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Budget Structure and Pollution Control: A Cross-country Analysis and Implications for China

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Abstract

In the published literature, the differences in environmental performance across countries are typically explained using the Environmental Kuznets Curve. The Environmental Kuznets Curve states that pollution initially increases with economic growth. Once GDP per capita reaches a certain level, the relationship reverses. In the present paper, we provide an alternative hypothesis, where budget structure plays an important role in explaining the variations in pollution across the world: the lower the business-related taxes as a share of total tax revenue, the higher the property tax in total tax revenue and the higher the ratio of public health expenditure in total expenditure, then the stronger the incentive of pollution control and the lower the pollution level. Our empirical findings reveal that the budget structure does have an important impact on pollution control. The policy implication of this research is that effective control of environmental pollution requires changes in tax structure and expenditure assignment. This research has important policy implications for China's tax system reform and pollution control efforts.

Key words: budget structure, expenditure, pollution control, tax
JEL codes: E61, H30, Q58

I. Introduction

Environmental quality control has gained an increasingly important role in government policy and business practice as people have become more aware of the consequences of a

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polluted environment. The issue of pollution and environmental quality is particularly important for China, a large developing country that is industrializing rapidly and at the same time experiencing very serious environmental degradation as a result of growing industrial activity. The World Bank has suggested that China's recent success in terms of industrial growth has been clouded by hundreds of thousands of premature deaths and incidents of serious respiratory illness caused by exposure to industrial air pollution. Seriously contaminated by industrial discharges, many of China's waterways are largely unfit for direct human use. Adding the non-health impacts of pollution, which are estimated to be approximately 1.5 percent of GDP, the total cost of air and water pollution in China is approximately 5.8 percent of GDP (World Bank, 2007).

Many believe that China's pollution is an issue relating to its stage of development. As China continues to grow, heavy and polluting industries will be phased out and industrial pollution will finally decline. This is consistent with the famous "Environmental Kuznets Curve" (EKC), which is widely used to account for the variations in pollution levels across countries. The EKC states that pollution is a concave function of GDP per capita. In the early stages of economic development, pollution tends to increase. Once GDP per capita reaches a certain level, the relationship reverses. In other words, economic growth contributes to the reduction of pollution once a certain level of economic development is achieved. This is because economic growth creates demand for higher environmental quality; better definition of property rights and other institutional arrangements assist in the reduction of pollution and lead to improvements in environmental quality.

The EKC explains the variations in environmental quality mostly through the variations in GDP per capita. This is undoubtedly useful in shaping good public policies. Nevertheless, this hypothesis suffers from several problems. First, what is taking place in the real world is not that consistent with what the EKC has predicted. For example, based on the EKC's prediction, countries at the same level of GDP per capita should have similar preferences in dealing with environmental problems. However, rich countries such as those in the European Unions and the USA differ greatly in their climate change policies. Second, most of the published EKC literature uses aggregated data over different units, which imposes a potential heteroskedasticity problem. Third, as Arrow *et al.* (1995) argue, the EKC only considers the impact of production on the pollution of the environment, assuming that there are no feedback effects from the environment to the production process. This assumption seems impractical in view of the ever-increasing economic activity worldwide and the limited carrying capacity of the environment. Fourth, the policy implication of ERC seems to be that we just need to wait for economic growth to help us reduce the amount of pollution generated. Finally, and perhaps more fundamentally, from our point of view, the EKC ignores the important fact that environmental quality is a public good that is publicly provided. Therefore, government behavior needs to be taken into consideration when we try to understand environmental variations.

In the present paper, we offer a hypothesis in which the government's incentive is explicitly modeled as a determinant of environmental performance. From our perspective, there are two channels through which environmental quality can affect government behavior. On the revenue side, pollution is positively correlated to production levels, while the production levels represent the bases of major taxes. Because higher production means higher tax revenues, government may tolerate higher levels of pollution for the purpose of obtaining greater revenue, thus resulting in relatively low efforts in terms of pollution control. In contrast, pollution can damage other tax bases, such as property tax. The extent of this damage might also affect a government's incentives on the revenue side of the budget to control pollution. On the expenditure side of the budget, more pollution means more expenditure on health care due to the negative effects that pollutants have on human health. Therefore, pollution levels might significantly affect the composition of government budgetary expenditure. However, the government's incentives to control pollution might vary depending on how costly pollution is to the budget.[1]

Our paper is a first attempt to capture the relationship between the budget structure and the government's pollution control incentives. We hope to offer a new perspective for addressing China's environmental problems. It is intended that the present study will help China in the design of effective environmental policies to combat its serious pollution problems.

The rest of the paper is organized as follows: in Section II, we offer an alternative explanation to the published literature, taking into consideration government fiscal incentives in controlling pollution. We propose three hypotheses to account for pollution from a fiscal perspective under an assumption of a Leviathan type government with revenue maximization. In Section III, we test the three hypotheses derived in Section II using a cross-section, time-series dataset that includes 108 countries over the period 1990–2002. We suggest that changes in budget structure might have important impacts on government behavior, and, therefore, on environmental performance. China's case is also presented in this section. The final section concludes, stating that government incentives to fight pollution should be taken into account when making environmental policy decisions. Policy implications for reforming China's public finance system to combat pollution are also outlined in this section.

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[1] There is an obvious endogeneity issue here: the level of pollution affects health-care expenditure, but the composition of the budget, which also reflects how much we care about pollution, may also affect the level of pollution, or at least anti-pollution policy efforts. This is a problem that we will have to deal with in our estimation.

II. Budget Structure, Government Behavior and Pollution Control

We assume that a Leviathan-type government has its own interests. Without effective control from citizens, the government might be willing to exploit its constituency fiscally, trying to maximize potential revenue sources, or using minimum resources to meet certain requirements.

Pollution has an impact on the Leviathan government on both the revenue side and the expenditure side. On the revenue side, pollution can be both good and bad. Pollution is inherently related to production in that, in general, a higher level of production brings about a higher level of pollution. Higher production can bring government higher value-added tax or other tax revenues collected as a result of expanded production activities and an enlarged economic base.

For 2007, the correlation coefficient between the output level of China's secondary industry and the industrial emission level is 0.63 (calculations based on the *China Statistical Yearbook* (2008)). The correlation coefficient between the output level of secondary industry and the value-added tax (VAT), a very important component of provincial revenues, is as high as 0.96. The evidence from China also supports the argument that high production levels lead to high revenues. We also find that the correlation coefficient between the VAT and the emission level is 0.51, which implies that these two variables move in the same direction.

However, higher levels of pollution that come along with the higher level of production might in turn damage the bases of other taxes, in particular property tax. As a rational agent, the government will seek a balance between production level and property tax in order to maximize its revenue target. Under this situation, the tax structure might have a significant impact on the government's incentives to deal with pollution. If tax revenues are mostly taken up by pollution-related activities, as opposed to commercial or residential bases, such as property tax, then the government will have an incentive to expand economic activities with the hope of compensating for the loss of property tax revenue with more revenue from pollution-related activities. The government might not have much interest in controlling pollution in this case, because maximizing production means maximizing revenue. However, if most tax revenue is from property taxes, in order to protect the property tax base, the government will have a stronger incentive to control pollution and to impose strict environmental regulations to protect the environment, lowering pollution levels as much as possible.

On the expenditure side, if health care is assigned to the government, the government will have an incentive to curb pollution because pollutants negatively affect its constituents' health status. This might in turn increase government expenditure on health care (Narayan and Narayan, 2008). If health care as a share of total government expenditure were high, less pollution would be preferred in order to minimize the costs and to maximize the "surplus". Using provincial data, we find that in China the correlation coefficient between the emission level and health expenditure is 0.53.

Pollution affects government behavior on both the revenue side and the expenditure side of the budget. The interaction between the two sides of the budget makes the problem even more complicated. For example, if a government does not need to spend much on health care and relies heavily on pollution-producing activities (from which government can collect tax), it might even try to attract those high-polluting industries into its jurisdiction to increase its tax base. However, with the same level of expenditure responsibility for health care, the government will be interested in maintaining higher environmental quality where most tax revenue is from property tax. We can see the outcomes of the interaction more clearly in Table 1.

According to Table 1, we expect some interactions between budget structure and government behavior relating to pollution control. To summarize, if we assume that the government's efforts in terms of pollution control can effectively achieve a desired pollution level, we can formulate the following three hypotheses:

Hypothesis I: A higher proportion of tax revenue collected from business-related taxes gives government disincentive to protect environmental quality. Therefore, a higher ratio of business-related taxes over total tax revenue will result in lower efforts in terms of pollution control and higher pollution levels.

Hypothesis II: A higher proportion of tax revenue collected from property tax gives government an incentive to protect environmental quality. Therefore, a higher ratio of property tax over total tax revenue will result in greater efforts in terms of pollution control and lower pollution levels.

Table 1. Government Incentives under Different Budget Structures

		Share of public health expenditure	
		High	Low
Main component of revenue source	Tax collected from pollution-producing activities	Trade-off	Lowest incentives
	Property tax	Highest incentives	Trade-off

Source: Compiled by authors.

Hypothesis III: A fuller assignment of expenditure responsibilities on health care gives government an incentive to protect environmental quality. Therefore, the higher the ratio of public health expenditure over total expenditure, the stronger the incentive of pollution control and the lower the pollution level.

III. Data and Methodological Issues

1. Model Specifications

In this section, we will empirically test the three hypotheses using a cross-section time-series dataset. We investigate whether differences in the budget structure have an impact on the government's incentive to control pollution. More specifically, using the shares of business-related tax and property tax in total tax as the proxies on the revenue side, and using the share of health expenditure in total government expenditure as the proxy on the expenditure side, we want to see how pollution levels are affected by fiscal incentives.[2] Therefore, our empirical specification is the following:[3]

$$M_{i,t} = \beta_1 + \beta_2 Iratio_{i,t} + \beta_3 Cratio_{i,t} + \beta_4 Lratio_{i,t} + \beta_5 Hratio_{i,t} + \beta_6 dem_{i,t} + \beta_7 cpi_{i,t} + \beta_8 pgdp_{i,t} + \beta_9 land_i + \beta_{10} pop_{i,t} + v_{i,t} \,. \quad (1)$$

In Equation (1), *Iratio* is the ratio of revenue from business-related taxes over total tax revenue. According to Hypothesis I, the expected sign for the coefficient on this variable is positive in that a higher business tax ratio leads to lower efforts in terms of pollution control and, therefore, to higher pollution levels due to the government's motive of accruing higher tax revenue.

For property tax, the ratio of property tax over total revenue at both the central level and local level are adopted, because in our sample, property tax either constitutes the main revenue source of local government, or goes to the central government's coffer.[4] We use *Cratio* to denote the ratio of property tax over total tax revenue collected by the central government and the regional government. *Lratio* is the ratio of locally collected property

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[2] This is under the assumption that the government's policy can always achieve the desirable outcome.

[3] In our model, $n_{i,t}$ is a composite error term, which can be alternatively formulated in a way that includes country heterogeneity that does not change over time, and the idiosyncratic disturbance term. Usually for time-series cross-sectional data, we would also consider the time effect, which changes over time. However, as we will see later on, we have few countries for which many time periods of data are available, so we mostly conduct one-way error component analysis.

[4] In many countries, government is divided into central, regional (state or province) and local government. We group central and regional government into central government.

tax over total local government tax revenue. According to Hypothesis II, the expected signs of *Cratio* and *Lratio* are both negative. We would expect the effect of *Lratio* to be more important because damage to the property tax is more evident at the local level. In other words, a larger share of property tax in local tax revenue would lead to the local government exerting greater effort in terms of pollution control, and, therefore, would result in a lower pollution level, and vice versa.

To capture the effects of pollution on the expenditure side of government behavior, we use the ratio of government health-care expenditure over total public expenditure, *Hratio* in Equation (1).[5] A higher *Hratio* means that the government spends a greater share of resources on public health services; therefore, the government will have more incentive to control pollution so as to save on health-care expenditure. We anticipate this variable to have a negative effect, meaning that a higher share of public expenditure on health care would induce greater government incentive to control pollution.

Furthermore, we also want to investigate whether the relationship between budget structure and government incentive in pollution control is more significant in democratic countries than in non-democratic countries. To do this, we include a variable *dem*, which measures the extent of democracy in the country. An important point made by Dasgupta *et al.* (2004) is that only countries with good governance can achieve the desired policy objectives, including environmental policy. Even with the incentive to control pollution, a country with a corrupt government might not be able to achieve environmental policy objectives. Here we use *cpi*, the corruption perception index, as the measure of governance.

Finally, we include a number of control variables in our model. First, per capita GDP enters our regression, denoted by *pgdp*. We assume that, as a public good, environmental quality is a normal good. In other words, as per capita GDP increases, the demand for environmental quality also grows. When income levels are higher, government is not only under more pressure to provide a better environment, but can afford to do so. We also control for population in a country, *pop*, because a larger population might lead to further economic activity and, therefore, more pollution. However, if a population is spread out in a country of large territory, pollution should be lower than is the case in a population that is concentrated in a country of small territory. From this perspective, the land area, *land*, also needs to be included in the model.

[5] Our dataset does not differentiate between local government's health-care expenditures and those of the central government, mainly due to data availability. Actually, in most of the countries, central governments are at least partially responsible for health care (China is an exception).

2. Data

We follow the tradition of the EKC literature and use air pollution data to carry out our empirical test. To empirically investigate the relationship between budget structure and environmental performance, we choose the following pollutants as our environmental indicators: nitrogen oxide (NO_x), carbon monoxide (CO) and sulfur dioxide (SO_2). Of the six widely used "criteria" pollutants, these are used due to data availability.[6] Because they might have different impacts on human health as well as on the environment, the government might treat them differently in controlling their emissions. In our analysis, we will analyze the relationship between pollution level and budget structure for each of the three pollutants.

The data used in our empirical analysis come from several sources. We obtain a cross-sectional time-series dataset that includ es a total of 108 countries for the years 1990–2002. Table 2 shows the descriptive statistics of the variables used in the estimation. Detailed explanations and sources of each variable are presented in Table 3.

3. Regression Results

We use several estimation strategies. We use the log-linear functional form, taking the

Table 2. Summary Statistics

Variable	Observations	Mean	Standard deviation	Minimum	Maximum
Nitrogen oxide (NO_X)	477	1129.89	3566.588	0.08	22860
Carbon monoxide (CO)	478	5438.914	18040.28	0.02	130580
Ratio of business tax	613	0.376824	1.347949	0	17.05926
Ratio of property tax at central level	511	0.031641	0.033209	6.48E-06	0.171187
Ratio of property tax at local level	378	0.476918	3.598491	7.99E-06	70.02703
Population	1404	2.40E+07	3.96E+07	770000	2.88E+08
Ratio of health expenditure	864	10.89664	4.519649	1.6	28.9
Democracy	1383	0.601772	0.307262	0	1
Per capita GDP	1381	7001.864	10769.6	84.73576	46894.91
Corruption perception index	470	5.219468	2.463203	0.4	10
Land area	1365	799957.1	2085717	670	1.69E+07

Source: Compiled by authors.

[6] According to the US Environmental Protection Agency, six principal pollutants, also called "criteria" pollutants, are considered harmful to public health and the environment (see National Ambient Air Quality Standards): ozone, particulate matter (PM), carbon monoxide (CO), nitrogen dioxide (NO_x), sulfur dioxide (SO_2) and lead.

Table 3. Variable List

Variables	Label	Unit	Source
Pollution level measured by total emissions of NO_x	NO_x	Thousand metric tons	United Nations Framework Convention on Climate Change, Greenhouse Gas Inventory Database
Pollution level measured by total emissions of CO	CO	Thousand metric tons	United Nations Framework Convention on Climate Change, Greenhouse Gas Inventory Database
Ratio of value-added tax revenue in total tax revenue	Iratio	In percentage	IMF Government Finance Statistics, 2004
Ratio of central property tax revenue in total central revenue	Cratio	In percentage	IMF Government Finance Statistics, 2004
Ratio of local property tax revenue in total local revenue	Lratio	In percentage	IMF Government Finance Statistics, 2004
Population	pop	Number of people	World Development Indicator Database, 2004
Ratio of public health expenditure over total public expenditure	Hratio	in percentage	Various issues of World Health Report published by World Health Organization
Democracy	dem	[0,1]	Freedom House
Per capita GDP	pgdp	In constant 1995 dollars	World Development Indicator Database, 2004
Corruption perception index	cpi	[0,10]	Transparency International
Land areas	land	Square kilometers	World Development Indicator Database, 2004

Source: Compiled by authors.
Notes: CO, carbon monoxide; NO_x, nitrogen oxide.

logarithm of the dependent and independent variables except for the ratio of health expenditure.[7] We estimate four different models for each of the pollutants here. Model 1 is the pooled OLS regressions. Models 2–4 are the random effects regressions.[8] Models 2 and 3 are the traditional random effects regressions, and are a special form of feasible generalized least squares (FGLS), which takes the country heterogeneity into account and

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[7] The usual empirical practice is that taking logarithms of ratio variables would generate negative values if the relationship between pollution level and ratio of taxes is not linear, we take the logarithm of them after doing some mathematic transformation.
[8] The Hausman specification test indicates that random effects are preferable to fixed effects for our analysis.

which we tend to consider the most appropriate models for our purpose. We include a time trend to account for the time-specific effects in Model 3. Model 4 is the more general form of the FGLS regression in which we try to correct for potential heteroskedasticity. We also check for the potential endogeneity problem for the ratio of health expenditure, using life expectancy at birth as our instrument. The results tell us that in our sample, there is no evidence of endogeneity. The results from all four models are presented in Tables 4 and 5.

From Table 4 we can see that, in all four models, the share of business-related taxes has a positive and statistically significant impact on pollution levels, which supports Hypothesis I. We also find that the magnitude of the relationship between pollution and the business tax ratio ranges from 1.29–1.98 percentage points, indicating that an increase by 1 percentage point in the business tax ratio will lead to a rise in the pollution level of 1.29–1.98 percentage points. The effects of the property tax share at the local level are relatively small, but have significantly negative impacts. This supports Hypothesis II. The coefficients of the property tax ratio at the central and local levels are mixed, which is consistent with our earlier conjecture. The ratios of health expenditures always have negative coefficients, and in Model 4 they are significant.[9] This provides some supporting evidence for Hypothesis III.

The Chinese data provide some additional evidence relevant to our empirical investigation. First, as mentioned above, VAT is closely related to the emission level in China. Second, data from China also reveals the insignificant signs of the property tax ratio at central and local levels. The insignificant result of the property tax ratio at the central level is probably due to the fact that in countries like China, property tax is mainly a local tax.

The measure of democracy gives us systematically positive signs. This suggests that with NO_x in our sample, environmental policy control is performing worse in democratic countries than in non-democratic countries. Given our results, it seems that the impact of the tax structure on government pollution control is larger in non-democratic countries. As a measure of governance, the corruption perception index provides mixed results. In the first three models, the signs are negative, meaning that countries with good governance should have better environments or less pollution, but the effects are not significant. This might be the case because our sample size is small or because the two indexes we use might not be able to capture the political characteristics and overall quality of governance very well.

For the control variables, population and per capita GDP are always positive and significant, meaning that more populated countries and richer countries have higher levels

[9] We did not take the logarithm of the health expenditure ratio; therefore, we need to take caution when interpreting and comparing the results.

Table 4. Regression Results for NO_x

	Model (1) Pooled OLS with robust standard error	Model (2) Random effects	Model (3) Random effects with time trend	Model (4) Feasible generalized least square/correct for heteroskedasticity
	Dependent variable: Logarithm of NO_x			
Ratio of business tax	1.982	1.287	1.448	1.945
	(6.94)***	(2.83)***	(3.39)***	(9.65)***
Ratio of property tax at central level	0.004	–0.020	–0.032	–0.007
	(0.12)	(0.26)	(0.45)	(0.25)
Ratio of property tax at local level	–0.394	–0.300	–0.360	–0.357
	(4.59)***	(1.97)**	(2.51)**	(6.03)***
Ratio of health expenditure	–0.048	–0.071	–0.001	–0.048
	(1.50)	(1.40)	(0.01)	(2.38)**
Population	1.515	1.409	1.374	1.477
	(19.29)***	(8.75)***	(9.21)***	(24.21)***
Democracy	1.557	0.412	0.659	1.699
	(3.39)***	(0.50)	(0.81)	(2.41)**
Per capita GDP	0.472	0.572	0.437	0.394
	(3.46)***	(2.37)**	(1.85)*	(4.55)***
Corruption perception index	–0.066	–0.263	–0.092	0.274
	(0.17)	(0.70)	(0.24)	(1.37)
Land area	–0.321	–0.390	–0.345	–0.285
	(3.62)***	(2.81)***	(2.66)***	(3.89)***
Time trend			–0.073	
			(1.97)**	
Constant	–24.170	–20.003	–19.617	–23.794
	(9.69)***	(4.77)***	(5.01)***	(13.93)***
Observations	64	64	64	64
R^2	0.90			
Number of countries		18	18	18

Source: Compiled by authors.

Notes: Absolute values of *t*-statistics are in parentheses. *, ** and *** indicate statistical significance at 10, 5 and 1 percent levels, respectively. NO_x, nitrogen oxide.

of pollution. Given the high correlation between per capita GDP and the democratic measure, our positive results for democracy are not surprising: countries with higher incomes are

Table 5. Regression Results for CO

	Model (1) Pooled OLS with robust standard error	Model (2) Random effects	Model (3) Random effects with time trend	Model (4) Feasible generalized least square/correct for heteroskedasticity
	Dependent variable: Logarithm of CO			
Ratio of business tax	0.619	0.312	0.502	0.827
	(3.05)***	(0.75)	(1.42)	(7.05)***
Ratio of property tax at central level	0.028	–0.004	–0.010	0.018
	(0.86)	(0.06)	(0.16)	(0.87)
Ratio of property tax at local level	–0.119	0.001	–0.056	–0.134
	(1.21)	(0.00)	(0.48)	(3.02)***
Ratio of health expenditure	–0.072	–0.056	–0.004	–0.091
	(2.07)**	(1.23)	(0.07)	(5.98)***
Population	1.061	0.999	0.975	1.096
	(14.30)***	(6.65)***	(8.02)***	(20.78)***
Democracy	0.266	0.126	0.281	–0.128
	(0.49)	(0.17)	(0.39)	(0.50)
Per capita GDP	0.347	0.340	0.243	0.358
	(3.46)***	(1.54)	(1.23)	(5.41)***
Corruption perception index	–0.409	–0.444	–0.305	0.093
	(1.37)	(1.33)	(0.92)	(0.68)
Land area	0.012	–0.043	0.005	0.046
	(0.17)	(0.33)	(0.05)	(0.90)
Time trend			–0.058	
			(1.75)*	
Constant	–13.794	–11.558	–11.703	–16.187
	(6.73)***	(2.99)***	(3.61)***	(15.01)***
Observations	64	64	64	64
R^2	0.87			
Number of countries		18	18	18

Source: Compiled by authors.

Notes: Absolute values of *t*-statistics are in parentheses. *, ** and *** indicate statistical significance at 10, 5 and 1 percent levels, respectively.

usually more democratic, and these countries have more serious pollution problems.[10] Land area is always negative and mostly significant, suggesting that NO_x gets dispersed as

[10] The pair-wise correlation between per capita GDP and democracy is 0.585, and is highly significant.

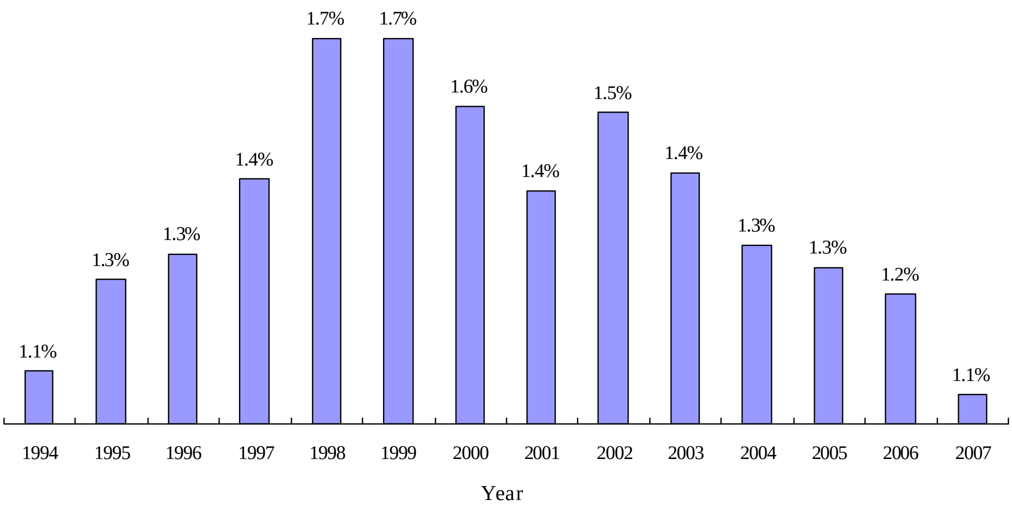
the country is larger in territory.

From Table 5, we can see that for the pollutant CO, we generally have a similar story to that of NO_x, with a smaller magnitude for the business tax ratio. The results are similar for the central (and local) property tax ratio and health expenditure ratio. However, in the two random effects models (2 and 3), business tax ratios are not significant. In addition, the local property tax ratio and the per capita GDP do not have the expected results; however, the health expenditure ratio is always negative and significant in two out of four models. Results for the democracy and corruption perception index are still mixed and the coefficients are mostly insignificant.

China's budget structure also contributes greatly to its fast growing pollution. On the revenue side, as Figure 1 indicates, the overall effect of the Chinese budget structure is pro-pollution. This is probably because the high VAT share discourages the government to control pollution. Moreover, the incentive to control pollution from protecting property tax bases is relative low given the low property tax share (Figure 1 and Table 6). Figure 1 shows China's property-related tax as a share of total tax revenue. Apparently, the incentive to protect the environment is dominated by the incentive to maintain a high level of production, which further leads to a high level of pollution.

Table 6 shows the property tax as a share of total tax by province in China. At the local level, revenue structure does not depart from the national level. For example, the ratios of

Figure 1. China's Property-related Tax as a Share of Total Tax Revenue



Source: Compiled by authors.

Table 6. China's Property-related Tax as a Share of Total Tax Revenue by Province

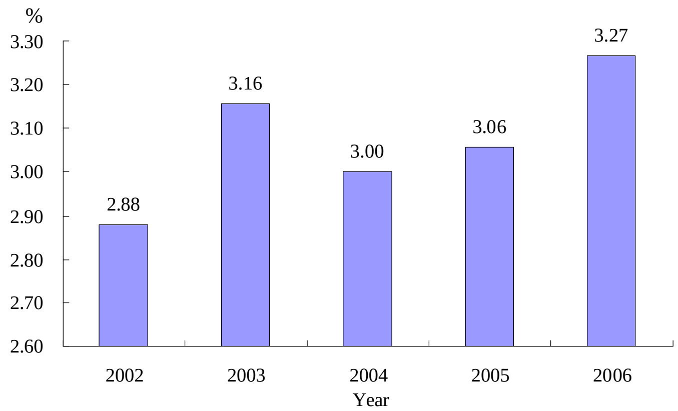
Province	Property tax as share of total tax %	Province	Property tax as share of total tax %	Province	Property tax as share of total tax %
Hainan	4.2	Zhejiang	3.2	Ningxia	2.5
Gansu	4.0	Inner Mongolia	3.1	Chongqing	2.4
Jilin	4.0	Guangxi	3.1	Anhui	2.4
Hei Longjiang	3.8	Hubei	2.9	Qinghai	2.4
Liaoning	3.7	Jiangsu	2.9	Hebei	2.3
Beijing	3.6	Guizhou	2.7	Shanghai	2.2
Fujian	3.6	Hunan	2.7	Jiangxi	2.1
Xinjiang	3.6	Sichuan	2.6	Shanxi	2.0
Shandong	3.4	Shannxi	2.6	Tibet	0.0
Tianjin	3.3	Yunnan	2.5		
Guangdong	3.3	Henan	2.5		

Source: NBS (2008).

property-related tax over total tax revenue are still low for all provinces.

In Figure 2, we present public health expenditure as a share of government expenditure in China. The relatively low share of public health expenditure in the budget structure provides little incentive to government to control pollution. From 2002 to 2006, public health expenditure as a share of total government expenditure was only 2.88, 3.16, 3.00, 3.06 and 3.27 percent, respectively.

Figure 2. Public Health Expenditure as Share of Government Expenditure in China



Source: NBS (2008).

Table 7. Provincial Health Expenditure as a Share of Total Expenditure

Province	Share (%)	Province	Share (%)	Province	Share (%)
Beijing	7.2	Henan	5.3	Ningxia	4.7
Qinghai	6.9	Anhui	5.3	Jiangsu	4.5
Yunnan	6.8	Hebei	5.2	Guangdong	4.5
Jiangxi	6.4	Hubei	5.2	Chongqing	4.4
Tibet	6.2	Guangxi	5.1	Shandong	4.4
Zhejiang	6.2	Hainan	5.1	Hunan	4.4
Guizhou	6.1	Shanxi	5.0	Shanghai	4.1
Ganxu	6.1	Tianjin	4.9	Inner Mongolia	4.1
Xinjiang	5.8	Heilongjiang	4.8	Liaojing	3.8
Fujian	5.7	Jilin	4.8		
Sichuan	5.6	Shannxi	4.7		

Source: NBSC (2008).

Table 7 portrays health expenditure as a share of total expenditure at the provincial level. Health expenditure as a share of local expenditure is low in all provinces; therefore, the negative consequence of pollution to human health would not attract local governments' attention, as Hypothesis 3 predicts. Therefore, the budget structure in China also provides little incentive to protect the environment at the local level.

On both the revenue and the expenditure sides of China's budget structure, neither the national nor local governments have strong incentives to curb pollution. In other words, the return from protecting the environment is low. We believe that the budget structure can help in the understanding of why pollution is so rampant in China.

IV. Conclusion and Policy Implications for China

In this study we provide empirical evidence to support the proposition that government budget structure can influence government incentives and, therefore, has a significant impact on the provisions of public goods, such as environmental quality. We establish that government incentives and budget structure can have significant impacts on government behavior and that these impacts exist regardless of the political characteristics of particular countries. Therefore, for the purpose of dealing with environmental problems, in addition to other direct and indirect regulations, incorporating government budget structure into the process of decision-making might be worthwhile. More specifically, transition from a more business-related tax system to a tax system more dependent on property tax, as well as establishing a government-financing health-care system might be conducive to improving environmental performance.

China has been growing very fast over the past several decades. Along with fast economic growth, industrial activities bring about higher pollution levels. To make things worse, local governments in many regions, in competing for industrial investment and tax revenue, are sacrificing local quality of life by allowing industrial investors to pollute local environments. At present, the issue of pollution control is high on the central policy agenda. We believe that the policy implications derived from our empirical analysis are clear. China should not only strengthen its pollution supervision and control system, but also further reform its public finance system to reduce local fiscal incentives in competing polluting industries. Given that the VAT and business tax are the most important government revenue sources in China, a shift to a tax system that is more dependent on property tax would certainly help to improve local government incentives to control pollution and improve the environment. In addition, raising the share of public health expenditure in total government expenditure will also assist China to win the war against industrial pollution.

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