownership advantages" as would be afforded by possession of relatively large amounts intangible assets, as well as "location advantages" and "internalization advantages" before investing.[2]

The important implication here is that, if one accepts that MNCs have relatively large amounts of knowledge-based, intangible assets, MNCs will tend to be relatively efficient producers compared to non-MNCs, at least in some respect. And this relatively high efficiency could involve the MNC becoming more energy efficient and/or polluting less as part of efforts to facilitate increased demand among consumers and minimize production

[1] Caves (2007) and Dunning and Lundan (2008) provide thorough literature reviews. The work of Markusen (2002) has also been influential in recent years.

[2] Dunning's OLI (ownership-location-internalization) paradigm has been influential, but others (Buckley and Casson 1992, Casson 1987, Rugman 1980, 1985) emphasize that the concept of internalization alone can explain the existence of the MNC and its characteristics.

costs related to energy and pollution abatement needs. Moreover, because MNCs tend to be relatively R&D- and patent-intensive, and because technologies for clean energy and pollution control usually require relatively sophisticated technological inputs, it is logical to expect that MNCs are relatively efficient producers and consumers of goods and services that promote energy efficiency and pollution reduction. Evidence from Cole et al. (2006) suggests that Japanese firms with FDI tend to have better environmental performance (pollute less and manage emissions better) than firms without FDI is consistent with the notion that MNCs are both better able to and more highly motivated to pollute less than other firms.[3]

On the other hand, the fact that MNCs can move productive resources internationally clearly gives them the opportunity to locate polluting activities where related regulations tend to be relatively lax, and this might give them an incentive to be less energy efficient or pollute more than local firms. As indicated in the introduction, with some exceptions, the existing literature suggests that there is not much evidence supporting the pollution haven hypothesis that MNCs tend to locate in pollution-friendly areas. Although the volume is limited, a greater proportion of the existing literature comparing energy or pollution intensities in MNCs and local firms (again, see introduction) indicates that MNCs tend to be relatively energy efficient and pollute less than local counterparts.

Although the theoretical rationale for expecting MNCs to have relatively high productivity is

[3] Cole et al. (2006) also provide evidence that firms with trade are also more likely to have better environmental performance than firms without trade. Correspondingly, they emphasize that internationalized firms are more likely to have better environmental performance than others.

rather convincing, it is important to note that the empirical evidence on productivity differentials between foreign MNCs and local firms in developing economies (which are predominantly non-MNCs) is not as clear. For example, studies of productivity differentials between MNCs and non-MNCs in the manufacturing sectors of Malaysia (Oguchi et al 2002, Haji Ahmad 2010), Thailand (Ramstetter 2004, 2006), and Vietnam (Ramstetter and Phan 2008) suggest that differentials tended to be relatively small and were often statistically insignificant in Thailand and Vietnam. Other evidence from Malaysia (Menon 1998, Oguchi et al. 2002) indicates that the growth of total factor productivity (TFP) was often less rapid in MNCs than non-MNCs. Evidence from Indonesia suggests productivity differentials were somewhat larger, and always statistically significant in samples of all manufacturing plants combined (using industry dummies), but here again the differentials become statistically insignificant in a number of cases when plants are disaggregated by industry (allowing for differences in production function slopes, as well as the constant, Takii 2006). The only known evidence for China also suggests significant differences in both capital- and labor-productivity when all manufacturing firms are combined into one sample (Jefferson and Su 2006). Meanwhile, alternative evidence shows that takeovers of SOEs by MNCs have generated the larger productivity gains than takeovers by locally owned private companies in Eastern Europe (Brown et al., 2004, 2005), which suggests MNCs are best able to improve the productivity of their takeover targets.

2b. Are SOEs Likely to Pollute More or Less than Private Firms?

In contrast to the literature on the MNC, the literature on SOEs and privatization emphasizes that the lack of clearly defined property rights in SOEs leads SOE managers to have weaker incentives to pursue profit and efficiency than those in privately owned firms including MNCs.[4] Hence SOEs are often expected to be relatively inefficient compared to private firms. Moreover, governments have often established SOEs in imperfectly competitive or highly regulated industries, where the lack of competition further weakens the pressure to instill efficiency. Correspondingly, most of the empirical evidence seems consistent with the conclusion of Megginson and Netter's (2001, p. 380) survey that "Research now supports the proposition that privately owned firms are more efficient and more profitable than otherwise-comparable state-owned firms". However, these studies, as well as earlier surveys by Aharoni (2000) and Stretton and Orchard (1994) also highlight several cases in which SOE do not appear to be less profitable and/or less efficient than private firms.

The first question here is: do SOE-private productivity and profitability differentials have any implications for relative pollution levels? The model of Earnhart and Lizal (2006) suggests that the answer to this question might be yes because they hypothesize that relatively large profits can increase the availability of financial resources to mitigate or reduce pollution. On the other hand, Earnhart and Lizal (2006) also suggest that costs related to emissions are not always correlated with profitability (or productivity), but rather with the relative level of (largely bureaucratically

[4] See Stretton and Orchard (1994) and Meggison and Netter (2001) for surveys of the literature. See Jefferson (1998) for an application of the theory to issues raised by China's SOEs.

determined) emission and reduction costs in private and local firms. The second question is thus: are SOEs more or less motivated than private firms to deal with emissions and related abatement issues?

For example, in Vietnam, SOEs are clearly expected to be more responsive to public or government needs that private firms and the government has emphasized how SOEs should play leading roles in industry and that private firms should seek to cooperate with SOEs (Vu 2005, pp. 304-306). Thus, if the government puts a priority on low pollution and/or abatement of emissions, then it is reasonable to expect that SOEs might be more motivated to pollute less and abate more than private firms. However, it is difficult to argue convincingly that the Vietnamese government has put a high priority on pollution reduction or abatement in the last decade, for example, or that the government has emphasized energy efficiency or low pollution when operating its SOEs. Thus, if the SOEs in Vietnam pollute relatively little, it is probably more related to differences in technical characteristics of the firms and the fact that the Vietnamese government chooses to own SOEs that are often relatively sophisticated technologically compared to private firms. As in the comparison of MNCs and non-MNCs, the fact that one group possesses more technology-related assets than the other is the key, differentiating characteristic.

3. The Data and Some Descriptive Statistics

The data in this study used come from the firm-level detail underlying Vietnam's annual economic censuses (General Statistics Office various years a, b) and cover most all firms in Vietnam's manufacturing industries in the two years studied, 2002 and 2004. These years are

chosen primarily because they are the only years for which data on emissions and on technology-related activities were included. As indicated above, technology-related differences may be closely related to differences stemming from the characteristics of MNCs, SOEs, and private firms in Vietnam and this makes it important to try to distinguish from the influences of technological sophistication and ownership on emissions.. Unfortunately, technology-related data are only available for 2002, 2004, and 2007, while emissions' data are only available for the five years 2001-2002 and 2004-2006. Thus, 2002 and 2004 are the only intersections of these crucial variables that are available.

The Vietnamese data come in several different files for each year with varying coverage for each indicator and pollution indicators are included in the main data files so there are entries for all firms covered. However, many of these entries are non-responses, which have no entry in the database (see below for details). The technology indicators, which will be used as control variables below, come from smaller databases, implying large numbers of non-responses.[5] Finally, data on intermediate consumption, another important control variable in the model used below, comes from a separate data set on the major products of surveyed firms. The coverage of the data on intermediate consumption thus excludes some products included in total sales, but the coverage of the major product samples appears to have been very good.[6] In general, the quality of the data is pretty good, especially

[5] For example, the data files with technology indicators included only 18,522 firms in 2002 and 43,722 in 2004, compared to samples of 62,908 and 91,755, respectively, in the main data files (General Statistics Office various years b).

[6] For example, ratios of net sales of major products to total sales for all manufacturing firms were

considering Vietnam's level of development. However, they do have one severe problem: namely they contain increasing numbers of duplicate entries in more recent years. Duplicates arise because some firms report separately for branches in different regions, but are assigned the same firm code. For these firms, the dataset is not compiled at the firm level but at the branch level; thus new codes were assigned n-1 out of each set of n duplicates to insure the firm code remained unique for each firm or branch in the database (see Ramstetter and Phan 2007, Appendix A for details). Another less severe problem results from apparent inconsistencies in firm codes over time and high rates of entry and exit. Thus, panels based on these data quickly become highly unbalanced and may have important linkage problems that do not exist in the cross sections employed in this paper.

Because a number of firms do not report emissions, the estimates of total emissions in Table 1 are also of questionable reliability and one can reasonably question whether the data reflect the propensity of firms to report pollution more than their actual emissions. However, whichever interpretation one chooses, the data are of keen interest in the Vietnamese context. The most obvious problems are in estimates of solid waste in food products and basic metals in 2002; both of these industries contained one SOE reporting unusually high levels (several times larger than the sum of all other manufacturing firms combined in 2002; see Appendix Table 1c), but both of these firms did not exist in the 2004 data. Thus, these firms are excluded from the samples examining solid waste in the analysis below. Moreover, Table 1

1.0075 in 2002 and 1.0047 percent in 2004 (General Statistics Office various years b).

and the subsequent analysis includes only seven of the 27 manufacturing industries defined in Appendix Tables 1a-1c for gaseous waste, eight for gaseous waste, and 10 for solid waste, because it is meaningful to focus analysis on industries that cause the largest quantitative damage in each category when analyzing pollution. Excluded industries accounted for only 8 percent of liquid waste in both years, 5 and 20 percent of gaseous waste in 2002 and 2004, respectively, and 8 and 13 percent of solid waste, respectively.

After excluding these outliers from the solid waste data, the data in Table 1 suggest a small reduction in liquid waste between 2002 and 2004, but a 20 percent increase in gaseous emissions, and a 10 percent increase in solid waste. Although these aggregate estimates may not seem unreasonable, examination of similar growth rates in the major polluting industries reveal several unusually high or negative growth rates. For example, growth rates exceeded 100 percent for liquid waste in textiles and chemicals and there were correspondingly large decreases in beverages, basic metals, and general machinery where large polluters apparently did not report in one of the two years. For gaseous waste, there was similarly large growth in wood products and chemicals, and a slightly smaller decrease (-47 percent) in motor vehicles. Five of the 11 major polluting industries reported two-fold or larger increases of solid waste (textiles, plastics, non-metallic mineral products, basic metals, electric machinery), with correspondingly large decreases in beverages and other transportation equipment.

Table 1 also shows that SOEs were the largest creators of liquid and gaseous waste while MNCs were the largest source of solid waste. However, the industries involved were not

consistent. For example, in 2002 the largest emitters of liquid waste were SOEs in beverages and basic metals but in 2004 they were SOEs in textiles and chemicals. Data on gaseous waste are a bit more consistent, showing SOEs in non-metallic mineral products and food products to be the largest in both years, but they also show large SOE emissions in chemicals and textiles for 2004 that did not exist in 2002. Data on solid waste (excluding the two SOE outliers mentioned above) are more consistent showing MNCs in footwear to be the largest emitters. However, if one looks across the three pollution categories, three ownership groups, and three major polluters, these data suggest that there is a fairly clear pattern for SOEs to be the largest polluters in the Vietnam's industries with the largest emissions.[7]

In other words, SOEs are the largest of the major polluters, but are they the largest after sample and size characteristics are accounted for? As mentioned above, the reported amount of emissions is so inconsistent across years for some industry-ownership categories that it is only natural to ask whether the data are reflecting actual pollution levels or the propensity to report pollution. For example, I personally find the notion that SOEs are more likely to account for and report more emissions than other ownership categories in Vietnam to be plausible. However, I can only intuitively guess whether the proposition that SOEs tend to be both large emitters and more responsive reporters than others is actually true or not. On the other hand, I think MNCs have a clear motive to have a higher propensity to report emissions

[7] SOEs were the largest mean emitters of liquid waste in five of seven large polluting industries in 2002 and 2004, respectively. This was true for five of eight industries with large gaseous emissions. For solid emissions, SOE dominance was less prevalent, six of ten industries in 2002 and five in 2004 (Table 1).

(and other data) primarily because they are better able to keep relevant records. MNCs also recognize they are conspicuous and tend to cooperate with bureaucrats in order to avoid possible problems with regulators.

Consistent with this proposition, Table 2 indicates that MNCs tended to have the highest propensities to report all three types of pollution in both years. MNC propensities were highest for solid waste (27 industry means of 67 and 49 percent in 2002 and 2004, respectively) followed by liquid waste (53 and 43 percent, respectively) and lastly by gaseous waste (38 and 30 percent, respectively). SOEs also had higher propensities than private firms for liquid and solid waste but not for gaseous waste. Among the major polluting industries, MNCs had the highest propensities to report emissions in 17 of the 25 emission-industry combinations in 2002, but only 9 of 25 in 2004. By 2004, SOEs had the highest propensities to report for 4 of the 7 industries for liquid waste and 4 of 10 for solid waste, in addition to 1 of the 8 industries for gaseous waste. Interestingly, among firms reporting emissions SOEs tended to have higher proportions with positive emissions.

Although interesting, the data in Tables 1-2 don't adjust emissions for firm scale. To this end, emission propensities or ratios of emissions to sales are calculated and presented in Table 3, which shows which ownership groups have the highest mean tendency to pollute after controlling for industry affiliation and firm scale. If all 27 manufacturing industries are averaged, all three types of emissions were generally lowest in MNCs. Solid waste in 2004 was the sole exception, when SOEs were slightly more efficient by this measure. However,

among major polluting industries, the story is quite different. MNCs were the lowest emitters of liquid waste in all seven industries in 2002 but this number fell to four in 2004. MNCs were also the lowest emitters of solid waste in six of ten industries in 2002, but only three in 2004. And for gaseous waste, MNCs were the lowest emitters in only three of eight industries in 2002 and four in 2004. Thus, although there was a strong tendency for MNCs to have lower liquid emission propensities in 2002, these data do not suggest a strong tendency for MNCs to have lower gaseous or solid emission propensities.

4. Comparisons Accounting for Other Firm-Level Influences

The simple comparisons of mean pollution propensities above are an important first step toward understanding the relationship between ownership and emissions. However, it is also important to account for other known influences on pollution levels and to examine the statistical significance of differences among ownership groups in more rigorous detail. To this end, this section estimates a model similar to that in Eskeland and Harrison (2004, 16-18), who view the use of energy and electricity as an factor used in the production of output, and derives the relevant factor (pollution) demand (measured as the share of the factor's income in value added) as a function of the logs of other factor inputs (intermediate consumption, fixed assets, and labor) and factors thought to affect technological progress.

Pollution is not a production input in the same sense that energy is, but it is the other side of the coin, the result of using energy and other inputs. Thus, the product of pollution and its

shadow price (unknown) can be viewed as an input into production in a similar fashion, and its share in value added can be proxied with the emission propensities in Table 3. From this data set it is also possible to include a proxy for technological sophistication (the ratio of technical workers to all workers) and ownership distinctions, which are captured by including dummies for MNCs and SOEs (i.e., private firms are used as the reference group).[8]

The resulting model for a cross section of i=1…n firms is:

$$(EP)_i = a0 + a1\ln(M_i) + a2\ln(K_i) + a3\ln(L_i) + a4(ES_i) + a5(DS_i) + a6((DF_i) \quad (1)$$

where
DF=a dummy equal to 1 for MNCs, 0 otherwise
DS=a dummy equal to 1 for SOEs, 0 otherwise
EP=emission propensity or emissions per unit of sales
ES=share of technical workers in all workers at yearend
L=number of workers at yearend
K=fixed assets less depreciation at yearend
M=intermediate consumption for production of major products.

If the coefficient *a6* is positive and negative, for example, it would mean that MNCs had significantly lower emission propensities after accounting for the influences of other factors of production (and demands for their services) and the share of technical workers. Because all slope coefficients are likely to differ greatly across industries (reflecting the heterogeneity of pollution generation across industries), regressions for all major polluting industries are compared with regressions performed at the industry level. Because many firms report zero emission propensities, estimation of equation (1) accounts for the large number of zero values in the dependent variable in

[8] In addition to these factors Eskeland and Harrison (2004) also include vintage and machinery import variables, but they are not available from this data set.

two ways. First, probably the most reliable estimates come from one-sided Tobit estimates (e.g., emission propensities are only censored at their lowest value, 0) for all firms reporting emissions, including zero values.[9] Second, OLS estimates for samples of firms with positive emissions (emitters) provide an alternative perspective, but these estimates generally perform poorly and are more likely to be affected by sample selection bias.

Tables 4-6 show coefficients on dummy variables for SOEs and MNCs, which reveal the direction and significance of differences between emission propensities in these two ownership groups, respectively, and private firms (the control ownership group), as well as tests of the hypothesis that coefficients on SOEs and MNCs are equal. They also show the F-tests (OLS) or likelihood ratio, Chi-squared tests (tobit) of the hypothesis that all slopes are zero. A relative large number of the OLS regressions, in particular, cannot reject this crucial hypothesis at standard (5 percent) significance levels. Other results (e.g. dummy coefficients) from such equations are obviously of questionable reliability. All major regression results are reported in Appendix Tables 4-6.[10]

Another pattern emerging from all three tables is that the estimates for all polluting industries combined generally perform much better than the estimates by industry. Tobit estimates from these samples suggest that SOEs had higher emission propensities than private firms for all three types of pollution in both years, and that these differences were at least weakly significant at the 10 percent level or better. They also suggest that MNCs had relatively high liquid and solid emission

[9] One could greatly increase sample size by assuming all firms not reporting emissions had no emissions, but this assumption seems highly unrealistic and is avoided here.

[10] Coefficients on industry dummies were omitted to save space but are available from the author on request.

propensities in 2004 but no significant differences in 2002; the only (weakly) significant differences between MNCs and private firms for gaseous emission propensities in these large samples were observed in the OLS estimates for emitters in 2002, but not in 2004.

The Vietnamese results from large samples spanning many distinct polluting industries are thus similar to those presented in Eskeland and Harrison (2003). However, they also differ in three important respects. First, the emission propensities used as dependent variables here differ from emission shares of value added used by Eskeland and Harrison. In cross sections like these, emission propensities should be highly correlated with emission shares of value added so this is unlikely to be a very large difference, however. The second difference is that these results suggest a weak tendency for MNCs to have higher or the same emission propensities than local firms, whereas the results of Eskeland and Harrison suggested that MNC had relatively low propensities in the countries they studied (Coˆte d'Ivoire, Mexico, and Venezuela).

Third, Eskeland and Harrison (2003, 18) report they "redid the analysis limiting the sample to chemical firms" and that "the results were unaffected", but the results from a wider range of industries with large emissions in Tables 4-6 suggest some large differences between industry-level results and results combining all large polluting industries. Perhaps the most conspicuous difference is that the industry-level results suggest that significant differences among ownership groups are rarer at the industry level than estimates for all polluting industries combined. For example, focusing on the tobit estimates, which perform better in most cases, differences between SOEs and private firms were at least weakly significant in only three of seven industries for liquid emissions (both years),

four (2002) or three (2004) of eight cases for gaseous emissions and only two of 10 cases for solid emissions (both years). On the other hand, industry-level results suggest that MNCs had higher emission propensities than private firms for that were at least weakly significant for liquid and gaseous emission propensities in three of the seven or eight industries in 2004 but none in 2002, and for solid emission propensities in two of the ten industries in 2002, but none in 2004. In other words, not only are ownership-related differences in emission propensities rather inconsistent across industries, but they are also rather inconsistent across this short, two-year span.

Significant differences in liquid emission propensities between SOEs and MNCs on the one hand, and private firms on the other, were consistent over the two years in only one case, the difference between SOEs and private firms in paper products. For gaseous emissions, there is more consistency in the tobit estimates, which reveal significantly higher emission propensities in SOEs in food products, wood products, and non-metallic mineral products; MNCs also had significantly higher propensities in both years in chemicals. According to tobit estimates, MNCs also had solid emission propensities in both years in chemicals, but SOEs had significantly higher propensities in only one industry, food products. Some industry-level samples are relative small and small sample size is probably one reason for differences between results for industries combined and more disaggregate results in some cases, especially for smaller samples of emitters. However, industries are generally defined to result in sufficiently large samples (usually over 100) to generate relatively reliable results. And the large differences between many coefficients in industry-level equations and the pooled results suggest that pooling of industries is generally not justifiable.

In the final analysis, this exercise must also confront the uncomfortable reality that many Vietnamese firms are not likely to report emissions as part of the economic census, from which these data come. In other words, there is a large possibility that the regression results and data presented might reflect the propensities of firms to report emissions, rather than their actual propensities to emit. Indeed, the tendency for MNCs and especially SOEs to report relatively high emission propensities might be viewed as a result of their inclination to be better monitored and more motivated to report than private firms. However, even if this is the case, the analysis is still of some use as a first step to learning how ownership affects emissions in Vietnam.

5. Conclusion

This paper has examined emission propensities by industry for MNCs, SOEs, and private firms in Vietnam in 2002 and 2004. Simple descriptive statistics suggest that MNCs tended to have relatively low propensities in a few industries while SOEs tended to have relatively high ratios in a few more industries. More rigorous analysis then asked if these propensities differed among ownership groups after accounting for the influences of other factor demands and technology intensity. These results suggested SOEs tended to have relatively high emission propensities in a number of cases and that MNCs also had relatively high emission propensities in a few cases. However, in most industry-year combinations, it was difficult to find statistically significant differences in emission propensities among ownership groups.

What does this all mean? First of all, it should not be interpreted as a rationale for discriminating

among ownership groups when making environmental policy. SOEs and MNCs are concentrated in certain industries for political and technical reasons, and their technical characteristics may be a major cause of their weak tendency to have relatively high emissions in Vietnam. Rather environmental policy should seek to achieve environmental targets, regardless of ownership. Second, the weakness of the data (large number of non-reporters) is notable and has the potential to affect the interpretation of the results (i.e., the results may reflect factors that determine the tendency to report emissions rather than actual levels of emissions). Having substantial experience with this data set, I personally believe this to be a particularly important consideration, though I can offer not hard evidence to support this concern. Third, the scope of this paper is narrow and related extensions will be very important. For example, the data also include information on abatement that one could examine. One could also explore panel estimates, though panelization would result in smaller samples and can be very difficult for some firms (because firm codes are duplicated or change). Another important extension would be to examine data for more recent years. Pollution data exist for 2005-2006 but data on technology activities do not so these years have been excluded here. Using alternative analytical approaches, it should be possible to add such data and gain more understanding of the issues at hand.

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Table 1: Waste Emissions by Owner for High Pollution Industries (liquid and gaseous waste in million cubic meters, solid waste in thousand cubic meters)

Industry	2002				2004			
	Total	Private	SOEs	MNCs	Total	Private	SOEs	MNCs
Liquid waste, manufacturing	270	26	220	24	266	42	198	26
Food products	29	6	18	5	53	33	15	4
Beverages	75	1	71	2	7	2	3	2
Textiles	12	1	6	4	103	2	95	6
Paper products	19	2	17	0	16	2	13	1
Chemicals	25	13	11	1	64	0	64	1
Basic metals	78	0	75	2	3	0	1	2
General machinery	11	0	11	0	0	0	0	0
Other manufacturing	20	2	10	9	20	3	7	10
Gaseous waste, manufacturing	1,649	211	982	457	1,972	148	1,367	457
Food products	484	32	297	155	434	1	309	124
Textiles	76	29	21	26	149	3	143	3
Wood products	14	0	14	0	75	5	70	0
Paper products	82	60	23	0	81	46	35	0
Chemicals	117	10	56	51	342	1	292	49
Non-metallic mineral products	483	37	432	14	467	45	382	40
Basic metals	203	0	107	96	253	2	85	166
Motor vehicles	100	0	0	99	53	0	0	53
Other manufacturing	90	42	33	15	118	45	51	23
Solid waste, manufacturing	8,483	726	1,749	6,008	9,304	1,523	2,562	5,219
Food products	811	268	464	79	1,333	102	866	366
Beverages	692	3	672	17	219	21	163	35
Textiles	72	5	42	25	796	16	721	59
Footwear	5,020	22	8	4,991	2,958	15	1	2,942
Chemicals	219	11	143	65	178	11	103	65
Plastics	4	2	0	1	370	1	0	369
Non-metallic mineral products	272	70	199	3	1,412	1,223	169	21
Basic metals	88	11	62	16	514	4	496	14
Electrical machinery	332	1	2	329	1,044	0	1	1,042
Other transport equipment	284	241	17	27	129	0	11	117
Other manufacturing	689	94	141	454	350	130	31	189

Note: Samples exclude firms with non-positive employment or sales; outliers are excluded from the solid emissions data for SOEs in food products (1 firm) and basic metals (1 firm) in 2002.
Source: Vietnam, General Statistics Office (various years b)

Table 2: Propensitites to Report Emissions by Owner for High Pollution Industries (percent of all firms in each category)

	2002						2004					
	Private		SOEs		MNCs		Private		SOEs		MNCs	
Industry	>=0	>0	>=0	>0	>=0	>0	>=0	>0	>=0	>0	>=0	>0
Liquid waste, manufacturing	37	14	41	28	53	26	32	7	40	25	43	21
Food products	25	17	58	51	59	42	20	11	54	45	50	37
Beverages	53	43	74	70	74	68	28	16	59	55	58	52
Textiles	46	13	54	49	49	18	38	9	53	47	44	26
Paper products	63	31	63	56	58	28	53	22	48	41	37	20
Chemicals	56	21	49	38	68	58	46	10	56	45	50	41
Basic metals	33	17	43	33	52	32	24	13	38	25	48	38
General machinery	52	6	34	17	47	21	45	4	31	17	28	14
Gaseous waste, manufacturing	29	6	27	13	38	6	28	3	26	9	30	3
Food products	13	4	26	15	29	6	13	3	25	10	26	8
Textiles	37	2	28	18	42	5	34	1	25	14	31	4
Wood products	12	2	19	7	30	0	12	1	18	5	22	0
Paper products	40	5	16	9	40	5	41	7	17	10	25	3
Chemicals	47	8	40	24	29	11	41	3	44	27	22	7
Non-metallic mineral prod.	29	21	32	29	38	19	21	12	22	16	23	5
Basic metals	28	12	33	29	44	16	20	9	25	19	28	14
Motor vehicles	25	6	21	11	27	16	31	4	24	4	19	3
Liquid waste, manufacturing	49	27	54	42	67	40	37	12	41	26	49	27
Food products	35	27	47	38	51	31	20	10	38	25	37	20
Beverages	21	11	38	32	45	29	17	5	45	39	39	24
Textiles	48	16	57	46	67	32	38	6	39	29	45	20
Footwear	78	40	67	54	89	53	65	22	49	31	60	33
Chemicals	60	23	56	44	54	43	47	10	53	40	37	27
Plastics	74	26	76	56	62	34	58	10	38	19	53	29
Non-metallic mineral prod.	37	29	45	42	58	37	30	21	32	27	42	25
Basic metals	57	41	57	52	88	68	35	25	56	50	59	52
Electrical machinery	67	36	68	64	58	33	53	14	56	44	55	34
Other transport equipment	49	30	58	42	75	58	33	14	44	23	44	33

Note: Samples exclude firms with non-positive employment or sales; outliers are not exclud
Source: Vietnam, General Statistics Office (various years b)

Table 3: Emission Propensities by Owner for High Pollution Industries (liquid and gaseous waste in cubic meters/thousand dong, solid waste in cubic meters/dong)

	2002			2004		
Industry	Private	SOEs	MNCs	Private	SOEs	MNCs
Liquid waste, manufacturing	295	234	20	217	44	36
Food products	1,231	274	216	1,363	148	73
Beverages	1,654	4,690	8	2,894	57	6
Textiles	248	65	38	1,142	596	659
Paper products	136	148	86	152	126	10
Chemicals	161	36	19	32	136	38
Basic metals	32	53	5	7	6	5
General machinery	5	163	2	1	2	2
Gaseous waste, manufacturing	596	1,087	113	843	822	36
Food products	724	4,239	998	297	3,987	302
Textiles	402	27	150	1,169	911	36
Wood products	9	421	0	165	915	0
Paper products	1,277	120	51	318	400	0
Chemicals	100	615	1,381	8	1,814	59
Non-metallic mineral products	5,922	19,170	13	16,638	11,489	28
Basic metals	24	513	222	21	113	372
Motor vehicles	3	0	67	0	0	30
Solid waste, manufacturing	235.04	41.98	17.90	186.53	24.31	27.88
Food products	149.84	7.52	1.24	32.74	6.74	1.22
Beverages	4.22	17.86	0.05	2.19	7.04	0.06
Textiles	0.75	1.35	0.09	3.78	5.66	9.52
Footwear	0.69	0.21	5.79	0.63	0.03	2.33
Chemicals	3.59	0.57	0.52	1.41	0.28	0.40
Plastics	1.98	0.01	0.06	0.28	0.00	0.66
Non-metallic mineral products	21.37	12.62	0.43	44.23	1.80	0.28
Basic metals	0.59	0.09	0.06	0.48	2.39	2.90
Electrical machinery	0.18	0.01	0.45	0.04	0.01	1.06
Other transport equipment	14.45	0.51	0.70	0.19	0.06	0.24

Note: Samples exclude firms with non-positive employment or sales; estimates for solid waste exclude two SOE outliers in food products and basic metals for 2002.
Source: Vietnam, General Statistics Office (various years b)

Table 4: Liquid Emission Propensities in SOEs and MNCs Compared to Private Firms after Accounting for Other Factor Demands and Skill Intensity

	2002				2004			
	OLS estimates for emitters		Tobit estimates for all reporters		OLS estimates for emitters		Tobit estimates for all reporters	
Industry, Indicator	Coef-ficient	Sig. level	Coef-ficient	Sig. level	Coef-ficient	Sig. level	Coef-ficient	Sig. level
7 polluting industries	1,579 firms		2,510 firms		1,202 firms		2,397 firms	
DS_i	21.08	0.27	32.85	0.00	0.71	0.84	9.00	0.07
DF_i	4.89	0.31	11.58	0.21	-3.52	0.40	9.30	0.03
Test $DS_i=DF_i$	1.23	0.27	3.90	0.05	0.61	0.44	0.00	0.96
F-statistic/Chi-Sq.	1.67	0.03	267.05	0.00	1.20	0.24	284.11	0.00
Food products	591 firms		812 firms		437 firms		719 firms	
DS_i	2.93	0.01	3.91	0.01	-0.34	0.85	1.94	0.57
DF_i	2.23	0.11	2.22	0.18	-4.87	0.06	-0.86	0.79
Test $DS_i=DF_i$	0.16	0.69	0.87	0.35	3.31	0.07	0.50	0.48
F-statistic/Chi-Sq.	2.89	0.00	109.11	0.00	2.08	0.03	68.62	0.00
Beverages	443 firms		520 firms		222 firms		333 firms	
DS_i	79.36	0.31	112.89	0.01	6.28	0.07	18.47	0.90
DF_i	6.53	0.59	22.71	0.70	14.59	0.34	4.97	0.19
Test $DS_i=DF_i$	1.10	0.29	2.20	0.14	0.29	0.58	0.24	0.62
F-statistic/Chi-Sq.	0.55	0.77	27.67	0.00	1.98	0.01	26.68	0.00
Textiles	110 firms		274 firms		116 firms		304 firms	
DS_i	-3.15	0.34	0.84	0.75	-12.84	0.69	0.75	0.98
DF_i	-2.80	0.42	-2.48	0.28	22.71	0.17	36.56	0.12
Test $DS_i=DF_i$	0.06	0.80	1.44	0.23	0.87	0.35	1.47	0.23
F-statistic/Chi-Sq.	0.91	0.51	41.76	0.00	0.65	0.74	74.47	0.00
Paper products	172 firms		330 firms		181 firms		391 firms	
DS_i	7.70	0.10	8.82	0.00	10.78	0.10	8.96	0.00
DF_i	6.30	0.41	1.31	0.58	0.43	0.58	-0.84	0.56
Test $DS_i=DF_i$	0.04	0.85	6.01	0.01	2.94	0.09	23.83	0.00
F-statistic/Chi-Sq.	1.15	0.34	66.75	0.00	2.24	0.04	108.99	0.00
Chemicals	183 firms		323 firms		161 firms		367 firms	
DS_i	-2.15	0.44	-1.59	0.40	2.21	0.12	4.05	0.06
DF_i	-1.73	0.42	1.83	0.23	-0.26	0.81	5.06	0.00
Test $DS_i=DF_i$	0.30	0.59	2.51	0.11	1.30	0.26	0.21	0.65
F-statistic/Chi-Sq.	1.07	0.38	34.83	0.00	0.94	0.48	79.45	0.00

Table 4 (continued)

Industry, Indicator	2002				2004			
	OLS estimates for		Tobit estimates		OLS estimates for		Tobit estimates	
	Coef-ficient	Sig. level	Coef-ficient	Sig. level	Coef-ficient	Sig. level	Coef-ficient	Sig. level
Basic metals	43 firms		75 firms		49 firms		77 firms	
DS_i	1.64	0.80	3.01	0.49	0.92	0.21	0.63	0.32
DF_i	-6.52	0.22	-3.89	0.32	0.94	0.21	0.84	0.06
Test $DS_i=DF_i$	1.75	0.20	2.46	0.12	0.00	0.98	0.12	0.73
F-statistic/Chi-Sq.	0.72	0.67	23.09	0.00	0.96	0.48	14.06	0.08
General machinery	37 firms		176 firms		36 firms		206 firms	
DS_i	2.75	0.70	6.72	0.45	0.17	0.07	0.25	0.01
DF_i	-12.62	0.35	0.47	0.96	0.05	0.44	0.15	0.08
Test $DS_i=DF_i$	0.96	0.33	0.32	0.57	1.68	0.21	1.29	0.26
F-statistic/Chi-Sq.	0.15	1.00	42.85	0.00	1.91	0.10	51.80	0.00

Note: Samples exclude firms with non-positive employment, sales, intermediate consumption, and fixed assets..

Table 5: Gaseous Emission Propensities in SOEs and MNCs Compared to Private Firms after Accounting for Other Factor Demands and Skill Intensity

	2002				2004			
	OLS estimates for emitters		Tobit estimates for all reporters		OLS estimates for emitters		Tobit estimates for all reporters	
Industry	Coef-ficient	Sig. level	Coef-ficient	Sig. level	Coef-ficient	Sig. level	Coef-ficient	Sig. level
8 polluting industries	608 firms		1,661 firms		491 firms		1,840 firms	
DS_i	199.33	0.07	213.52	0.00	312.39	0.07	288.53	0.00
DF_i	102.09	0.10	3.47	0.94	70.62	0.33	36.71	0.52
Test $DS_i=DF_i$	2.23	0.14	16.07	0.00	4.81	0.03	14.67	0.00
F-statistic/Chi-Sq.	notcalc	notcalc	404.51	0.00	notcalc	notcalc	431.44	0.00
Food products	132 firms		393 firms		106 firms		425 firms	
DS_i	105.44	0.06	128.10	0.00	234.98	0.06	225.29	0.00
DF_i	66.68	0.19	-1.45	0.98	18.81	0.50	74.10	0.19
Test $DS_i=DF_i$	0.22	0.64	7.04	0.01	3.00	0.09	7.12	0.01
F-statistic/Chi-Sq.	1.59	0.13	122.42	0.00	1.14	0.30	108.86	0.00
Textiles	26 firms		212 firms		21 firms		243 firms	
DS_i	-	-	36.92	0.38	-	-	112.86	0.43
DF_i	-	-	-16.21	0.63	-	-	20.07	0.86
Test $DS_i=DF_i$	-	-	1.51	0.22	-	-	0.47	0.50
F-statistic/Chi-Sq.	-	-	32.32	0.00	-	-	51.26	0.00
Wood products	27 firms		122 firms		21 firms		156 firms	
DS_i	-	-	70.73	0.02	-	-	363.67	0.00
DF_i	-	-	-435.14	(1 firm)	-	-	-1,018	(1 firm)
Test $DS_i=DF_i$	-	-	266.79	0.00	-	-	164.61	0.00
F-statistic/Chi-Sq.	-	-	30.62	0.00	-	-	28.43	0.00
Paper products	30 firms		203 firms		55 firms		286 firms	
DS_i	-317.18	0.38	-10.82	0.94	109.82	0.30	83.20	0.01
DF_i	-129.82	0.45	-129.54	0.22	-10.67	0.52	-35.72	0.22
Test $DS_i=DF_i$	0.59	0.45	0.58	0.45	1.48	0.23	8.72	0.00
F-statistic/Chi-Sq.	0.30	0.93	14.22	0.03	0.66	0.68	63.77	0.00
Chemicals	63 firms		233 firms		50 firms		235 firms	
DS_i	34.24	0.21	44.47	0.26	97.81	0.05	144.82	0.00
DF_i	163.08	0.14	91.81	0.02	17.99	0.69	78.72	0.06
Test $DS_i=DF_i$	1.52	0.22	0.98	0.32	2.46	0.12	2.09	0.15
F-statistic/Chi-Sq.	notcalc	notcalc	34.16	0.00	0.96	0.47	64.77	0.00

Table 5 (continued)

Industry	2002				2004			
	OLS estimates for emitters		Tobit estimates for all firms		OLS estimates for emitters		Tobit estimates for all firms	
	Coef-ficient	Signifi-cance	Coef-ficient	Signifi-cance	Coef-ficient	Signifi-cance	Coef-ficient	Signifi-cance
Non-metallic min.pro	278 firms		374 firms		195 firms		310 firms	
DS_i	349.06	0.12	355.17	0.00	536.39	0.19	464.76	0.00
DF_i	88.57	0.46	4.03	0.98	112.10	0.52	-93.68	0.68
Test DS_i=DF_i	3.81	0.05	5.64	0.02	2.36	0.13	5.37	0.21
F-statistic/Chi-Sq.	1.35	0.23	54.85	0.00	4.70	0.00	61.48	0.00
Basic metals	31 firms		63 firms		32 firms		61 firms	
DS_i	101.17	0.38	82.17	0.17	51.77	0.00	18.24	0.58
DF_i	52.02	0.49	-41.29	0.43	101.01	0.09	49.78	0.03
Test DS_i=DF_i	0.16	0.69	4.30	0.04	0.77	0.39	0.95	0.33
F-statistic/Chi-Sq.	0.41	0.90	16.59	0.03	notcalc	notcalc	15.91	0.04
Motor vehicles	21 firms		61 firms		11 firms		74 firms	
DS_i	-	-	-18.73	0.03	-	-	-2.02	0.74
DF_i	-	-	-9.77	0.17	-	-	-1.90	0.68
Test DS_i=DF_i	-	-	1.62	0.21	-	-	0.00	0.98
F-statistic/Chi-Sq.	-	-	27.99	0.00	-	-	12.04	0.06

Note: Samples exclude firms with non-positive employment, sales, intermediate consumption, and fixed assets..

Table 6: Solid Emission Propensities in SOEs and MNCs Compared to Private Firms after Accounting for Other Factor Demands and Skill Intensity

	2002				2004			
	OLS estimates for emitters		Tobit estimates for all firms		OLS estimates for emitters		Tobit estimates for all firms	
Industry	Coef-ficient	Sig. level	Coef-ficient	Sig. level	Coef-ficient	Sig. level	Coef-ficient	Sig. level
10 polluting industrie	2,222 firms		3,469 firms		1,445 firms		3,084 firms	
DS_i	0.0810	0.18	0.1822	0.00	0.0211	0.72	0.1167	0.01
DF_i	0.0062	0.90	0.0538	0.19	0.0112	0.74	0.1357	0.00
Test $DS_i=DF_i$	1.86	0.17	7.08	0.01	0.02	0.88	0.14	0.71
F-statistic/Chi-Sq.	4.08	0.00	443.92	0.00	0.01	0.00	458.90	0.00
Food products	799 firms		1,042 firms		348 firms		659 firms	
DS_i	0.1265	0.03	0.2153	0.01	0.1530	0.07	0.1652	0.05
DF_i	0.0514	0.26	0.0549	0.52	-0.0363	0.34	0.0107	0.90
Test $DS_i=DF_i$	1.58	0.21	2.70	0.10	3.89	0.06	2.57	0.11
F-statistic/Chi-Sq.	8.74	0.00	204.89	0.00	1.78	0.07	112.59	0.00
Beverages	120 firms		204 firms		78 firms		198 firms	
DS_i	0.4484	0.30	0.6237	0.12	0.3357	0.37	0.4869	0.04
DF_i	-0.0705	0.67	-0.3129	0.60	-0.1796	0.32	0.0801	0.81
Test $DS_i=DF_i$	0.11	0.31	2.31	0.13	0.98	0.32	1.38	0.24
F-statistic/Chi-Sq.	0.42	0.86	32.32	0.00	0.21	0.97	36.39	0.00
Textiles	128 firms		301 firms		83 firms		299 firms	
DS_i	0.0403	0.55	0.0547	0.10	-0.3198	0.65	0.0329	0.93
DF_i	0.0060	0.70	0.0065	0.79	0.0828	0.64	0.4193	0.12
Test $DS_i=DF_i$	0.41	0.52	2.30	0.13	0.30	0.58	1.09	0.30
F-statistic/Chi-Sq.	0.44	0.88	33.26	0.00	0.39	0.92	60.87	0.00
Footwear	115 firms		198 firms		83 firms		187 firms	
DS_i	-0.0565	0.25	0.0255	0.79	-0.0506	0.15	0.0074	0.89
DF_i	0.0487	0.33	0.0471	0.56	0.0078	0.75	0.0432	0.25
Test $DS_i=DF_i$	1.47	0.23	0.04	0.84	1.92	0.19	0.46	0.50
F-statistic/Chi-Sq.	0.31	0.93	18.53	0.01	,75	0.61	26.69	0.00
Chemicals	172 firms		323 firms		136 firms		354 firms	
DS_i	0.0082	0.60	0.0271	0.24	-0.0137	0.22	-0.0025	0.90
DF_i	0.0166	0.47	0.0625	0.00	0.0080	0.52	0.0491	0.00
Test $DS_i=DF_i$	0.35	0.56	1.81	0.18	1.83	0.18	5.90	0.02
F-statistic/Chi-Sq.	1.07	0.39	36.13	0.00	0.90	0.51	62.47	0.00

Table 6 (continued)

Industry	2002				2004			
	OLS estimates for emitters		Tobit estimates for all firms		OLS estimates for emitters		Tobit estimates for all firms	
	Coef-ficient	Signifi-cance	Coef-ficient	Signifi-cance	Coef-ficient	Signifi-cance	Coef-ficient	Signifi-cance
Plastics	176 firms		445 firms		116 firms		491 firms	
DS_i	-0.0014	0.75	0.0339	0.07	-0.0236	0.33	0.0198	0.37
DF_i	-0.0076	0.42	0.0175	0.16	0.0025	0.50	0.0343	0.00
Test $DS_i=DF_i$	0.54	0.46	0.71	0.40	1.15	0.29	0.43	0.51
F-statistic/Chi-Sq.	0.73	0.62	36.97	0.00	0.70	0.65	39,94	0.00
Non-metallic min.pro	398 firms		494 firms		350 firms		459 firms	
DS_i	0.1270	0.32	0.1573	0.02	-0.2038	0.09	-0.2064	0.13
DF_i	0.0384	0.45	-0.0002	1.00	-0.1890	0.08	-0.2423	0.13
Test $DS_i=DF_i$	1.13	0.29	2.87	0.09	0.14	0.71	0.04	0.84
F-statistic/Chi-Sq.	2.54	0.01	37.30	0.00	2.07	0.05	33.25	0.00
Basic metals	94 firms		123 firms		89 firms		114 firms	
DS_i	-0.0049	0.00	-0.0008	0.93	0.1311	0.59	0.0886	0.59
DF_i	-0.0072	0.00	-0.0094	0.16	0.3235	0.24	0.2997	0.01
Test $DS_i=DF_i$	0.23	0.63	0.97	0.33	0.20	0.65	1.57	0.21
F-statistic/Chi-Sq.	1.52	0.16	5.22	0.73	0.76	0.64	25.07	0.00
Electrical machinery	88 firms		148 firms		74 firms		166 firms	
DS_i	-0.0121	0.13	-0.0107	0.34	-0.0388	0.35	-0.0197	0.64
DF_i	0.0071	0.13	-0.0012	0.89	0.0060	0.70	0.0072	0.80
Test $DS_i=DF_i$	3.43	0.07	0.68	0.41	0.97	0.33	0.48	0.49
F-statistic/Chi-Sq.	0.79	0.65	25.58	0.01	0.11	1.00	34.03	0.00
Other transport equip	132 firms		191 firms		88 firms		157 firms	
DS_i	-0.5954	0.33	-0.2749	0.37	-0.0114	0.35	-0.0073	0.22
DF_i	-0.7072	0.34	-0.4884	0.15	0.0056	0.40	0.0056	0.24
Test $DS_i=DF_i$	0.52	0.47	0.37	0.54	2.33	0.13	4.15	0.04
F-statistic/Chi-Sq.	0.14	1.00	6.42	0.60	0.96	0.48	19.00	0.01

Note: Samples exclude firms with non-positive employment, sales, intermediate consumption, and fixed assets. Estimates exclude two SOE outliers in food products and basic metals for 2002.

Appendix Table 1a: Liquid Waste Emissions for 27 Manufacturing Industries (million cubic meters)

Industry	2002				2004			
	Total	Private	SOEs	MNCs	Total	Private	SOEs	MNCs
Manufacturing	270	26	220	24	266	42	198	26
Food products	28.99	6.23	17.73	5.04	52.62	33.07	15.44	4.11
Beverages	74.58	1.33	70.97	2.28	6.79	2.14	2.78	1.88
Tobacco	0.35	0.00	0.35	0.00	0.62	0.00	0.62	0.00
Textiles	11.90	1.29	6.31	4.29	102.74	2.19	94.85	5.70
Apparel	1.66	0.15	0.17	1.33	2.03	0.36	0.24	1.42
Leather	0.36	0.25	0.02	0.09	0.16	0.00	0.02	0.14
Footwear	1.31	0.15	0.05	1.11	1.40	0.03	0.13	1.23
Wood products	0.08	0.02	0.04	0.02	0.23	0.06	0.07	0.11
Paper products	19.45	1.88	17.30	0.27	15.83	1.82	12.72	1.28
Publishing	0.09	0.00	0.09	0.00	0.05	0.00	0.05	0.00
Petroleum products	0.01	0.01	-	0.00	0.00	0.00	0.00	0.00
Chemicals	25.41	13.36	11.16	0.89	64.45	0.25	63.58	0.62
Rubber products	2.58	0.02	0.25	2.31	0.98	0.02	0.56	0.39
Plastics	0.34	0.02	0.02	0.30	0.68	0.07	0.05	0.56
Non-metallic mineral prod.	9.63	0.48	8.02	1.13	6.48	1.63	4.44	0.41
Basic metals	77.76	0.33	75.17	2.26	3.20	0.05	0.77	2.37
Fabricated metals	0.86	0.38	0.26	0.23	0.74	0.10	0.23	0.41
General machinery	11.49	0.02	11.39	0.08	0.23	0.02	0.13	0.09
Office & computing mach.	1.10	0.00	-	1.10	1.34	0.00	-	1.34
Electrical machinery	0.50	0.01	0.38	0.11	0.89	0.11	0.54	0.24
Radio, television & commun.	0.25	0.00	0.00	0.25	0.21	0.00	0.00	0.21
Precision machinery	0.08	0.02	0.00	0.06	0.11	0.05	0.00	0.06
Motor vehicles	0.29	0.02	0.07	0.20	1.27	0.01	0.02	1.25
Other transport equipment	0.49	0.00	0.20	0.29	2.27	0.03	0.38	1.86
Furniture	0.15	0.01	0.13	0.01	0.53	0.07	0.06	0.40
Miscellaneous manufacturing	0.18	0.01	0.00	0.17	0.09	0.01	0.00	0.09
Recycling	0.01	0.01	-	-	0.01	0.01	-	0.00

Note: Samples exclude firms with non-positive employment or sales; - = no firms in the category
Source: Vietnam, General Statistics Office (various years b)

Appendix Table 1b: Gaseous Waste Emissions for 27 Manufacturing Industries (million cubic meters)

Industry	2002				2004			
	Total	Private	SOEs	MNCs	Total	Private	SOEs	MNCs
Manufacturing	1,649	211	982	457	1,972	148	1,367	457
Food products	483.59	32.43	296.54	154.63	434.34	1.29	309.24	123.80
Beverages	18.92	7.99	5.82	5.11	21.64	0.09	21.05	0.50
Tobacco	0.26	0.00	0.26	0.00	1.86	0.00	1.86	0.00
Textiles	75.73	28.83	20.66	26.24	148.95	2.53	143.45	2.97
Apparel	1.90	0.01	1.87	0.02	1.08	0.00	1.08	0.00
Leather	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Footwear	8.16	0.01	0.03	8.12	8.77	0.01	0.76	8.00
Wood products	14.06	0.03	14.03	0.00	74.96	4.96	70.00	0.00
Paper products	82.29	59.52	22.60	0.17	81.19	46.02	35.17	0.00
Publishing	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00
Petroleum products	0.00	0.00	-	0.00	0.00	0.00	0.00	0.00
Chemicals	117.38	10.48	55.96	50.94	341.83	1.44	291.87	48.52
Rubber products	0.14	0.01	0.06	0.07	23.77	12.96	10.79	0.02
Plastics	2.86	0.05	2.79	0.01	12.75	0.10	0.00	12.64
Non-metallic mineral prod.	483.49	37.18	431.84	14.48	467.48	45.28	381.98	40.23
Basic metals	203.20	0.22	106.75	96.24	252.87	2.14	84.54	166.19
Fabricated metals	16.39	11.14	5.20	0.05	3.06	0.00	3.02	0.04
General machinery	0.03	0.00	0.03	0.00	0.14	0.12	0.00	0.01
Office & computing mach.	1.00	0.00	-	1.00	1.28	0.00	-	1.28
Electrical machinery	0.01	0.00	0.00	0.01	12.24	0.00	12.24	0.00
Radio, television & commun.	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.10
Precision machinery	0.01	0.01	0.00	0.00	0.01	0.01	0.00	0.00
Motor vehicles	99.66	0.18	0.02	99.46	52.53	0.02	0.00	52.50
Other transport equipment	7.46	0.00	7.33	0.13	0.34	0.33	0.01	0.00
Furniture	21.73	21.72	0.00	0.00	0.32	0.10	0.18	0.03
Miscellaneous manufacturing	0.91	0.90	0.00	0.01	30.98	30.95	0.00	0.03
Recycling	0.00	0.00	-	-	0.00	0.00	-	0.00

Note: Samples exclude firms with non-positive employment or sales; - = no firms in the category
Source: Vietnam, General Statistics Office (various years b)

Appendix Table 1c: Solid Waste Emissions for 27 Manufacturing Industries (thousand cubic meters)

Industry	2002				2004			
	Total	Private	SOEs	MNCs	Total	Private	SOEs	MNCs
Manufacturing	125,977	726	119,243	6,008	9,304	1,523	2,562	5,219
(excluding 2 SOE outliers 02	8,483	726	1,749	6,008	9,304	1,523	2,562	5,219
Food products	51,607	268	51,260	79	1,333	102	866	366
(excluding 1 SOE outlier 02)	811	268	464	79	1,333	102	866	366
Beverages	692	3	672	17	219	21	163	35
Tobacco	11	0	11	0	8	0	8	0
Textiles	72	5	42	25	796	16	721	59
Apparel	125	4	4	118	6	1	3	3
Leather	1	1	0	1	1	0	0	1
Footwear	5,020	22	8	4,991	2,958	15	1	2,942
Wood products	19	11	2	6	22	15	3	4
Paper products	155	30	97	28	37	27	10	0
Publishing	1	0	1	0	3	0	3	0
Petroleum products	0	0	-	0	0	0	0	0
Chemicals	219	11	143	65	178	11	103	65
Rubber products	3	0	2	1	5	0	2	3
Plastics	4	2	0	1	370	1	0	369
Non-metallic mineral prod.	272	70	199	3	1,412	1,223	169	21
Basic metals	66,787	11	66,760	16	514	4	496	14
(excluding 1 SOE outlier 02)	88	11	62	16	514	4	496	14
Fabricated metals	176	24	4	148	95	52	1	41
General machinery	9	0	8	1	114	2	1	111
Office & computing mach.	1	0	-	1	3	0	-	3
Electrical machinery	332	1	2	329	1,044	0	1	1,042
Radio, television & commun.	2	0	0	2	2	0	0	1
Precision machinery	0	0	0	0	0	0	0	0
Motor vehicles	152	1	12	139	8	0	0	8
Other transport equipment	284	241	17	27	129	0	11	117
Furniture	26	22	0	3	34	25	1	9
Miscellaneous manufacturing	7	1	0	6	11	8	0	3
Recycling	0	0	-	-	0	0	-	0

Note: Samples exclude firms with non-positive employment or sales; - = no firms in the category.
Source: Vietnam, General Statistics Office (various years b)

Appendix Table 2a: Percentages of Firms Reporting Liquid Waste Emissions for 27 Manufacturing Industries (percent)

	2002						2004					
	Private		SOEs		MNCs		Private		SOEs		MNCs	
Industry	>=0	>0	>=0	>0	>=0	>0	>=0	>0	>=0	>0	>=0	>0
Manufacturing	37	14	41	28	53	26	32	7	40	25	43	21
Food products	25	17	58	51	59	42	20	11	54	45	50	37
Beverages	53	43	74	70	74	68	28	16	59	55	58	52
Tobacco	0	0	44	28	0	0	17	0	50	44	0	0
Textiles	46	13	54	49	49	18	38	9	53	47	44	26
Apparel	61	3	20	11	60	10	57	2	21	7	53	14
Leather	79	12	80	40	61	13	65	2	71	14	47	4
Footwear	53	8	44	26	65	26	48	5	31	11	48	19
Wood products	13	4	18	5	41	17	13	3	26	13	37	18
Paper products	63	31	63	56	58	28	53	22	48	41	37	20
Publishing	49	9	47	10	40	7	43	1	45	7	54	11
Petroleum products	50	13	-	-	50	25	31	8	100	100	100	50
Chemicals	56	21	49	38	68	58	46	10	56	45	50	41
Rubber products	65	18	50	21	56	30	51	8	50	25	53	25
Plastics	59	6	40	24	46	18	53	4	38	24	42	15
Non-metallic mineral prod.	19	11	27	23	48	26	18	9	26	23	36	19
Basic metals	33	17	43	33	52	32	24	13	38	25	48	38
Fabricated metals	30	6	26	17	54	26	27	2	29	20	41	19
General machinery	52	6	34	17	47	21	45	4	31	17	28	14
Office & computing mach.	57	0	-	-	75	25	53	0	-	-	25	13
Electrical machinery	47	13	32	24	43	16	44	5	48	36	37	16
Radio, television & commun.	63	4	43	5	59	25	48	1	47	5	43	17
Precision machinery	45	13	0	0	48	17	49	5	0	0	46	15
Motor vehicles	36	18	25	14	43	32	36	10	32	12	33	20
Other transport equipment	27	8	30	13	46	27	23	4	32	12	30	17
Furniture	21	6	20	13	21	16	19	4	18	6	29	21
Miscellaneous manufacturing	50	9	33	0	54	17	46	4	0	0	41	13
Recycling	14	14	-	-	-	-	6	6	-	-	0	0

Note: Samples exclude firms with non-positive employment or sales.
Source: Vietnam, General Statistics Office (various years b)

Appendix Table 2b: Percentages of Firms Reporting Gaseous Waste Emissions for 27 Manufacturing Industries (percent)

	2002						2004					
	Private		SOEs		MNCs		Private		SOEs		MNCs	
Industry	>=0	>0	>=0	>0	>=0	>0	>=0	>0	>=0	>0	>=0	>0
Manufacturing	29	6	27	13	38	6	28	3	26	9	30	3
Food products	13	4	26	15	29	6	13	3	25	10	26	8
Beverages	22	11	20	16	32	16	14	1	25	16	30	9
Tobacco	0	0	33	11	0	0	17	0	25	19	0	0
Textiles	37	2	28	18	42	5	34	1	25	14	31	4
Apparel	59	0	13	4	54	1	56	0	16	2	43	1
Leather	70	0	60	0	55	3	64	1	71	14	43	2
Footwear	50	3	28	10	48	3	47	1	26	6	32	1
Wood products	12	2	19	7	30	0	12	1	18	5	22	0
Paper products	40	5	16	9	40	5	41	7	17	10	25	3
Publishing	42	1	38	2	33	0	42	0	39	1	43	0
Petroleum products	50	13	-	-	50	0	23	0	0	0	100	50
Chemicals	47	8	40	24	29	11	41	3	44	27	22	7
Rubber products	58	8	50	21	44	15	49	4	31	6	35	8
Plastics	59	6	28	8	35	2	52	2	29	0	32	1
Non-metallic mineral prod.	29	21	32	29	38	19	21	12	22	16	23	5
Basic metals	28	12	33	29	44	16	20	9	25	19	28	14
Fabricated metals	31	6	21	14	43	7	26	1	17	6	34	2
General machinery	48	1	23	6	42	9	42	1	16	2	20	3
Office & computing mach.	57	0	-	-	75	25	53	0	-	-	25	13
Electrical machinery	40	5	24	8	38	6	41	1	24	12	29	3
Radio, television & commun.	61	2	43	5	43	2	48	0	47	5	36	4
Precision machinery	35	3	0	0	35	0	49	2	0	0	35	4
Motor vehicles	25	6	21	11	27	16	31	4	24	4	19	3
Other transport equipment	21	3	22	4	24	7	19	0	23	3	13	1
Furniture	19	3	20	13	13	3	17	1	18	6	17	4
Miscellaneous manufacturing	47	3	33	0	45	6	43	1	0	0	33	3
Recycling	7	7	-	-	-	-	3	3	-	-	0	0

Note: Samples exclude firms with non-positive employment or sales.
Source: Vietnam, General Statistics Office (various years b)

Appendix Table 2c: Percentages of Firms Reporting Solid Waste Emissions for 27 Manufacturing Industries (percent)

	2002						2004					
	Private		SOEs		MNCs		Private		SOEs		MNCs	
Industry	>=0	>0	>=0	>0	>=0	>0	>=0	>0	>=0	>0	>=0	>0
Manufacturing	49	27	54	42	67	40	37	12	41	26	49	27
Food products	35	27	47	38	51	31	20	10	38	25	37	20
Beverages	21	11	38	32	45	29	17	5	45	39	39	24
Tobacco	25	25	72	67	0	0	33	17	50	44	33	33
Textiles	48	16	57	46	67	32	38	6	39	29	45	20
Apparel	72	19	45	37	79	34	62	7	37	23	59	21
Leather	82	14	80	60	84	29	69	7	86	29	62	19
Footwear	78	40	67	54	89	53	65	22	49	31	60	33
Wood products	38	29	42	33	74	56	25	15	33	21	48	31
Paper products	68	36	50	44	68	33	56	23	34	28	41	22
Publishing	62	22	68	32	47	20	47	5	48	13	54	11
Petroleum products	50	13	-	-	100	75	46	23	0	0	100	50
Chemicals	60	23	56	44	54	43	47	10	53	40	37	27
Rubber products	71	23	86	57	81	59	56	15	56	31	70	45
Plastics	74	26	76	56	62	34	58	10	38	19	53	29
Non-metallic mineral prod.	37	29	45	42	58	37	30	21	32	27	42	25
Basic metals	57	41	57	52	88	68	35	25	56	50	59	52
Fabricated metals	56	33	53	49	67	37	38	13	32	21	54	31
General machinery	63	21	66	53	70	42	50	10	33	22	38	24
Office & computing mach.	71	14	-	-	100	50	53	0	-	-	38	25
Electrical machinery	67	36	68	64	58	33	53	14	56	44	55	34
Radio, television & commun.	74	15	71	38	68	36	53	4	63	21	49	25
Precision machinery	71	39	43	43	74	43	54	7	17	17	54	27
Motor vehicles	47	28	46	36	64	57	42	15	32	12	49	38
Other transport equipment	49	30	58	42	75	58	33	14	44	23	44	33
Furniture	58	45	53	53	69	67	35	19	41	29	46	37
Miscellaneous manufacturing	63	20	67	33	72	38	52	10	0	0	49	20
Recycling	21	21	-	-	-	-	6	6	-	-	0	0

Note: Samples exclude firms with non-positive employment or sales.
Source: Vietnam, General Statistics Office (various years b)

Appendix Table 3a: Mean Ratios of Liquid Waste Emissions to Sales for 27 Manufacturing Industries (cubic meters per thousand dong)

Industry	2002			2004		
	Private	SOEs	MNCs	Private	SOEs	MNCs
Manufacturing (27 industry mean)	295	234	20	217	44	36
Food products	1,231	274	216	1,363	148	73
Beverages	1,654	4,690	8	2,894	57	6
Tobacco	0	1	0	0	1	0
Textiles	248	65	38	1,142	596	659
Apparel	12	9	34	19	1	80
Leather	4,137	1	3	3	1	2
Footwear	9	2	12	4	3	15
Wood products	7	1	8	14	2	8
Paper products	136	148	86	152	126	10
Publishing	7	6	0	30	2	0
Petroleum products	0	-	0	0	0	0
Chemicals	161	36	19	32	136	38
Rubber products	6	1	19	2	2	19
Plastics	89	0	2	8	1	11
Non-metallic mineral prod.	179	157	9	138	12	3
Basic metals	32	53	5	7	6	5
Fabricated metals	37	4	9	22	4	11
General machinery	5	163	2	1	2	2
Office & computing mach.	0	-	0	0	-	0
Electrical machinery	5	4	5	1	2	1
Radio, television & commun.	0	0	7	0	0	5
Precision machinery	1	0	1	0	0	1
Motor vehicles	5	1	12	2	0	16
Other transport equipment	1	3	6	2	4	5
Furniture	2	1	1	6	0	5
Miscellaneous manufacturing	10	0	14	3	0	6
Recycling	4	-	-	1	-	0

Note: Samples exclude firms with non-positive employment or sales.
Source: Vietnam, General Statistics Office (various years b)

Appendix Table 3b: Mean Ratios of Gaseous Waste Emissions to Sales for 27 Manufacturing Industries (cubic meters per thousand dong)

	2002			2004		
Industry	Private	SOEs	MNCs	Private	SOEs	MNCs
Manufacturing (27 industry mean)	596	1,087	113	843	822	36
Food products	724	4,239	998	297	3,987	302
Beverages	1,133	307	30	166	836	4
Tobacco	0	1	0	0	5	0
Textiles	402	27	150	1,169	911	36
Apparel	1	7	0	0	2	0
Leather	0	0	0	0	0	0
Footwear	0	1	11	0	5	11
Wood products	9	421	0	165	915	0
Paper products	1,277	120	51	318	400	0
Publishing	0	464	0	0	0	0
Petroleum products	0	-	0	0	0	0
Chemicals	100	615	1,381	8	1,814	59
Rubber products	5	1	3	3,322	11	2
Plastics	138	9	0	25	0	110
Non-metallic mineral prod.	5,922	19,170	13	16,638	11,489	28
Basic metals	24	513	222	21	113	372
Fabricated metals	628	86	6	0	24	3
General machinery	0	1	0	48	0	0
Office & computing mach.	0	0	0	0	0	0
Electrical machinery	1	0	0	0	32	0
Radio, television & commun.	1	-	0	0	-	0
Precision machinery	0	0	0	0	0	0
Motor vehicles	3	0	67	0	0	30
Other transport equipment	0	99	2	1	0	0
Furniture	5,682	0	0	3	1	1
Miscellaneous manufacturing	55	0	0	571	0	4
Recycling	0	-	-	1	-	0

Note: Samples exclude firms with non-positive employment or sales.
Source: Vietnam, General Statistics Office (various years b)

Appendix Table 3c: Mean Ratios of Solid Waste Emissions to Sales for 27 Manufacturing Industries (cubic meters per thousand dong, exluding 2 SOE outliers in 2002)

	2002			2004		
Industry	Private	SOEs	MNCs	Private	SOEs	MNCs
Manufacturing	235.037	41.983	17.903	186.529	24.305	27.878
Food products	149.835	7.515	1.243	32.738	6.741	1.219
Beverages	4.222	17.863	0.046	2.195	7.036	0.058
Tobacco	0.000	0.020	0.000	0.001	0.012	0.000
Textiles	0.748	1.352	0.094	3.777	5.665	9.518
Apparel	0.407	0.156	0.999	0.257	0.032	0.117
Leather	0.033	0.020	0.024	0.051	0.005	0.025
Footwear	0.693	0.212	5.790	0.626	0.028	2.330
Wood products	23.121	0.098	0.414	12.883	0.061	0.224
Paper products	3.394	0.363	0.316	5.804	0.083	0.041
Publishing	0.362	0.081	0.001	0.101	0.031	5.001
Petroleum products	0.000	0.000	0.007	0.186	0.000	0.000
Chemicals	3.595	0.573	0.517	1.407	0.282	0.398
Rubber products	0.144	0.015	0.033	0.101	0.005	0.060
Plastics	1.975	0.014	0.063	0.277	0.001	0.665
Non-metallic mineral prod.	21.369	12.624	0.427	44.231	1.801	0.280
Basic metals	0.593	0.094	0.064	0.482	2.393	2.901
Fabricated metals	3.104	0.081	4.984	8.621	0.024	1.829
General machinery	0.111	0.306	0.104	0.266	0.017	1.188
Office & computing mach.	0.000	0.000	0.000	0.000	0.000	0.001
Electrical machinery	0.182	0.013	0.449	0.044	0.011	1.056
Radio, television & commun.	0.061	0.001	0.077	0.006	0.001	0.016
Precision machinery	0.136	0.002	0.007	0.007	0.000	0.047
Motor vehicles	0.183	0.031	0.917	0.079	0.002	0.062
Other transport equipment	14.454	0.512	0.705	0.195	0.062	0.236
Furniture	5.096	0.037	0.201	2.897	0.014	0.439
Miscellaneous manufacturing	1.166	0.000	0.422	69.274	0.000	0.165
Recycling	0.053	0.000	0.000	0.025	0.000	0.000

Note: Samples exclude firms with non-positive employment or sales.
Source: Vietnam, General Statistics Office (various years b)

Appendix Table 4: Determinants of Liquid Emission Propensities (Dependent variable = cubic meters of emissions per 1,000 dong, OLS estimates with Heteroskedastic consistent standard errors and Tobit estimates)

	2002				2004			
	OLS estimates for emitters		Tobit estimates for all reporters		OLS estimates for emitters		Tobit estimates for all reporters	
Industry	Coef-ficient	Sig. level	Coef-ficient	Sig. level	Coef-ficient	Sig. level	Coef-ficient	Sig. level
7 High Emission Industries (with 3-digit VSIC industry [intercept] dummies)								
$\ln(M_i)$	-2.28	0.02	-8.54	0.00	-3.65	0.07	-5.72	0.00
$\ln(K_i)$	0.37	0.43	9.11	0.00	2.12	0.09	7.32	0.00
$\ln(L_i)$	2.54	0.23	8.62	0.01	-0.17	0.94	5.47	0.00
ES_i	-0.10	0.08	-0.89	0.00	0.36	0.44	-0.30	0.00
DS_i	21.08	0.27	32.85	0.00	0.71	0.84	9.00	0.07
DF_i	4.89	0.31	11.58	0.21	-3.52	0.40	9.30	0.03
Constant	4.74	0.07	-47.20	0.00	20.63	0.03	-43.00	0.00
Sigma	-	-	112.94	-	-	-	54.69	-
Test DS_i=DF_i	1.23	0.27	3.90	0.05	0.61	0.44	0.00	0.96
F-statistic/Chi-Sq.	1.67	0.03	267.05	0.00	1.20	0.24	284.11	0.00
R^2 or Pseudo R^2	0.01	-	0.01	-	0.04	-	0.02	-
No. of observations	1,579	-	2,510	-	1,202	-	2,397	-
Food products (with 3-digit VSIC industry [intercept] dummies)								
$\ln(M_i)$	-1.51	0.00	-2.25	0.00	-1.86	0.19	-3.40	0.00
$\ln(K_i)$	0.33	0.19	0.97	0.00	2.00	0.06	3.76	0.00
$\ln(L_i)$	0.69	0.08	1.41	0.01	-1.13	0.51	1.67	0.20
ES_i	-0.07	0.02	-0.19	0.00	0.01	0.93	-0.28	0.00
DS_i	2.93	0.01	3.91	0.01	-0.34	0.85	1.94	0.57
DF_i	2.23	0.11	2.22	0.18	-4.87	0.06	-0.86	0.79
Constant	9.50	0.00	6.82	11.22	0.08	0.04	-7.66	0.15
Sigma	-	-	11.96	-	-	-	25.02	-
Test DS_i=DF_i	0.16	0.69	0.87	0.35	3.31	0.07	0.50	0.48
F-statistic/Chi-Sq.	2.89	0.00	109.11	0.00	2.08	0.03	68.62	0.00
R^2 or Pseudo R^2	0.06	-	0.02	-	0.03	-	0.02	-
No. of observations	591	-	812	-	437	-	719	-

Appendix Table 4 (continued)

Industry	2002				2004			
	OLS estimates for emitters		Tobit estimates for all firms		OLS estimates for emitters		Tobit estimates for all firms	
	Coef-ficient	Sig. level	Coef-ficient	Sig. level	Coef-ficient	Sig. level	Coef-ficient	Sig. level
Beverages (3 digit category, no VSIC dummies)								
$\ln(M_i)$	-4.08	0.22	-8.86	0.34	-3.22	0.63	1.65	0.30
$\ln(K_i)$	2.42	0.26	26.39	0.01	-0.65	0.76	12.12	2.47
$\ln(L_i)$	6.79	0.39	-12.37	0.42	-2.58	0.72	-14.35	-1.79
ES_i	-0.71	0.31	-2.47	0.00	-0.36	0.12	-1.38	-3.60
DS_i	79.36	0.31	112.89	0.01	6.28	0.07	18.47	0.90
DF_i	6.53	0.59	22.71	0.70	14.59	0.34	4.97	0.19
Constant	1.41	0.89	-93.50	0.06	51.81	0.18	-55.21	-2.29
Sigma	-	-	210.99	-	-	-	83.86	-
Test $DS_i=DF_i$	1.10	0.29	2.20	0.14	0.29	0.58	0.24	0.62
F-statistic/Chi-Sq.	0.55	0.77	27.67	0.00	1.98	0.01	26.68	0.00
R^2 or Pseudo R^2	0.02	-	0.00	-	0.02	-	0.01	-
No. of observations	443	-	520	-	222	-	333	-
Textiles (with 3-digit VSIC industry [intercept] dummies)								
$\ln(M_i)$	-2.22	0.11	-1.05	0.12	-35.36	0.08	-27.35	0.00
$\ln(K_i)$	1.83	0.13	0.58	0.32	10.52	0.35	10.02	0.18
$\ln(L_i)$	0.34	0.71	2.43	0.02	36.20	0.09	56.39	0.00
ES_i	-0.10	0.37	-0.12	0.18	4.40	0.15	2.90	0.00
DS_i	-3.15	0.34	0.84	0.75	-12.84	0.69	0.75	0.98
DF_i	-2.80	0.42	-2.48	0.28	22.71	0.17	36.56	0.12
Constant	8.33	0.09	-8.26	0.03	41.64	0.33	-191.58	0.00
Sigma	-	-	10.00	-	-	-	111.84	-
Test $DS_i=DF_i$	0.06	0.80	1.44	0.23	0.87	0.35	1.47	0.23
F-statistic/Chi-Sq.	0.91	0.51	41.76	0.00	0.65	0.74	74.47	0.00
R^2 or Pseudo R^2	0.12	-	0.04	-	0.29	-	0.05	-
No. of observations	110	-	274	-	116	-	304	-

Appendix Table 4 (continued)

Industry	2002				2004			
	OLS estimates for emitters		Tobit estimates for all firms		OLS estimates for emitters		Tobit estimates for all firms	
	Coef-ficient	Sig. level	Coef-ficient	Sig. level	Coef-ficient	Sig. level	Coef-ficient	Sig. level
Paper products (3 digit category, no VSIC dummies)								
$\ln(M_i)$	-1.07	0.07	-2.98	0.00	-0.46	0.06	-1.49	0.00
$\ln(K_i)$	0.78	0.37	2.07	0.00	-0.09	0.71	1.12	0.00
$\ln(L_i)$	0.40	0.79	1.99	0.04	0.70	0.04	1.66	0.00
ES_i	-0.02	0.55	-0.11	0.07	-0.02	0.35	-0.11	0.00
DS_i	7.70	0.10	8.82	0.00	10.78	0.10	8.96	0.00
DF_i	6.30	0.41	1.31	0.58	0.43	0.58	-0.84	0.56
Constant	2.40	0.45	-0.97	0.78	2.76	0.30	-3.81	0.06
Sigma	-	-	8.86	-	-	-	5.33	-
Test $DS_i=DF_i$	0.04	0.85	6.01	0.01	2.94	0.09	23.83	0.00
F-statistic/Chi-Sq.	1.15	0.34	66.75	0.00	2.24	0.04	108.99	0.00
R^2 or Pseudo R^2	0.10	-	0.05	-	0.21	-	0.08	-
No. of observations	172	-	330	-	181	-	391	-
Chemicals (with 3-digit VSIC industry [intercept] dummies)								
$\ln(M_i)$	-0.27	0.36	-0.78	0.16	-0.86	0.17	-0.67	0.24
$\ln(K_i)$	0.15	0.57	0.64	0.14	0.92	0.33	0.72	0.14
$\ln(L_i)$	0.74	0.09	2.10	0.02	0.57	0.47	2.13	0.02
ES_i	-0.02	0.29	-0.00	1.00	0.00	0.79	0.00	0.89
DS_i	-2.15	0.44	-1.59	0.40	2.21	0.12	4.05	0.06
DF_i	-1.73	0.42	1.83	0.23	-0.26	0.81	5.06	0.00
Constant	0.45	0.89	-8.06	0.00	2.19	0.25	-12.09	0.00
Sigma	-	-	8.18	-	-	-	8.98	-
Test $DS_i=DF_i$	0.30	0.59	2.51	0.11	1.30	0.26	0.21	0.65
F-statistic/Chi-Sq.	1.07	0.38	34.83	0.00	0.94	0.48	79.45	0.00
R^2 or Pseudo R^2	0.02	-	0.02	-	0.07	-	0.06	-
No. of observations	183	-	323	-	161	-	367	-

Appendix Table 4 (continued)

Industry	2002				2004			
	OLS estimates for emitters		Tobit estimates for all firms		OLS estimates for emitters		Tobit estimates for all firms	
	Coef-ficient	Sig. level	Coef-ficient	Sig. level	Coef-ficient	Sig. level	Coef-ficient	Sig. level
Basic metals (with 3-digit VSIC industry [intercept] dummies)								
$\ln(M_i)$	-0.33	0.80	0.10	0.93	-0.08	0.31	0.03	0.78
$\ln(K_i)$	1.22	0.37	1.05	0.27	-0.05	0.64	-0.13	0.30
$\ln(L_i)$	4.09	0.23	1.89	0.27	-0.00	0.99	0.12	0.49
ES_i	-0.12	0.20	-0.09	0.27	-0.00	0.46	-0.01	0.23
DS_i	1.64	0.80	3.01	0.49	0.92	0.21	0.63	0.32
DF_i	-6.52	0.22	-3.89	0.32	0.94	0.21	0.84	0.06
Constant	-18.25	0.06	-15.91	0.02	1.36	0.04	0.22	0.76
Sigma	-	-	7.06	-	-	-	0.90	-
Test $DS_i=DF_i$	1.75	0.20	2.46	0.12	0.00	0.98	0.12	0.73
F-statistic/Chi-Sq.	0.72	0.67	23.09	0.00	0.96	0.48	14.06	0.08
R^2 or Pseudo R^2	0.51	-	0.07	-	0.21	-	0.08	-
No. of observations	43	-	75	-	49	-	77	-
General machinery (with 3-digit VSIC industry [intercept] dummies)								
$\ln(M_i)$	-3.77	0.35	-1.29	0.72	-0.03	0.30	-0.02	0.55
$\ln(K_i)$	4.91	0.34	4.88	0.04	0.04	0.07	0.06	0.01
$\ln(L_i)$	6.25	0.37	8.49	0.11	-0.02	0.70	-0.00	0.99
ES_i	0.11	0.48	0.09	0.63	0.00	0.08	-0.00	0.52
DS_i	2.75	0.70	6.72	0.45	0.17	0.07	0.25	0.01
DF_i	-12.62	0.35	0.47	0.96	0.05	0.44	0.15	0.08
Constant	-25.38	0.42	0.76	0.00	0.12	0.32	-0.51	0.00
Sigma	-	-	24.04	-	-	-	0.23	-
Test $DS_i=DF_i$	0.96	0.33	0.32	0.57	1.68	0.21	1.29	0.26
F-statistic/Chi-Sq.	0.15	1.00	42.85	0.00	1.91	0.10	51.80	0.00
R^2 or Pseudo R^2	0.21	-	0.10	-	0.39	-	0.40	-
No. of observations	37	-	176	-	36	-	206	-

Note: Samples exclude firms with non-positive employment, sales, intermediate consumption, and fixed assets..

Appendix Table 5: Determinants of Gaseous Emission Propensities (Dependent variable = cubic meters of emissions per 1,000 dong, OLS estimates with Heteroskedastic consistent standard errors and Tobit estimates)

	2002				2004			
	OLS estimates for emitters		Tobit estimates for all reporters		OLS estimates for emitters		Tobit estimates for all reporters	
Industry	Coef-ficient	Sig. level	Coef-ficient	Sig. level	Coef-ficient	Sig. level	Coef-ficient	Sig. level
8 High Emission Industries (with 3-digit VSIC industry [intercept] dummies)								
$\ln(M_i)$	-25.34	0.06	-52.37	0.00	-9.29	0.51	-61.13	0.00
$\ln(K_i)$	5.32	0.61	33.10	0.00	-0.61	0.94	55.77	0.00
$\ln(L_i)$	24.04	0.25	65.68	0.00	-28.21	0.00	47.64	0.03
ES_i	0.49	0.31	-3.59	0.00	1.58	0.47	-7.86	0.00
DS_i	199.33	0.07	213.52	0.00	312.39	0.07	288.53	0.00
DF_i	102.09	0.10	3.47	0.94	70.62	0.33	36.71	0.52
Constant	29.16	0.68	-541.11	0.00	114.86	0.03	-709.25	0.00
Sigma	-	-	379.12	-	-	-	443.27	-
Test $DS_i=DF_i$	2.23	0.14	16.07	0.00	4.81	0.03	14.67	0.00
F-statistic/Chi-Sq.	notcalc	notcalc	404.51	0.00	nc	nc	431.44	0.00
R^2 or Pseudo R^2	0.05	-	0.04	-	0.06	-	0.05	-
No. of observations	608	-	1,661	-	491	-	1,840	-
Food Products (with 3-digit VSIC industry [intercept] dummies)								
$\ln(M_i)$	-7.64	0.38	-46.57	0.00	-2.34	0.73	-28.87	0.03
$\ln(K_i)$	10.36	0.24	37.92	0.00	-5.64	0.39	25.57	0.05
$\ln(L_i)$	-2.16	0.76	31.39	0.07	10.29	0.42	31.64	0.15
ES_i	-0.21	0.83	-5.06	0.00	0.23	0.77	-6.38	0.00
DS_i	105.44	0.06	128.10	0.00	234.98	0.06	225.29	0.00
DF_i	66.68	0.19	-1.45	0.98	18.81	0.50	74.10	0.19
Constant	-11.52	0.78	-206.13	0.00	-87.01	0.15	-394.89	0.00
Sigma	-	-	176.31	-	-	-	211.32	-
Test $DS_i=DF_i$	0.22	0.64	7.04	0.01	3.00	0.09	7.12	0.01
F-statistic/Chi-Sq.	1.59	0.13	122.42	0.00	1.14	0.30	108.86	0.00
R^2 or Pseudo R^2	0.13	-	0.06	-	0.34	-	0.06	-
No. of observations	132	-	393	-	106	-	425	-

Appendix Table 5 (continued)

Industry	2002				2004			
	OLS estimates for emitters		Tobit estimates for all reporters		OLS estimates for emitters		Tobit estimates for all reporters	
	Coef-ficient	Signifi-cance	Coef-ficient	Signifi-cance	Coef-ficient	Signifi-cance	Coef-ficient	Signifi-cance
Textiles (with 3-digit VSIC industry [intercept] dummies)								
$\ln(M_i)$	-	-	24.63	0.10	-	-	-6.17	0.89
$\ln(K_i)$	-	-	3.51	0.72	-	-	15.00	0.68
$\ln(L_i)$	-	-	-6.22	0.72	-	-	107.00	0.07
ES_i	-	-	-1.87	0.28	-	-	9.67	0.00
DS_i	-	-	36.92	0.38	-	-	112.86	0.43
DF_i	-	-	-16.21	0.63	-	-	20.07	0.86
Constant	-	-	-331.94	0.00	-	-	-1,093	0.00
Sigma	-	-	90.36	-	-	-	272.85	-
Test $DS_i=DF_i$	-	-	1.51	0.22	-	-	0.47	0.50
F-statistic/Chi-Sq.	-	-	32.32	0.00	-	-	51.26	0.00
R^2 or Pseudo R^2	-	-	0.08	-	-	-	0.13	-
No. of observations	26	-	212	-	21	-	243	-
Wood Products (with 3-digit VSIC industry [intercept] dummies)								
$\ln(M_i)$	-	-	8.19	0.34	-	-	-31.84	0.28
$\ln(K_i)$	-	-	7.99	0.22	-	-	48.62	0.02
$\ln(L_i)$	-	-	-0.44	0.97	-	-	7.48	0.80
ES_i	-	-	-5.95	0.01	-	-	-7.57	0.20
DS_i	-	-	70.73	0.02	-	-	363.67	0.00
DF_i	-	-	-435.14	(1 firm)	-	-	-1,018	(1 firm)
Constant	-	-	-186.21	0.01	-	-	-607.67	0.01
Sigma	-	-	71.02	-	-	-	28.43	-
Test $DS_i=DF_i$	-	-	266.79	0.00	-	-	164.61	0.00
F-statistic/Chi-Sq.	-	-	30.62	0.00	-	-	28.43	0.00
R^2 or Pseudo R^2	-	-	0.08	-	-	-	0.08	-
No. of observations	27	-	122	-	21	-	156	-

Appendix Table 5 (continued)

Industry	2002				2004			
	OLS estimates for emitters		Tobit estimates for all reporters		OLS estimates for emitters		Tobit estimates for all reporters	
	Coef-ficient	Signifi-cance	Coef-ficient	Signifi-cance	Coef-ficient	Signifi-cance	Coef-ficient	Signifi-cance
Paper Products (3 digit category, no VSIC dummies)								
$\ln(M_i)$	-8.46	0.82	-42.59	0.15	12.49	0.24	-15.09	0.03
$\ln(K_i)$	7.52	0.73	39.02	0.08	0.21	0.94	24.83	0.00
$\ln(L_i)$	80.02	0.32	53.74	0.16	-11.73	0.36	2.10	0.85
ES_i	-1.32	0.70	-1.62	0.55	0.94	0.35	-2.47	0.01
DS_i	-317.18	0.38	-10.82	0.94	109.82	0.30	83.20	0.01
DF_i	-129.82	0.45	-129.54	0.22	-10.67	0.52	-35.72	0.22
Constant	-215.33	0.52	-344.58	0.04	-58.57	0.47	-119.75	0.00
Sigma	-	-	213.78	-	-	-	61.28	-
Test DS_i=DF_i	0.59	0.45	0.58	0.45	1.48	0.23	8.72	0.00
F-statistic/Chi-Sq.	0.30	0.93	14.22	0.03	0.66	0.68	63.77	0.00
R^2 or Pseudo R^2	0.19	-	0.03	-	0.26	-	0.08	-
No. of observations	30	-	203	-	55	-	286	-
Chemicals (with 3-digit VSIC industry [intercept] dummies)								
$\ln(M_i)$	-17.90	0.25	-12.93	0.24	7.16	0.69	7.48	0.55
$\ln(K_i)$	-1.41	0.81	9.08	0.36	-6.44	0.55	-2.84	0.78
$\ln(L_i)$	22.64	0.22	27.98	0.12	-6.95	0.82	13.06	0.50
ES_i	-0.94	0.36	-0.39	0.62	-0.54	0.35	-0.99	0.26
DS_i	34.24	0.21	44.47	0.26	97.81	0.05	144.82	0.00
DF_i	163.08	0.14	91.81	0.02	17.99	0.69	78.72	0.06
Constant	69.60	0.34	-144.88	0.02	29.72	0.76	-211.35	0.00
Sigma	-	-	132.30	-	-	-	129.31	-
Test DS_i=DF_i	1.52	0.22	0.98	0.32	2.46	0.12	2.09	0.15
F-statistic/Chi-Sq.	notcalc	notcalc	34.16	0.00	0.96	0.47	64.77	0.00
R^2 or Pseudo R^2	0.16	-	0.04	-	0.13	-	0.08	-
No. of observations	63	-	233	-	50	-	235	-

Appendix Table 5 (continued)

Industry	2002				2004			
	OLS estimates for emitters		Tobit estimates for all reporters		OLS estimates for emitters		Tobit estimates for all reporters	
	Coef-ficient	Signifi-cance	Coef-ficient	Signifi-cance	Coef-ficient	Signifi-cance	Coef-ficient	Signifi-cance
Non-metallic mineral products (with 3-digit VSIC industry [intercept] dummies)								
$\ln(M_i)$	-98.21	0.06	-137.42	0.00	-37.62	0.56	-107.70	0.05
$\ln(K_i)$	11.59	0.59	31.59	0.19	17.49	0.53	50.63	0.22
$\ln(L_i)$	122.93	0.11	176.84	0.00	-45.69	0.27	72.64	0.33
ES_i	3.18	0.12	-1.46	0.62	-8.48	0.32	-30.74	0.00
DS_i	349.06	0.12	355.17	0.00	536.39	0.19	464.76	0.00
DF_i	88.57	0.46	4.03	0.98	112.10	0.52	-93.68	0.68
Constant	63.70	0.68	-201.28	0.27	540.33	0.06	-383.94	0.20
Sigma	-	-	522.28	-	-	-	655.21	-
Test $DS_i=DF_i$	3.81	0.05	5.64	0.02	2.36	0.13	5.37	0.21
F-statistic/Chi-Sq.	1.35	0.23	54.85	0.00	4.70	0.00	61.48	0.00
R^2 or Pseudo R^2	0.08	-	0.01	-	0.05	-	0.02	-
No. of observations	278	-	374	-	195	-	310	-
Basic metals (with 3-digit VSIC industry [intercept] dummies)								
$\ln(M_i)$	2.95	0.86	20.44	0.15	0.77	0.92	8.92	0.16
$\ln(K_i)$	2.73	0.83	3.73	0.74	-1.82	0.89	-8.18	0.27
$\ln(L_i)$	-15.11	0.52	-17.87	0.41	-3.31	0.52	8.03	0.37
ES_i	0.16	0.87	-0.90	0.48	0.12	0.90	-0.58	0.33
DS_i	101.17	0.38	82.17	0.17	51.77	0.00	18.24	0.58
DF_i	52.02	0.49	-41.29	0.43	101.01	0.09	49.78	0.03
Constant	1.05	0.99	-172.63	0.04	17.76	0.31	-64.30	0.10
Sigma	-	-	84.33	-	-	-	42.57	-
Test $DS_i=DF_i$	0.16	0.69	4.30	0.04	0.77	0.39	0.95	0.33
F-statistic/Chi-Sq.	0.41	0.90	16.59	0.03	notcalc	notcalc	15.91	0.04
R^2 or Pseudo R^2	0.23	-	0.04	-	0.45	-	0.04	-
No. of observations	31	-	63	-	32	-	61	-

Appendix Table 5 (continued)

Industry	2002				2004			
	OLS estimates for		Tobit estimates		OLS estimates for		Tobit estimates	
	Coef-ficient	Signifi-cance	Coef-ficient	Signifi-cance	Coef-ficient	Signifi-cance	Coef-ficient	Signifi-cance
Motor vehicles								
$\ln(M_i)$	-	-	-0.21	0.92	-	-	2.05	0.17
$\ln(K_i)$	-	-	1.41	0.33	-	-	1.08	0.29
$\ln(L_i)$	-	-	3.89	0.24	-	-	-2.54	0.36
ES_i	-	-	0.42	0.00	-	-	-0.24	0.13
DS_i	-	-	-18.73	0.03	-	-	-2.02	0.74
DF_i	-	-	-9.77	0.17	-	-	-1.90	0.68
Constant	-	-	-33.56	0.01	-	-	-19.85	0.00
Sigma	-	-	9.66	-	-	-	6.72	-
Test $DS_i=DF_i$	-	-	1.62	0.21	-	-	0.00	0.98
F-statistic/Chi-Sq.	-	-	27.99	0.00	-	-	12.04	0.06
R^2 or Pseudo R^2	-	-	0.13	-	-	-	0.10	-
No. of observations	21	-	61	-	11	-	74	-

Note: Samples exclude firms with non-positive employment, sales, intermediate consumption, and fixed assets..

Appendix Table 6: Determinants of Solid Emission Propensities (Dependent variable = emissions per sales unit, OLS estimates with Heteroskedastic consistent standard errors and Tobit estimates)

	2002				2004			
	OLS estimates for emitters		Tobit estimates for all firms		OLS estimates for emitters		Tobit estimates for all firms	
Industry	Coef-ficient	Sig. level	Coef-ficient	Sig. level	Coef-ficient	Sig. level	Coef-ficient	Sig. level
10 High Emission Industries (with 3-digit VSIC industry [intercept] dummies)								
$\ln(M_i)$	-0.0598	0.00	-0.0862	0.00	-0.0362	0.19	-0.0744	0.00
$\ln(K_i)$	0.0161	0.06	0.0374	0.00	0.0191	0.36	0.0450	0.00
$\ln(L_i)$	0.0461	0.00	0.0795	0.00	0.0346	0.17	0.1083	0.00
ES_i	-0.0005	0.32	-0.0027	0.00	-0.0011	0.10	-0.0039	0.00
DS_i	0.0810	0.18	0.1822	0.00	0.0211	0.72	0.1167	0.01
DF_i	0.0062	0.90	0.0538	0.19	0.0112	0.74	0.1357	0.00
Constant	0.3023	0.00	0.0317	0.62	0.0685	0.30	-0.4333	0.00
Sigma	-	-	0.6211	-	-	-	0.5775	-
Test $DS_i=DF_i$	1.86	0.17	7.08	0.01	0.02	0.88	0.14	0.71
F-statistic/Chi-Sq.	4.08	0.00	443.92	0.00	0.01	0.00	458.90	0.00
R^2 or Pseudo R^2	0.04	-	0.08	-	0.03	-	0.11	-
No. of observations	2,222	-	3,469	-	1,445	-	3,084	-
Food Products (with 3-digit VSIC industry [intercept] dummies)								
$\ln(M_i)$	-0.0786	0.00	-0.0999	0.00	-0.0284	0.21	-0.0847	0.00
$\ln(K_i)$	0.0046	0.75	0.0323	0.03	0.0529	0.01	0.0753	0.00
$\ln(L_i)$	0.0323	0.02	0.0373	0.07	-0.0600	0.11	0.0314	0.28
ES_i	-0.0024	0.03	-0.0073	0.00	-0.0037	0.01	-0.0093	0.00
DS_i	0.1265	0.03	0.2153	0.01	0.1530	0.07	0.1652	0.05
DF_i	0.0514	0.26	0.0549	0.52	-0.0363	0.34	0.0107	0.90
Constant	0.5923	0.00	0.3944	0.00	0.1872	0.08	-0.1048	0.33
Sigma	-	-	0.5746	-	-	-	0.4919	-
Test $DS_i=DF_i$	1.58	0.21	2.70	0.10	3.89	0.06	2.57	0.11
F-statistic/Chi-Sq.	8.74	0.00	204.89	0.00	1.78	0.07	112.59	0.00
R^2 or Pseudo R^2	0.08	-	0.11	-	0.06	-	0.13	-
No. of observations	799	-	1,042	-	348	-	659	-

Appendix Table 6 (continued)

Industry	2002				2004			
	OLS estimates for emitters		Tobit estimates for all firms		OLS estimates for emitters		Tobit estimates for all firms	
	Coef-ficient	Signifi-cance	Coef-ficient	Signifi-cance	Coef-ficient	Signifi-cance	Coef-ficient	Signifi-cance
Beverages (3 digit category, no VSIC dummies)								
$\ln(M_i)$	-0.2246	0.27	-0.2967	0.01	-0.0540	0.40	-0.1314	0.07
$\ln(K_i)$	0.1759	0.29	0.3978	0.00	0.0486	0.42	0.1596	0.02
$\ln(L_i)$	0.2005	0.34	0.1054	0.59	0.0009	0.98	0.1296	0.26
ES_i	-0.0065	0.41	-0.0165	0.05	0.0065	0.32	-0.0094	0.08
DS_i	0.4484	0.30	0.6237	0.12	0.3357	0.37	0.4869	0.04
DF_i	-0.0705	0.67	-0.3129	0.60	-0.1796	0.32	0.0801	0.81
Constant	-0.2425	0.51	-1.4529	0.00	0.0017	0.99	-1.0477	0.00
Sigma	-	-	1.4957	-	-	-	0.7796	-
Test $DS_i=DF_i$	0.11	0.31	2.31	0.13	0.98	0.32	1.38	0.24
F-statistic/Chi-Sq.	0.42	0.86	32.32	0.00	0.21	0.97	36.39	0.00
R^2 or Pseudo R^2	0.06	-	0.06	-	0.04	-	0.12	-
No. of observations	120	-	204	-	78	-	198	-
Textiles (with 3-digit VSIC industry [intercept] dummies)								
$\ln(M_i)$	-0.0023	0.54	-0.0092	0.23	-0.4217	0.24	-0.2752	0.01
$\ln(K_i)$	-0.0058	0.29	-0.0019	0.77	0.1703	0.39	0.0561	0.50
$\ln(L_i)$	0.0050	0.72	0.0275	0.02	0.4484	0.26	0.6538	0.00
ES_i	-0.0002	0.53	-0.0006	0.52	0.0091	0.60	0.0134	0.08
DS_i	0.0403	0.55	0.0547	0.10	-0.3198	0.65	0.0329	0.93
DF_i	0.0060	0.70	0.0065	0.79	0.0828	0.64	0.4193	0.12
Constant	0.0642	0.13	-0.0932	0.04	0.6008	0.47	-2.1662	0.00
Sigma	-	-	0.1234	-	-	-	1.2148	-
Test $DS_i=DF_i$	0.41	0.52	2.30	0.13	0.30	0.58	1.09	0.30
F-statistic/Chi-Sq.	0.44	0.88	33.26	0.00	0.39	0.92	60.87	0.00
R^2 or Pseudo R^2	0.03	-	10.68	-	0.16	-	0.13	-
No. of observations	128	-	301	-	83	-	299	-

Appendix Table 6 (continued)

Industry	2002				2004			
	OLS estimates for emitters		Tobit estimates for all firms		OLS estimates for emitters		Tobit estimates for all firms	
	Coef-ficient	Signifi-cance	Coef-ficient	Signifi-cance	Coef-ficient	Signifi-cance	Coef-ficient	Signifi-cance
Footwear (3 digit category, no VSIC dummies)								
$\ln(M_i)$	0.0357	0.22	0.0004	0.99	0.0025	0.89	-0.0237	0.11
$\ln(K_i)$	0.0341	0.21	0.0310	0.29	0.0296	0.08	0.0353	0.01
$\ln(L_i)$	-0.0255	0.28	0.0452	0.27	-0.0027	0.84	0.0201	0.26
ES_i	-0.0036	0.31	0.0024	0.68	-0.0011	0.66	-0.0007	0.80
DS_i	-0.0565	0.25	0.0255	0.79	-0.0506	0.15	0.0074	0.89
DF_i	0.0487	0.33	0.0471	0.56	0.0078	0.75	0.0432	0.25
Constant	-0.4155	0.23	-0.7069	0.00	-0.2376	0.21	-0.3081	0.00
Sigma	-	-	0.3945	-	-	-	0.1734	-
Test $DS_i=DF_i$	1.47	0.23	0.04	0.84	1.92	0.19	0.46	0.50
F-statistic/Chi-Sq.	0.31	0.93	18.53	0.01	,75	0.61	26.69	0.00
R^2 or Pseudo R^2	0.39	-	0.09	-	0.17	-	0.43	-
No. of observations	115	-	198	-	83	-	187	-
Chemicals (with 3-digit VSIC industry [intercept] dummies)								
$\ln(M_i)$	-0.0271	0.08	-0.0312	0.00	-0.0146	0.25	-0.0104	0.05
$\ln(K_i)$	0.0066	0.07	0.0088	0.13	0.0068	0.25	0.0050	0.25
$\ln(L_i)$	0.0199	0.15	0.0357	0.00	0.0100	0.15	0.0256	0.00
ES_i	-0.0006	0.14	-0.0001	0.89	-0.0004	0.37	-0.0002	0.61
DS_i	0.0082	0.60	0.0271	0.24	-0.0137	0.22	-0.0025	0.90
DF_i	0.0166	0.47	0.0625	0.00	0.0080	0.52	0.0491	0.00
Constant	0.0344	0.09	0.0344	0.31	0.0932	0.24	-0.0585	0.04
Sigma	-	-	0.1042	-	-	-	0.0790	-
Test $DS_i=DF_i$	0.35	0.56	1.81	0.18	1.83	0.18	5.90	0.02
F-statistic/Chi-Sq.	1.07	0.39	36.13	0.00	0.90	0.51	62.47	0.00
R^2 or Pseudo R^2	0.10	-	-0.34	-	0.09	-	-0.73	-
No. of observations	172	-	323	-	136	-	354	-

Appendix Table 6 (continued)

Industry	2002				2004			
	OLS estimates for emitters		Tobit estimates for all firms		OLS estimates for emitters		Tobit estimates for all firms	
	Coef-ficient	Signifi-cance	Coef-ficient	Signifi-cance	Coef-ficient	Signifi-cance	Coef-ficient	Signifi-cance
Plastics (3 digit category, no VSIC dummies)								
$\ln(M_i)$	-0.0167	0.13	-0.0201	0.00	-0.0018	0.54	-0.0031	0.30
$\ln(K_i)$	0.0057	0.28	0.0039	0.24	0.0005	0.70	0.0012	0.64
$\ln(L_i)$	0.0100	0.20	0.0165	0.01	0.0105	0.22	0.0087	0.06
ES_i	0.0003	0.57	0.0005	0.13	-0.0000	0.94	0.0001	0.78
DS_i	-0.0014	0.75	0.0339	0.07	-0.0236	0.33	0.0198	0.37
DF_i	-0.0076	0.42	0.0175	0.16	0.0025	0.50	0.0343	0.00
Constant	0.0627	0.08	0.0263	0.19	-0.0225	0.59	-0.0679	0.00
Sigma	-	-	0.0670	-	-	-	0.0670	-
Test $DS_i=DF_i$	0.54	0.46	0.71	0.40	1.15	0.29	0.43	0.51
F-statistic/Chi-Sq.	0.73	0.62	36.97	0.00	0.70	0.65	39,94	0.00
R^2 or Pseudo R^2	0.09	-	-0.20	-	0.06	-	-0.42	-
No. of observations	176	-	445	-	116	-	491	-
Non-metallic mineral products (with 3-digit VSIC industry [intercept] dummies)								
$\ln(M_i)$	-0.0680	0.00	-0.0895	0.00	0.0595	0.55	-0.0370	0.41
$\ln(K_i)$	-0.0039	0.78	0.0037	0.82	-0.0272	0.59	0.0293	0.40
$\ln(L_i)$	0.0841	0.06	0.1190	0.00	0.0069	0.91	0.1077	0.10
ES_i	0.0024	0.17	-0.0006	0.77	-0.0032	0.49	-0.0108	0.02
DS_i	0.1270	0.32	0.1573	0.02	-0.2038	0.09	-0.2064	0.13
DF_i	0.0384	0.45	-0.0002	1.00	-0.1890	0.08	-0.2423	0.13
Constant	0.1730	0.03	0.0628	0.58	-0.1995	0.36	-0.8451	0.00
Sigma	-	-	0.4326	-	-	-	0.7489	-
Test $DS_i=DF_i$	1.13	0.29	2.87	0.09	0.14	0.71	0.04	0.84
F-statistic/Chi-Sq.	2.54	0.01	37.30	0.00	2.07	0.05	33.25	0.00
R^2 or Pseudo R^2	0.03	-	0.06	-	0.01	-	0.04	-
No. of observations	398	-	494	-	350	-	459	-

Appendix Table 6 (continued)

Industry	2002				2004			
	OLS estimates for		Tobit estimates		OLS estimates for		Tobit estimates	
	Coef-ficient	Signifi-cance	Coef-ficient	Signifi-cance	Coef-ficient	Signifi-cance	Coef-ficient	Signifi-cance
Basic metals (with 3-digit VSIC industry [intercept] dummies)								
$\ln(M_i)$	-0.0024	0.00	0.0002	0.90	-0.0531	0.11	-0.0485	0.04
$\ln(K_i)$	0.0010	0.00	0.0008	0.62	-0.0633	0.27	-0.0593	0.05
$\ln(L_i)$	0.0033	0.00	0.0011	0.70	0.1472	0.18	0.1634	0.00
ES_i	0.0001	0.00	0.0001	0.40	0.0002	0.93	-0.0009	0.72
DS_i	-0.0049	0.00	-0.0008	0.93	0.1311	0.59	0.0886	0.59
DF_i	-0.0072	0.00	-0.0094	0.16	0.3235	0.24	0.2997	0.01
Constant	0.0099	0.00	-0.0082	0.41	0.4227	0.17	0.2284	0.22
Sigma	-	-	0.0181	-	-	-	0.3336	-
Test $DS_i=DF_i$	0.23	0.63	0.97	0.33	0.20	0.65	1.57	0.21
F-statistic/Chi-Sq.	1.52	0.16	5.22	0.73	0.76	0.64	25.07	0.00
R^2 or Pseudo R^2	0.06	-	-0.01	-	1.98	-	0.23	-
No. of observations	94	-	123	-	89	-	114	-
Electrical machinery (with 3-digit VSIC industry [intercept] dummies)								
$\ln(M_i)$	-0.0086	0.07	-0.0044	0.16	-0.0055	0.38	-0.0059	0.58
$\ln(K_i)$	0.0016	0.47	-0.0003	0.92	-0.0003	0.94	0.0124	0.20
$\ln(L_i)$	0.0146	0.10	0.0160	0.00	0.0368	0.30	0.0326	0.03
ES_i	0.0002	0.16	0.0001	0.32	-0.0001	0.69	0.0003	0.64
DS_i	-0.0121	0.13	-0.0107	0.34	-0.0388	0.35	-0.0197	0.64
DF_i	0.0071	0.13	-0.0012	0.89	0.0060	0.70	0.0072	0.80
Constant	0.0018	0.91	-0.0402	0.03	-0.1414	0.32	-0.2886	0.00
Sigma	-	-	0.0320	-	-	-	0.1115	-
Test $DS_i=DF_i$	3.43	0.07	0.68	0.41	0.97	0.33	0.48	0.49
F-statistic/Chi-Sq.	0.79	0.65	25.58	0.01	0.11	1.00	34.03	0.00
R^2 or Pseudo R^2	0.27	-	-0.10	-	0.14	-	-3.16	-
No. of observations	88	-	148	-	74	-	166	-

Appendix Table 6 (continued)

Industry	2002				2004			
	OLS estimates for emitters		Tobit estimates for all firms		OLS estimates for emitters		Tobit estimates for all firms	
	Coef-ficient	Signifi-cance	Coef-ficient	Signifi-cance	Coef-ficient	Signifi-cance	Coef-ficient	Signifi-cance
Other transport equipment (with 3-digit VSIC industry [intercept] dummies)								
$\ln(M_i)$	0.0048	0.87	-0.0439	0.66	-0.0023	0.28	-0.0040	0.01
$\ln(K_i)$	0.0120	0.68	0.0985	0.26	0.0021	0.32	0.0024	0.13
$\ln(L_i)$	0.1594	0.31	0.0711	0.64	0.0005	0.85	0.0041	0.10
ES_i	0.0009	0.75	-0.0106	0.24	0.0000	0.96	-0.0001	0.66
DS_i	-0.5954	0.33	-0.2749	0.37	-0.0114	0.35	-0.0073	0.22
DF_i	-0.7072	0.34	-0.4884	0.15	0.0056	0.40	0.0056	0.24
Constant	-0.5452	0.36	-0.7682	0.10	0.0173	0.22	-0.0039	0.60
Sigma	-	-	1.2123	-	-	-	0.0176	-
Test $DS_i=DF_i$	0.52	0.47	0.37	0.54	2.33	0.13	4.15	0.04
F-statistic/Chi-Sq.	0.14	1.00	6.42	0.60	0.96	0.48	19.00	0.01
R^2 or Pseudo R^2	0.04	-	0.01	-	0.13	-	-0.05	-
No. of observations	132	-	191	-	88	-	157	-

Note: Samples exclude firms with non-positive employment, sales, intermediate consumption, and fixed assets..

Appendix Table 7: Sample Characteristics

	Firms (number)		Employees (number)		Sales (billion dong)	
	Sample Firms	Published Estimates	Sample Firms	Published Estimates	Sample Firms	Published Estimates
2002, Manufacturing	14,475	14,794	2,197,086	2,202,943	378,732	374,583
Private firms	11,443	-	824,278	-	98,265	-
SOEs	1,410	-	747,644	-	125,680	-
MNCs	1,622	-	625,164	-	154,787	-
2004, Manufacturing	20,075	20,531	2,889,742	2,893,080	622,715	608,473
Private firms	16,524	16,958	1,167,626	1,170,649	179,800	180,385
SOEs	1,247	1,247	757,199	757,199	176,870	165,392
MNCs	2,304	2,326	964,917	965,232	266,045	262,696

General Statistics Office (various years a, b)