Danish Municipalities' Monitoring Effort

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Abstract

Within Danish Environmental Law, the authority to monitor whether polluting firms keep specified emission standards is delegated to local authorities. Compared to existing analyses we test whether the size of municipalities influences the dependency between local interests and inspection frequencies. To do so, we use a panel data set of 267 Danish municipalities for the time period 1993-2002 that contains information on municipalities' inspection frequencies, labour-market conditions, emissions, income levels and the composition of the municipal council. We find that variations in these variables mainly seem to have a significant effect on inspection frequencies in smaller municipalities. At the same time, we find that the introduction of a reform aimed at increasing inspection frequencies seems to have influenced inspection frequencies in the short run.

JEL codes: C23, H11, P16, Q28.

Keywords: monitoring, municipalities, panel data, local interests.

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1. Introduction

Regulation is usually followed up by monitoring and enforcement procedures to determine whether polluting parties comply with regulation and to give them incentives to do so. In Denmark local authorities are responsible for the enforcement of national emission standards imposed on small and medium-sized firms within specified industrial sectors causing considerable pollution levels.[2][3] The emission standards specify maximal allowable emissions to the water, air and soil from polluting firms.[4] Local authorities are given the competence to enforce national standards which makes room for local differences in enforcement. Thus, local authorities choose inspection frequencies (whom to inspect and how often) and what sanctions to use in case of non-compliance. The responsibility to inspect polluting firms is divided between municipalities and counties where counties inspect the larger and heavily polluting firms and those with complicated production processes. The more precise division of responsibility between counties and municipalities is described in the Danish Environmental Law (for a description see Krarup, Ashlund & Pedersen, 2003). Our focus is on municipalities' choice of monitoring effort directed at polluting firms.

It is the choice of the municipalities to decide how often to control firms. This could imply heterogeneity between municipalities in their choice of inspection frequencies. In figure 1, box plots of the inspection frequencies (in per cent), directed at two groups of polluting firms, of every Danish municipality are included for every year in the time period 1993-2003. The box plots provide information on the median value of actual inspection frequencies and their spread across municipalities in a particular year. The box extends from the first to the third quartile of the distribution of the inspection frequencies where the horizontal line within the box indicates the median of all inspection frequencies in the particular year. The "+" in the box indicates the mean of all municipalities' inspection frequencies in a particular year. The frequencies are defined as the total number of inspected

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2 These sectors are specified in the Danish Environmental Protection Law, cf. Lovbekendtgørelse nr. 753 af 25/08/2001.

3 An earlier study showed that in practice emission standards imposed on polluting firms are unified across municipalities, cf. Krarup (1996).

4 In the following, we will not assess whether these emission standards are defined in an optimal way.

firms in relation to the total number of firms being subject to inspections in the municipality in every year. Thus, an inspection frequency of 100% means that on average every firm in a municipality has been inspected once a year, which implies that some firms are inspected more than once a year and others are inspected less frequent.

Figure 1. Box plots of inspection frequencies in Danish municipalities in 1993-2003
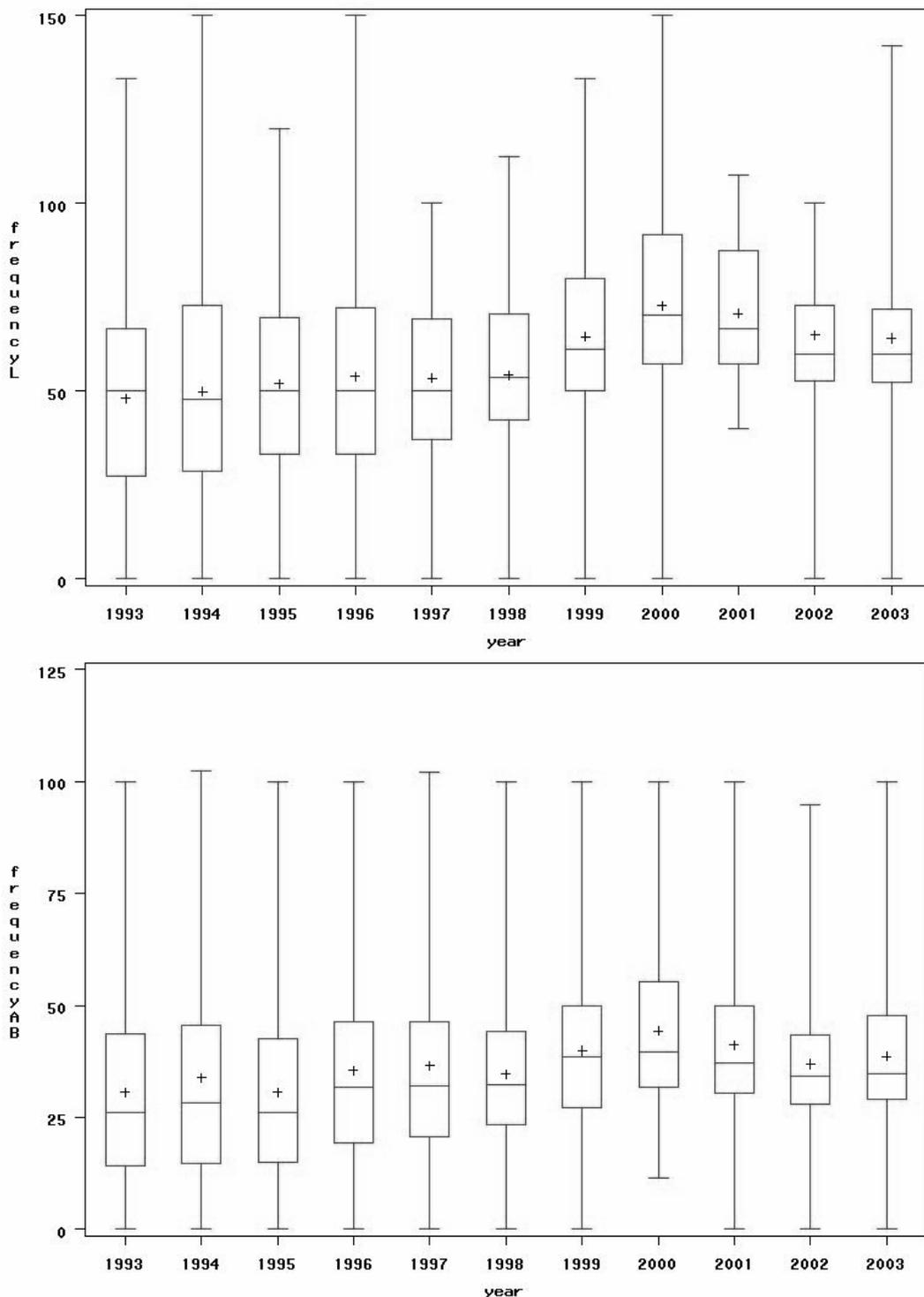
The box plots for the time period 1993-2003 show heterogeneity between municipalities in their choice of inspection frequencies. On average inspection frequency increased until 2000 and decreased subsequently. Moreover, it seems as if there is a large variation across municipalities in the inspection frequencies set in every year with a decrease in this heterogeneity over the years 1997-2003. The question that arises is why there is such heterogeneity in the choice of inspection frequencies across municipalities and whether heterogeneity in itself is preferable.

The literature on monitoring and enforcement describes why it is not always preferable to delegate enforcement to local authorities. Local authorities are not concerned with effects external to the local jurisdiction, local authorities lack the expertise to deal with complex environmental problems, and local authorities are overly concerned with negative local economic effects of enforcing pollution standards; cf. Burby & Paterson (1993). The literature gives at least two explanations for why this happens. The first concerns "inter-regional competition" as a source of distortion in public choices; cf. Oates & Schwab (1996), Oates (2002), Oates & Schwab (1988). Here each region maximises its social welfare including tax revenues and gains from pollution control. When firms' location across regions is endogenous regions compete in order to attract firms and thereby increase the local tax base by offering low levels of pollution control. This could lead to a relaxation of environmental regulation or enforcement so as to reduce costs of firms resulting in environmental degradation. This is the so-called "race to the bottom" problem. Looking at the literature, it is not evident in the literature whether such competition between regions always leads to a "race to the bottom". Oates & Schwab (1988) and Levinson (1997) show that environmental regulatory competition leads to overall efficiency whereas a contrary result is obtained by Markusen, Morey and Olewiler (1995).

Another explanation of why local authorities choose low levels of environmental regulation and enforcement is found in the literature on interest groups and their influence on political decision-making. Several theories exist that try to explain the choice of government

regulation of the economy and thereby the behaviour of political decision-makers.[5] One of them is the interest group theory saying that *"...regulation is supplied in response to the demands of interest groups struggling among themselves to maximise the incomes of their members"*, Posner (1974). Thus, the aim of the authority is not to maximise social welfare, but to maximise its political support and thereby the welfare of some interest groups. The actual choice of regulation or enforcement therefore depends on the influence of interest groups, which according to Cutter & DeShazo (2004), depends on individuals' or groups' costs and benefits from regulation, and their characteristics and organisational capacity. This implies that regulation depends on the benefits and costs of individuals or groups that are influenced by the regulation and their ability to influence political decision-making. Applied to enforcement this implies that the authority maximises the net additional support it gets by inspecting a given plant, cf. Peltzman (1976). Looking at local authorities, the net support generated by the monitoring and enforcement action depends on the inhabitants' gains from pollution abatement, (e.g. a cleaner environment), and their costs from pollution abatement, (e.g. higher costs to the industry when regulation is enforced might imply a risk of job loss). In order to maximise political support the local authority may trade-off the support of those concerned with environmental quality with those whose income is an important function of the economic activity generated by the presence of (polluting) plants locally.

Some empirical studies exist that test whether authorities' inspections of firms can be explained by the interest group theory. Some of these test whether inspection frequencies can be explained by the authorities' maximisation of political support from industry, cf. Gray & Deily (1996) and Deily & Gray (1991). Both studies use data on steelmaking plants in the USA. Variables are specified to test whether authorities give support to industrial interests when deciding their enforcement level directed at these plants. Both studies show

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5 Throughout the literature, it is usually assumed that government intervention is explained by the public interest theory, cf. Posner (1974). However, other theories have emerged trying to explain regulatory decision-making. Some of these are theories of rent- and office-seeking politicians (Persson & Tabellini, 2000), and problems of high-powered incentive schemes in hierarchical (Sánchez & Sobel, 1993) or multiple-principal systems (Spiller, 1990). However, in this paper we will take the view of the interest group theory.

that authorities inspect firms more often if they are located in areas with high unemployment, but inspect firm less frequent if they are large local employers.

Other studies test whether inspections of firms can be explained by a concern for either the industry or the environment. A study by Dion, Lanoie & Laplante (1998) tests whether local employment conditions or the damage of pollution explain the level of monitoring of 60 plants within the pulp and paper industry in Quebec. They find that firms are inspected more often if they cause high environmental damage or are large local employers, but less frequent if they are located in areas with high unemployment rates. Helland (1998) uses data on the inspection of 232 plants in 30 states in the USA. He found that firms located in areas with a high environmental movement or high incomes are inspected more often, whereas firms that are large local employers are inspected less often.

In this paper we test whether interest group theory of regulation can explain Danish municipalities' inspections of polluting firms in order to control whether they comply with specified emission standards. We expand on existing analyses by looking at local authorities of different sizes (in terms of the number of inhabitants) in order to test whether smaller municipalities are more influenced by local interests than bigger municipalities. This has not previously been done in the literature. Whereas the main part of the empirical studies undertaken so far use cross-sectional data (see Potters & Sloof, 1996), we use a panel data set. Our panel data set includes information of 267 Danish municipalities of the time period 1993-2002. This allows us to control for municipal-specific unobserved differences. Another advantage of our data set is that we have data at the level of municipalities, and thereby at the level of the decision-making authority. Controlling for different local interests our purpose is also to test whether the introduction of a reform introduced in 1998 (aimed at increasing overall inspection frequencies in municipalities) did have any effect on the municipalities' inspections.

We find that we cannot reject that some local characteristics, to some extent explain the inspection frequencies set by Danish municipalities. The actual impact depends on the size

of the municipalities (in terms of inhabitants). This suggests that variations in inspection frequencies can be explained by heterogeneous costs and benefits from pollution control across municipalities. Further, it seems as if the introduction of a reform in 1998 did increase the general level of inspection frequencies, at least in the short run.

The paper is organised as follows. We specify the instruments for the policy and interest group variables in section 2. The data and econometric issues are described in section 3. The influence of local interests is discussed in section 4 and the effects of the reform are discussed in section 5. Concluding remarks are given in section 6.

2. Specification

Our aim is to test the importance of local interests on the municipalities' choices of monitoring effort levels where municipalities have the authority to check whether firms are fulfilling emission limitations specified in their environmental approvals and in Danish environmental law. We assume that the inspection frequency represents the policy outcome of the local political decision-making process where different factors influence the final choice. In the following, we take the political outcome, the inspection frequency, as given, and we do not model the actual behaviour of individual political decision-makers or the collective decision-making process leading to the final choice. But we do hypothesise that local interests are able to influence the inspection frequencies set by municipalities and that this influence is detectable in the observed setting of frequencies. To explore this quantitatively we adopt the suggestion of Potters & van Winden (1996). We assume that the level of municipality i's inspection frequency, y_i, is determined by the influence function I (.), which relates the inspection frequency to the pressure from two interest groups p_i^E and p_i^I, in conjunction with a vector of exogenous variables, z :

$$y_i = I(p_i^E, p_i^I, z),$$

where p_i^E is the pressure from environmentally concerned inhabitants in municipality *i*, and p_i^I is the pressure from industrially concerned inhabitants in municipality *i*. The exogenous variables, *z*, encompass general conditions that influence inspection frequencies and initiatives aimed at enhancing the general quality of inspections in municipalities. Whether or not the resulting choice of inspection frequency is efficient or not in a social welfare context is not of our concern here.

We assume that the degree of pressure from these two groups is assumed to depend on their costs and benefits from inspections, which depend on the characteristics of firms and inhabitants in the municipality considered. We expect industrially concerned inhabitants to experience net costs from inspections, as these increase firms' costs from compliance with regulation. At the same time we expect that environmentally concerned inhabitants experience net benefits from inspections, as these are assumed to lead to lower emissions and therefore reduced pollution. The hypothesised effect of the pressure variables may then be summarised by the relations $\dfrac{\partial y_i}{\partial p_i^E} > 0$ and $\dfrac{\partial y_i}{\partial p_i^I} < 0$.

The question is then what determines the level of pressure from each of the groups. For this purpose we need to specify variables that can be used as proxies for the inhabitants' concern for either the local environment or industry. In the empirical literature (for a survey see Potters & Sloof, 1996), the interest group variables are usually either related to the activities of interest groups (e.g. campaign contributions and other lobbying activities) or special structural and environmental characteristics of the interest groups. In this analysis, on the other hand, we use different characteristics of the municipalities and their inhabitants that might reasonably be said in stand for local environmental or industrial interests. In the following we specify variables that allow us to test whether municipalities are influenced by either environmentally or industrially concerned inhabitants when they choose inspection frequencies. The variables should serve as proxies for factors that influence the environmental and industrial interests locally, which allow us to estimate the above equation. The choice of variables is inspired by the empirical studies referred to in section 1.

Environmental interests

We expect that inhabitants' demand for improved environmental quality can be captured by inhabitants' characteristics. If environmental quality can be considered as a normal good and one expects increased inspections to increase environmental quality, this suggests that the demand for inspections increases with the income of inhabitants in the municipalities. For given abatement costs the marginal benefit from more inspections (and thereby a better environment) is therefore expected to be higher in areas with high income inhabitants. Thus, we assume that inhabitants' income influences their demand for environmental quality. As an indicator of the inhabitants' income we use the tax base per inhabitant in the municipality.[6]

Another way to reflect the environmental consciousness of inhabitants is by including their votes in the local elections. We expect that the concern for environmental protection and regulation of polluting firms differ among the political parties, with left-wing parties being more concerned with environmental issues than right-wing parties. In order to test whether the composition of the municipal council has any effect on the inspection frequencies, we include a variable that measures the share of seats of the left-wing parties in relation to the total number of seats in the municipal council.[7]

The expected benefits to inhabitants depend also on the state of the environment in the municipality and degree of pollution. Here we only include a variable representing the local air pollution.[8] We assume that inhabitants are more concerned with the environment in heavily polluted areas as the marginal damage costs from pollution are generally taken to increase with pollution. The inhabitants' benefits from pollution control and thereby

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6 The tax base is defined as the municipalities' budget for revenues from income tax divided by the local government tax rate plus 7% of the taxable land value and an estimated taxable value of property per inhabitant.

7 The "left-wing" parties include the following political parties: the Social Democrats, the Socialist People's Party and the Danish Red-Green Alliance.

8 At first we included two indicators for the local environmental quality. These were the share of the municipality's area with drinking water reservoirs and the share of the municipality's area defined as environmentally sensitive due to a concern for specific nature characteristics. However, as these data were constant in the considered time period, no estimates can be obtained by using the first differencing model as we do. We did, however, calculate random effect estimators and found that they were not significant. Still, we cannot reject that these estimates are biased. It is also questionable whether the concern for environmental protection is higher in environmentally sensitive areas as the marginal value of such areas could be decreasing with the share of environmentally sensitive areas.

inspections are therefore assumed to be higher in more polluted areas. To simplify our analysis, we assume that municipalities do not consider the influence local emissions have on inhabitants in other municipalities. We capture the level of pollution locally, by including a variable measuring the sum of nitrogen and sulphur oxides emissions to the air from local polluting firms per inhabitant.[9] The emissions are calculated for every industrial sector by using information on total industrial sectors' use of energy and technology to burn fossil fuels. By using information on the number of firms within each industrial sector that is located in each municipality, the sector's total emissions are then allocated on these firms and the total emissions in each municipality are calculated and divided by the area of the municipality.

Industrial interests

We postulate that there is a possibility that the municipalities in their choice of inspection frequencies consider that inhabitants have an interest in protecting local industry from higher costs. One could argue that pollution control influences the local labour market, and that firms locate where pollution control is less stringent. In this case, the control would determine the type of industry locally and therefore the local labour market. If this happens, differences in inspection frequencies across municipalities should lead to variations in the number of firms in each municipality that are subject to inspections. However, the Danish data show that there are only small variations in the number of the most polluting firms in each municipality over the years despite variations in the inspection frequencies across municipalities. This might be so, because the enforcement of emission standards locally only forms a small part of the total regulation that Danish firms face. It is therefore plausible to assume that inspection frequencies alone do not influence location decisions of industry across municipalities.

As noted by Deily & Gray (1991) inhabitants are industrially concerned if firms' compliance costs are high. The reason is that when unemployment increases, the implicit price

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9 It would have been of interest to include emissions to the soil and water resources as well, but data have not been available.

of environmental protection increases as well (in terms of jobs); cf. Helland (1998). These costs depend among other things on the level of unemployment in the municipality. If the unemployment rate is high we expect the municipality do favour local jobs at the expense of the environment. Thus, we include the unemployment rate in the municipality. We also include a variable that explains the importance of local industrial employment. The reason for this is that if a large share of the local labour force is employed in firms subject to inspections such inhabitants are more vulnerable to the closing of these firms. We measure the importance of local firms as the number of inhabitants employed in the polluting industries in relation to the total local employment of inhabitants in the municipality.[10] The firms' costs of being inspected do also depend on their profits. Firms that are profitable are expected to have lower costs from complying, and therefore from inspections. We include a variable that serves as a proxy for firms' profit, the gross value. The variable is measured as the value of firms' production less current and constant expenses from production per polluting firm in the municipality.

To capture influences on inspection frequencies that vary over time, but not across municipalities, we include annual dummies for the time period 1995-2002 with 1994 as the reference year.

Descriptive statistics for the variables included in our analysis are summarised in table 1.

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[10] The pressure that industrial interests are able to put on municipalities could also depend on other factors, for example the size of the firms in the municipality. One would expect it to be more difficult for smaller firms to put pressure on the municipality than bigger firms. However, data on firm size have not been available.

Table 1. Descriptive statistics

Variable	N	Mean	Std. dev.	Minimum	Maximum
Inspection frequency	5802	47,9	25,6	0	400
Unemployment rate (%)	5852	6,9	2,9	2,2	24,5
Employment share in polluting industries (%)	5320	8,5	6,3	0,14	45,7
Gross value per polluting firm (mill. DKK)	5295	10,7	14,6	-11,6	246,0
The share of seats of left-wing parties in the municipal council (%)	5852	38,5	12,9	6,0	82,0
The tax base of the municipality per inhabitant (1,000 DKK)	5856	106,8	24,4	64,8	297,0
Emissions of SO_2 and NO_x (kilo per square kilometre)	5316	1520,6	2821,8	0	49620,5
Annual dummies (1994 is omitted for estimation)					
y95	5874	0,09	0,29	0	1
y96	5874	0,09	0,29	0	1
…					
y01	5874	0,09	0,29	0	1
y02	5874	0,09	0,29	0	1

Note: The table contains information on all municipalities in all years.

3. Data and empirical method

The sample analysed here contains observations from 267 municipalities and was construct-ed by merging data from Statistics Denmark and the Danish Environmental Agency. The data from Statistics Denmark cover information on inhabitants and municipalities (income levels, composition of the municipal councils) and the industry in the municipalities (unemployment rates, employment, gross values, emissions). The data from the Danish Environmental Agency consist of information on the municipalities' inspection of two groups of the local industry: a) larger firms causing substantial pollution and b) smaller

firms causing some pollution. The municipalities do also inspect a third group of firms (e.g. shops and restaurants), but these only cause minor pollution and the inspections are mainly motivated by complaints from neighbours. This group of firms is therefore not included in the sample.

We use a panel data set covering information on municipalities for the time period 1993-2002. As our purpose is to explain municipalities' inspection frequencies, it is, according to Solow (1987), important to employ information at the municipal level. If only aggregated data were used instead, information related to the behaviour of municipalities would probably be lost. Having a panel data set also allow us to control for (time invariant) unobserved heterogeneity between municipalities which otherwise could result in biased estimates.

First, we use differencing method to eliminate the possibility of unobserved time-invariant municipal-specific differences in the inspection frequencies. These differences could be due to different institutional conditions across municipalities that do not vary over time, for example different traditions for inspections, industrial composition or other things. In order to test whether the influence of local interests differs between different sizes of municipalities, parameters are estimated for four sizes of municipalities. More specific, we estimate the model for municipalities with less than 10,000 inhabitants, 10-30,000 inhabitants, 20-50,000 inhabitants and more than 50,000 inhabitants. Four of the Danish municipalities have more than 100,000 inhabitants and are due to problems of outliers excluded from the sample. Parameter estimates are presented in the following.

4. Local interests
The results from estimating the first differencing model are presented in table 2.

Table 2. Parameter estimates for different size of municipalities

	Municipalities with 0-10,000 inhabitants	Municipalities with 10-30,000 inhabitants	Municipalities with 30-50,000 inhabitants	Municipalities with 50-100,000 inhabitants	All municipalities
Unemployment rate (%)	- 2.05** (0.98)	0.65 (0.98)	- 1.36 (1.61)	- 1.54 (2.10)	-0.96 (0.63)
Employment share in polluting industries (%)	- 1.19 (0.84)	1.40 (0.95)	- 3.30* (1.84)	0.21 (2.89)	-0.28 (0.58)
Gross value per polluting firm (mill. DKK)	0.03 (0.09)	0.34*** (0.10)	0.36* (0.21)	0.36 (0.23)	0.18*** (0.06)
The share of seats of left-wing parties in the municipal council (%)	0.10 (0.17)	- 0.26** (0.11)	- 0.26* (0.14)	- 0.002 (0.18)	-0.12 (0.08)
The tax base per inhabitant (1,000 DKK)	0.05 (0.18)	0.53** (0.22)	0.32 (0.26)	0.23 (0.38)	0.22* (0.12)
Emissions of SO_2 and NO_x (kilo per square kilometre)	- 0.01*** (0.003)	- 0.002** (0.001)	- 0.001 (0.001)	- 0.002** (0.001)	-0.002*** (0.001)
Annual dummies: 1995	-1.95 (2.57)	-1.90 (2.44)	-11.28*** (3.73)	-1.60 (5.20)	-2.57 (1.60)
1996	2.52 (2.75)	1.66 (2.58)	-4.72 (3.93)	-2.12 (5.40)	1.54 (1.71)
1997	-1.79 (2.58)	1.95 (2.42)	-8.05** (3.69)	-0.15 (5.09)	-0.78 (1.60)
1998	-1.36 (2.84)	-2.83 (2.60)	-4.93 (4.02)	-1.04 (5.22)	-2.16 (1.74)
1999	8.42*** (3.03)	2.96 (2.95)	0.75 (4.62)	1.61 (6.16)	6.08*** (1.91)
2000	11.02*** (3.02)	1.91 (2.86)	-1.93 (4.48)	0.80 (6.09)	6.21*** (1.89)
2001	-5.27* (3.10)	-2.77 (3.03)	-10.45** (4.58)	-4.90 (6.60)	-4.26** (1.96)
2002	-3.80 (3.70)	-7.69** (3.53)	-7.54 (5.77)	2.34 (7.40)	-5.18** (2.32)
Number of municipalities	129	103	22	13	267

* Significant at the 10% level; ** Significant at the 5% level; *** Significant at the 1% level.

Industrial interest variables

The first industrial interest variable is the unemployment rate in the municipalities. Looking at table 2, we see that the estimated parameter on the unemployment rate is negative and significant for the small municipalities, only. This suggests that inspection frequencies decrease with the level of unemployment locally and that only smaller municipalities do consider the local unemployment rates when they choose their inspection frequencies. So, where Dion, Lanoie & Laplante (1998) and Helland (1998) find that inspection frequencies in general decrease with the local unemployment rate, our data only supports this for smaller municipalities.

The importance of local industry with respect to jobs is our second industrial interest variable. Here we see that the estimated parameter is only significant at a 10% level in municipalities with 30-50,000 inhabitants. The parameter estimate is here negative, which suggests that these municipalities make less frequent inspection when a large share of their inhabitants is employed in the local polluting firms. As comparison, Dion, Lanoie & Laplante (1998) show a positive relationship between inspections and the size of the inspected firm (numbers of employees in the firm divided by the total local employment) where Helland (1998) shows a negative relationship between inspection frequencies and employment at local mills (looking at inspections at single firms, only).

The last industrial interest variable is the average gross value in the local polluting industries. This parameter estimate is positive and highly significant in municipalities with 10-30,000 inhabitants and significant at a 10% level in municipalities with 30-50,000 inhabitants. This indicates that medium-sized municipalities make more frequent inspections when firms located in the municipality have a good financial situation (and less frequent inspections when local firms have a bad financial situation). In an earlier study Helland (1998) did find that local inspectors in general consider the possibility that firms are forced to shut down if violations are detected. However, we only find that relationship for some municipalities.

Environmental interest variables

The share of left-wing members of the municipal council is negative, but only significant at a 10% level for municipalities with 30-50,000 inhabitants and significant at a 5% level for municipalities with 10-30,000 inhabitants. This suggests that the setting of inspection frequency only to some extent is influenced by the political composition of the municipal council. Contrary to what we expected, it seems as if inspection frequencies decrease with the share of left-wing parties in the municipal council.

Looking at the inhabitants in the municipalities, we find that the estimated parameter on the average tax base is positive and significant at a 5% level for municipalities with 10-30.000 inhabitants. This suggests that only in some municipalities are inspection frequencies in-fluenced by the local income level. As comparison, Helland (1998) found a significant and positive relationship between inspections and the per capita income locally independently of the size of jurisdiction.

As a measure of the local pollution of the air we use the total emissions to the air from the polluting industry in the municipality per inhabitant. We see that this parameter estimate is small, but negative and significant for all types of municipalities, except for municipalities with 30-50,000 inhabitants. This suggests that inspection frequencies decrease with the local emissions to the air which contradicts our expectations.

Looking at the annual dummies we se that for all municipalities the annual dummies for the years 1999 and 2000 are positive and significant, but negative and significant in 2001 and 2002. An explanation of the influence of the years 1999 and 2000 can be the introduction of stricter requirements to the inspection frequencies which were formulated in an agreement ("The Minimum Agreement") between the Minister of Energy and the Environment and Local Government Denmark (LGDK). From 1998 the requirements were used to evaluate the municipalities´ inspections, with 1997 as the run-in period. However, the effect of the requirements seems rather short termed as the influence of the time dummies is negative in 2001 and 2002. Alternatively, other things might have happened in those years that have

had an influence on inspection frequencies. The question is then whether the reform has had any influence on municipalities that formerly had too low inspection frequencies. We return to this question in the next section.

5. Effect of the reform on non-compliant municipalities

The purpose of the Minimum Agreement was to enhance the quality of municipalities' inspections by specifying minimum requirements to how often municipalities should inspect polluting firms. The requirements are specified for two groups of the local industry: a) larger firms causing substantial pollution and b) smaller firms causing some pollution. The municipalities are required to inspect minimum 50% of the larger firms a year, and at least 50% of the smaller firms during the previous and actual year. The Danish Environmental Agency controls the municipalities in order to see whether the minimum requirements are kept. In case they are not, the Minister of the Environment makes a qualitative evaluation of the inspections by the municipalities in order to find explanations for the low inspection frequencies. If no reasonable explanations can be found the Minister lays down binding agreements on the future inspections of the municipality in question. If this happens the municipality has no influence on the setting of inspection frequencies.

The question is then whether the reform has influenced the frequency of municipalities' inspections of the two groups of industry. From figure 1 it seems as if the spread in the municipalities' inspection frequencies of the two groups of industrial sectors has narrowed slightly between 1997 and 2002.

We want to test whether the inspection frequencies have changed in the considered time period for example due to the reform. Then, we divide our sample into two groups. One group that includes the municipalities that prior to the reform (in 1995) chose to inspect both larger and smaller firms more often than the minimum requirements. The other group includes municipalities that prior to the reform (in 1995) chose inspection frequencies below

the minimum requirements.[11] We use the year dummies to evaluate whether special circumstances in a particular year did influence the choice of frequencies in all municipalities. Such a case can be the introduction of requirements to all municipalities' inspections as the reform, but of course other things could have happened in the different years which might have influenced inspection frequencies or diminished the effect of the reform. Controlling for the variables included in table 1, gives the following results, cf. table 3.

Table 3. Influence of year dummies

	Municipalities with inspection frequencies below the minimum requirements prior to the reform	Municipalities with inspection frequencies above the minimum requirements prior to the reform
1997	1.81 (2.01)	- 4.48* (2.64)
1998 (reform)	- 1.91 (2.17)	- 2.73 (2.86)
1999	6.58*** (2.39)	5.22* (3.14)
2000	7.17*** (2.37)	4.61 (3.09)
2001	- 5.20** (2.46)	- 3.05 (3.22)
2002	- 6.47** (2.93)	- 3.53 (3.78)

Note: Standard errors are in parentheses; * indicates significance at the 10%, ** at 5% and *** at 1% levels.

From table 3 the following can be concluded. For both groups of municipalities the parameter estimates for 1999 and 2000 are positive and negative for the parameter estimates for 2001 and 2002 implying increasing inspection frequencies just after the reform. However, this tendency is only significant for municipalities that prior to the reform had inspection frequencies below the minimum requirements, as the years 1999 and 2000 are significant at a 1% level and the years 2001-02 are significant at a 5% level. This could

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[11] We did find that if municipalities in 1995 had inspection frequencies below the minimum requirements the main part of this group had inspection frequencies below the minimum requirements in 1994, too. This shows that it is mainly the same municipalities that choose relatively too low inspection frequencies. Descriptive statistics show no systematic differences between the two groups except for the level of inspection frequencies.

indicate that the reform did have some effect on the inspection frequencies. However, the question is why the inspection frequencies did decrease in 2001 and 2002. One explanation could be that this group of municipalities could no longer afford to have relatively high inspection frequencies or the perceived sanctions from choosing (too) few inspections have not been strong enough. However, we cannot see whether the decrease has led to inspection frequencies below the minimum requirements.

In all, our analysis suggests that we cannot reject that the introduction of the reform did not on average have a significant effect on the inspection frequencies in municipalities, especially in municipalities that formerly had (too) few inspections. However, a proper evaluation is needed in order to assess the actual effect of the reform.

6. Concluding remarks

The aim of this paper has been to explain Danish municipalities' choices of inspection frequencies for polluting firms. Our results suggest that we cannot reject that local characteristics to some extent explain differences in inspection frequencies across municipalities, but this influence seems to differ between municipalities of different size. We find that it is only in smaller municipalities that the unemployment rate influences the level of inspection frequencies, whereas the importance of local industry in terms of local jobs only has a small influence on inspections negatively in municipalities with 30-50,000 inhabitants. The financial situation of firms only seems to have a significant influence on inspections in municipalities with 10-30,000 inhabitants. Moreover, the introduction of general require-ments to inspections seems to have influenced the inspection.

Thus, our analysis shows that some local factors influence the activities in the municipali-ties. This suggests that differences in local characteristics imply heterogeneity between municipalities in their enforcement of emission standards. So even though emission stan-dards imposed on firms to some extent are the same across municipalities, their enforcement is not. This suggests that delegation of authority to municipalities implies that different political forces have an impact on inspections in municipalities. Whether the delegation of

authority to municipalities increases firms' compliance with emission standards remains to be answered. So does an evaluation of the net effects on the environment and efficiency from delegating this kind of decision making to local authorities.

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