7

Conclusion: Rethinking Local Governance and Accountability

Air pollution creates a silent and invisible global pandemic, claiming many more lives than AIDS and malaria combined (Figure 7.1). Breathing polluted air makes one more vulnerable to dying from infection with COVID-19. Hence, understanding the determinants for air pollution regulation is highly critical and timely. From a political science perspective, I pose the question: how do local political incentives shape air quality over time?

Political scientists have identified three main reasons to explain the persisting and static existence of environmental problems. First, career-minded local politicians or leaders promote the economy and infrastructure projects to fulfill their constituencies' or political superiors' desires. Such pursuit of the more "critical," visible, and measurable policy outcomes often undermines environmental protection. Second, and relatedly, environmental planning led by local leaders tends to be shortsighted because, unlike growth and other policy goals, environmental policy outcomes can take a long time to manifest. A short-termed politician or leader may not be able to claim credit for their efforts. Last but not least, challenges with local monitoring can weaken the enforcement of environmental regulations.

However, what explains the systematic variation in air quality over time? Existing works have highlighted the role of ad hoc, top-down regulation campaigns in inducing local policy waves that influence air quality. In stark contrast to existing works, I put forth the political regulation wave theory to explain systematic patterns in air pollution regulation in the same locality across time, independent of weather, climate, seasonal factors, and top-down campaigns. It is intended to be a general theory on regulatory policy implementation, within scope conditions.

I posit that top local politicians or leaders are incentivized to prioritize different policies at different times across their tenure to improve their reelection or promotion chances. In a decentralized political system that provides local leaders with some degree of discretion over decision-making, local leaders or politicians can influence regulatory bureaucracies' activities to advance their preferred policies and their implementation. When implementing a particular policy involves a high level
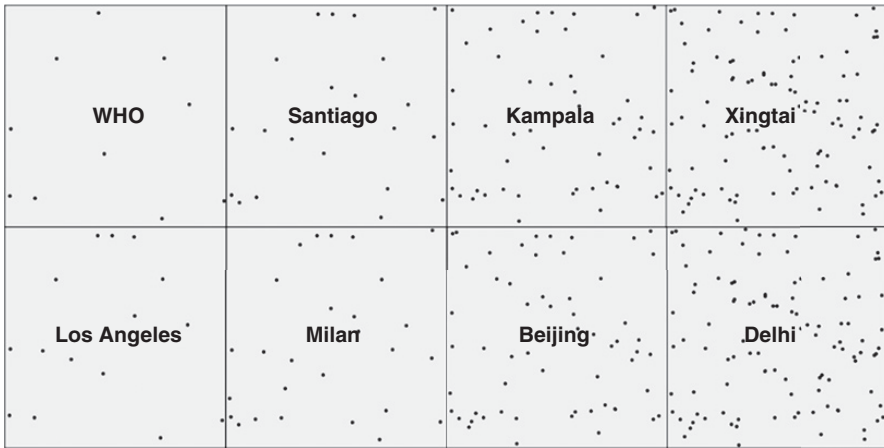
FIGURE 7.1 Display of annual average $PM_{2.5}$ pollution concentration in micrograms per cubic meter ($\mu g/m^3$) in cities worldwide in 2017, compared with the WHO recommended threshold of 10 $\mu g/m^3$. Each dot represents one microgram and each box represents one cubic meter. IQAir; WHO.

of conflict and a low level of ambiguity, such implementation is political. Hence, the local leaders or politicians can induce what I call "political regulation waves."

For pollutants like SO_2, whose characteristics satisfy the scope conditions of the theory, there are two major testable implications of its regulatory patterns. When the pollutant does not have binding reduction targets, top local leaders or politicians are incentivized to gradually order laxer regulation to promote employment, social stability, and (reported) economic growth, leading to a political pollution wave. When it does take on binding reduction targets, the regulation pattern should approximate a more Weberian-style one, where regulation is relatively consistent over time, leading to a political environmental protection wave.

For other types of pollutants like $PM_{2.5}$, whose control involves some ambiguity, effective policy implementation is not decided mainly by political power. When it is not yet a criteria air pollutant, we would expect to observe political pollution waves because economic growth and stability maintenance are critical and relatively unambiguous goals. Promoting those goals often comes hand in hand with the generation of $PM_{2.5}$. However, when incentives are built into the system to regulate $PM_{2.5}$ more and more aggressively over time, we may not observe a political environmental protection wave – as desired by local political leaders in accordance with their superiors – because efforts to regulate do not translate well into effectiveness of regulation. Worse still, some seemingly innocuous measures to reduce some precursor of $PM_{2.5}$ may inadvertently add to other precursors, resulting in more $PM_{2.5}$ pollution.

The case of air pollution regulation in China provides an exciting testing ground. I bring fresh insights from extensive field interviews and newly available satellite-derived air pollution datasets to shed light on how the career incentives of top local leaders in China shape environmental regulation over time, engendering systematic local policy waves and yielding significant normative consequences for social welfare, and posing difficult tradeoffs for decision-makers.

I use both official and satellite-derived statistics to uncover patterns in local air pollution regulation and economic development over time in China. Each data source gives valuable information: official statistics reveal what local leaders try to make their superiors believe about their performance, while satellite-derived data are believed to be more objective and reflective of reality. Consistent with my theoretical predictions, I identified political pollution waves of SO_2 and $PM_{2.5}$ before they became criteria air pollutants. Both official and satellite-based data corroborate the pattern of a political environmental protection wave for SO_2 regulation after SO_2 reduction received binding targets. In contrast, after $PM_{2.5}$ assumed criteria air pollutant status, political pollution waves continued, though official statistics would reveal much-dampened pollution waves for prefectures treated for $PM_{2.5}$ binding reduction targets. The effective management of $PM_{2.5}$ by local regulators is hampered by the nature of $PM_{2.5}$ pollution, which has several sources spanning a wide range of sectors and complex formation processes that scientists and policymakers are still trying to grapple with – the level of ambiguity is high. Effective regulation of a pollutant whose successful control does not rely solely on political power requires more intimate knowledge of the sources of $PM_{2.5}$ for each individual locality.

The key takeaway is that local political incentives can engender powerful, systematic policy waves, which raises new questions about local governance and accountability in autocracies and democracies alike. The political regulation wave bears normative significance and difficult tradeoffs. A political pollution wave may benefit jobs and the economy but claim and impair additional lives due to excessive pollution. A political environmental protection wave may boast cleaner air, but that may come at the expense of economic growth and employment.

The rest of the chapter unpacks this dilemma in three ways. First, I will demonstrate the applicability of the theory of the political regulation wave to countries beyond China, using municipal air quality patterns in Mexico as an example. Second, I will summarize the book's findings in more detail. Finally, I will discuss the results' broader implications for political science, public policy, and environmental studies as well as the insights they provide for making China's new and ongoing efforts to curb carbon emissions more successful. The chapter will end with a discussion of future research directions.

7.1 EXTERNAL VALIDITY

While the book uses China as the primary testing ground partly because much less is known about local governance in authoritarian regimes, the theory is meant to be a general theory applicable to a wide range of contexts under scope conditions within and beyond environmental governance. To recap, the three scope conditions are: (1) local political discretion and control over the bureaucracy, (2) career incentives to prioritize different policies at different times during tenure, and (3) high-conflict, low-ambiguity policy issues.

To demonstrate the external validity of the theory, I apply it to study air pollution trends at the municipal level in Mexico, where state governors have discretionary power over bureaucracies' regulatory activities. The promotion of expressed voter welfare, which is unambiguous, often involves scaling back on regulation, which results in more pollution.

I start with a telling anecdote. Amid a spike in fuel prices in 2017, Aristóteles Sandoval, then governor of the Mexican state of Jalisco, ordered the suspension of the smog check program, a pollution-reduction scheme he promised to revamp on the campaign trail. The "temporary suspension" of the program, he stated in a speech, was aimed at "protecting household finances" (Villaseñor 2017). However, the program was never restored, and Jalisco's air quality became even worse than that in Mexico City (Vallarta Daily News 2019). In the following gubernatorial election year, Sandoval stated before leaving his governor post that the environment should be part of the next governor's responsibility. The cost and frequency of smog checks made the program unpopular among the public. The behavior of Jalisco's governor is part of a general pattern where electorally minded politicians appeal to voter priorities by implementing such policies that offer one form of welfare improvement (e.g., less spending on smog treatment) but harm another form of welfare (e.g., clean air and public health) near election time.

In the following subsections, I will provide a brief overview of air pollution in local Mexico and the power of state governors in influencing air quality. Then I will lay out the testable implications of the political regulation wave theory in the context of Mexico, followed by a presentation of the empirical results. Empirics for this case study are drawn from collaborative work with Edgar Franco Vivanco and Cesar Martinez Alvarez.

7.1.1 *Air Quality Trends and Policies in Mexico*

After the Second World War, Mexico's import substitution industrialization strategy engendered massive amounts of pollution, especially in large urban centers. While industry contributed the most to Mexico's vexing air pollution problem in the early periods, the expansion of private vehicle ownership has emerged as the most critical driver of environmental woes in recent memory (Molina and Molina 2004). Mexico City and other metropolitan areas became notorious air pollution hubs that made

international headlines, impaired public health, and aroused concerns about the government's ability to handle pollution emergencies.

The federal and state governments implemented a series of policies in response to the pollution crisis. For the long term, politicians of Mexico City and Mexico State passed the Program of Air Quality Management (ProAire), which presented a cohesive strategy for a number of policies and encouraged cooperation among different levels of government and between ministries (Molina and Molina 2004). Other states followed suit and started implementing their own versions of the ProAire. For the intermediate term, the federal government ordered the relocation of large industrial facilities out of urban areas, imposed nationwide fuel standards and the installment of catalytic converters in automobiles, and reset the maximum permissible thresholds for pollutants.[35] Furthermore, Mexico City enacted two additional policies. First implemented in 1989, Programa Hoy No Circular served to limit the number of cars on the road. Policy evaluations suggest that policy effectiveness varied across time and space (Davis 2008; Guerra and Millard-Ball 2017; Vera, Rocha Romero, and Gómez Farías Mata 2015; Molina and Molina 2004). The other policy, Programa de Contingencia Ambiental, bestowed the mayor of Mexico City with the power to declare environmental emergencies.

These various measures combined paid off, and by the early 2000s, Mexican cities successfully exited the ranks of the most polluted in the world. However, environmental health remained a problem, with a deterioration of air quality in small- and medium-sized urban areas. It was estimated by official sources that an annual 29,000 premature deaths and 558,000 disability-adjusted life-years (DALY) from air pollution occurred in Mexico during 2015 (Dirección de Salud Ambiental 2016).

7.1.2 *How Mexican State Governors Can Influence Air Quality*

In this subsection, I will describe the political incentive structure and the discretionary power of subnational politicians, especially that of state mayors, in Mexico to influence air quality; such conditions make local air quality in Mexico a compelling case to apply the theory of the political regulation wave. Specifically, I focus on four aspects of political development that have shaped local politics in Mexico: (1) rising spending power of state governors, (2) decentralization of environmental policy, (3) electoral incentives to promote polluting activities around elections, and (4) low voter priority for environmental policies.

Rising Spending Power of State Governors
In the past three decades, decisions on public spending have been substantially delegated to state governors (Diaz-Cayeros 2019; Cejudo Ramírez and Ríos Cázares

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[35] Catalytic converters facilitate chemical reactions to transform harmful substances in exhaust gas (e.g., CO, NO_x, HCs (hydrocarbons) into less harmful ones (e.g., CO_2, H_2O).

2009; Sempere and Sobarzo 1998; Ugalde 2002). Furthermore, transfers of funds from the federal to local levels have offered little incentive for local governments to collect taxes (Diaz-Cayeros 2019). On average, states generate about 4 percent of their revenues from taxes and municipalities around 1.6 percent.[36] The rest of their revenues come from federal transfers.

The 1998 amendment to the Fiscal Coordination Law created special budget lines for education, health, and social infrastructure, which substantially increased state governors' spending power. In other words, states gained earmarked transfers in addition to revenue-sharing funds (Congreso de los Estados Unidos Mexicanos 1998). The two main budget lines are the Ramo 33 (*participaciones*), explicitly given to support education and development projects and which accounts for about 60 percent of transferred revenue, and the Ramo 28 (*aportaciones*), nonearmarked and discretionary funds that account for the remaining 40 percent of transferred revenue.

Auditing has been minimal, giving state governors considerable discretionary power in allocating funds. Created in 2002, Auditoría Superior de la Federación, the federal fiscal unit, does not wield de facto power over Ramo 28 allocations, and it only audits 100 out of 2,450 municipalities and half of the Ramo 33 allocations. All in all, the evolution of Mexico's fiscal state bestows more spending power on local governments, particularly state governors. Coupled with limited auditing, local politicians have gained more wiggle room to exercise discretion that may aid their political goals.

Decentralization of Environmental Policy

In addition to rising fiscal power, state governments have gained considerable power to make and implement environmental policies thanks to a series of reforms from the late 1980s to the early 1990s, especially the enactment of the 1988 General Law on Environmental Protection and Ecological Equilibrium (Domínguez 2010). Local politicians can influence air quality in indirect ways, too. For example, state governors can shape citizen mobility via the Hoy No Circula program, which restricts the number of cars in circulation on a daily basis, and the *tenencia*, which taxes car ownership (Molina and Molina 2004). State-level officials can also issue fines to vehicles that fail to comply with existing regulations and declare environmental emergencies as they see fit, though anecdotal evidence suggests some reluctance for state executives to declare emergencies because that could negatively affect their constituents financially.

To a lesser degree than state governors, mayors at the municipal level can also impact environmental policy implementation. For example, mayors' influence on decisions on land use permits, zoning, waste management, and other urban planning

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[36]   In other words, the extent of federal transfers is very high in Mexico. To put that in perspective, for OECD countries, the averages of the percentage of revenues from taxation are about 20 percent and 10 percent for secondary (e.g., state) and tertiary (e.g., municipality) levels – much higher than the levels in Mexico.

issues can affect air quality, since unpaved roads and construction are the two major sources of air pollution in Mexican metropolitan areas (Molina and Molina 2004).

Electoral Incentives to Promote Polluting Activities around Elections

The no-reelection rule has applied to local politicians for a long time and was only lifted very recently for mayors; however, they may still harbor incentives to provide immediate economic benefits to voters. Mexico's elections are centered around political parties; that is, voters tend to hold the political parties of the incumbents rather than incumbents themselves accountable. Hence, an incumbent's perceivably poor performance could negatively impact the party's electoral prospects in future elections (Arias et al. 2019; Chong et al. 2015; Larreguy, Marshall, and Snyder 2018). Since political party leaders can influence the future career of members of their parties, it is critical for the incumbent to leave a positive impression. As a result, local politicians can still be incentivized to cater to voters despite the no-reelection rule, especially around election times.

Low Voter Priority for Environmental Policies

Due to a general lack of awareness about pollution's deleterious health effects, the Mexican public tends to deprioritize environmental issues. Anecdotes and surveys suggest that Mexican voters care the most about their financial well-being and public safety, above all else, and thus would be willing to tolerate poor air if there are perceived economic benefits. Different economic policies, including but not limited to growth rate, inflation, and exchange rate, dominate public concerns and are closely correlated with electoral outcomes (Murillo and Visconti 2017; Hart 2013; Singer 2011, 2013; Singer and Carlin 2013). Other studies have documented acute voter concern over personal safety and crime rates (Romero, Magaloni, and Díaz-Cayeros 2016; Carlin, Love, and Martínez-Gallardo 2015).

The 2018 Latinobarometer survey further confirms the relatively low level of voter concern about the environment. According to the survey results, only 34 percent of respondents believed that the government should prioritize ecological protection over economic growth (Latinobarómetro 2018). Less than 1 percent considered the environment to be the utmost important issue in Mexico. All this evidence collectively shows that voter attention to environmental policies is low in Mexico.

To sum up, the political developments in the past few decades in Mexico provided conditions for political pollution waves to be observed at the state level. State governors have gained substantial influence over budget allocation, especially regarding public works (e.g., roads, highways, bridges), and the power to make decisions on most policies related to air quality. Mayors are relatively constrained in resources and authority. The federal government serves the role of coordination and institution building. Given voters' general lack of concern over environmental

issues, state governors are incentivized to appeal to the immediate, perceivable economic needs of the voters, which may be at the expense of air quality.

7.1.3 *Research Design and Empirical Findings*

The goal is to quantitatively assess the relationship between the gubernatorial electoral calendar and the air quality in Mexican municipalities. The timing of gubernatorial elections is plausibly exogenous, given that not all states have elections in the same years and that governors have no control over the timing of elections. Federal electoral authorities determine the timing of elections. The empirical strategy employed here is similar to those in other studies that exploit the exogenous timing of elections (Pailler 2018; Fukumoto, Horiuchi, and Tanaka 2020; Christensen and Ejdemyr 2020). The specification of the regression equation is expressed below.

$$\tau_{m,t} = \beta Election_{s,t} + \mu_m + \delta_s \times T_t + \epsilon_{m,t} \qquad (7.1)$$

In Eq. (7.1), $\tau_{m,t}$ represents the outcomes of interest in municipality m in year t. Such outcomes include $\log(PM_{2.5})$, the natural logarithm of the annual average $PM_{2.5}$, and various economic outcomes to be detailed later in the chapter. $Election_{s,t}$ is a dummy variable, which is assigned value "1" for a year when there was an election for governor in the state s where municipality m is located and "0" if otherwise. μ_m denotes municipality fixed effects, which control for time-invariant municipality-level characteristics. $\delta_s \times T_t$ represents the interaction effects between state and year fixed effects, which control for state-specific shocks in any given year that may affect pollution, such as state-level policy change. This interaction term should absorb the effects of state-initiated ProAire programs, implemented in different versions and at different times across states. $\epsilon_{m,t}$ is the disturbance term. The coefficient of interest is β, which measures the average effect of the gubernatorial election year on pollution, using nonelection years as the baseline. Since the outcome variables for the same municipality are very likely to be highly correlated, I cluster the standard errors at the municipal level.

The theory of the political regulation wave would predict that a strategizing state governor prioritizes different policies at different junctures during their office to maximize the chances for their political party to win the subsequent election. Catering to the prevailing voter preferences, a strategizing state governor would plausibly promote more infrastructure projects and/or order laxer environmental regulation, which could inadvertently result in the highest level of air pollution around election time; that is, β would be positive at a statistically significant level.

H1 **Political pollution wave**: *The level of pollution peaks in gubernatorial election years, ceteris paribus.*

As detailed in Chapter 5, in the China case, the gradual increase in air pollution is attributed solely to regulatory forbearance rather than economic growth. That makes intuitive sense because the tenure length is highly variable and timing economic activities, which would require advanced planning, would not be very feasible; in contrast, regulatory stringency can be adjusted quickly.

What about in Mexico? In most democracies, tenure length is fixed and is known as a "term." In Mexico, state governors and the mayor of Mexico City had fixed terms of six years, and municipal mayors had fixed terms of three years. Given fixed terms, politicians can plausibly time their policies strategically for electoral gains. As such, peak pollution in election years could be the result of economic boom, regulatory forbearance, or both. For instance, local politicians could signal their competence and commitment to their constituents' well-being by building visible infrastructure projects, such as roads, bridges, and highways, which can generate copious amounts of pollution.

H2a **Economic boom**: *Peak pollution in gubernatorial election years is the result of ex-ante strategic economic planning.*

It is also possible that politicians could strategically influence the enforcement of environmental regulations, such as vehicular emissions standards, less strictly around election time in order to reduce household expenditure like in the anecdote from Jalisco. It shall be noted that the existence of one mechanism does not preclude the possibility of the other; the two mechanisms can coexist.

H2b **Regulatory forbearance**: *Regulatory forbearance explains peak pollution in gubernatorial election years.*

Data and Variables

The main dependent variable is the annual average municipal-level $PM_{2.5}$ concentration. The major sources of $PM_{2.5}$ – industry, transportation, and construction – correspond to the types of economic projects that local politicians in Mexico tend to prioritize to appeal to voters. Similar to the China case, the same satellite-derived $PM_{2.5}$ dataset is used (van Donkelaar et al. 2015; van Donkelaar et al. 2019).

To assess whether and how the political pollution wave can be explained by economic factors, I regress gubernatorial election year on a series of dependent variables related to different dimensions of economic policies. First, I look into the overall level of economic activities. The lack of high-quality, consistent, and continuous GDP statistics at the municipal level creates a challenge. I follow Robles, Magaloni, and Calderón (2013) and use per capita electricity consumption as a proxy. This data is available from Comisión Federal de Electricidad (www.cfe.mx), Mexico's state-owned electricity utility. Second, I refer to per capita vehicle statistics. Although time-series gasoline and diesel consumption data are not available at the municipal level, per capita car ownership can be a proxy because there is a general correlation between the level of

ownership and overall fuel consumption. Car ownership data is from Mexico's National Institute of Geography and Statistics (INEGI) (www.inegi.org.mx). Third, I use data on public investments in infrastructure projects and overall municipal spending. Thanks to data from the INEGI, I refer to the length of federal highways, state highways, and rural roads as well as per capita investment in housing construction projects.

The key explanatory variable is the gubernatorial election year. Gubernatorial election dates from 2000 to 2015 were collected from the federal electoral court's official records, known as the *Tribunal Electoral del Poder Judicial de la Federación (TEPJF)* (www.te.gob.mx).

Finally, the analysis employs a wide range of control variables that could also influence pollution concentration. They are population and the number of companies in the construction, electricity, and manufacturing sectors. Firm data come from INEGI's National Statistical Directory of Economic Units (DENUE) (www.inegi.org.mx/app/mapa/denue) and are normalized to the number of firms per 100,000 inhabitants for each sector.

Empirical Evidence

The results in Table 7.1 suggest that compared to nonelection years, the gubernatorial election year is correlated with a 1.12 $\mu g/m^3$ increase, or 4.5 percent higher, in the annual average $PM_{2.5}$ concentration, *ceteris paribus*. An increase of 1.12 $\mu g/m^3$ is substantial, because the WHO recommends that the annual average $PM_{2.5}$ concentration should not exceed 10 $\mu g/m^3$, and 1.12 $\mu g/m^3$ is about 11 percent of that threshold. According to the results from the subsample analysis for urban and

TABLE 7.1 *Relationship between gubernatorial election year and satellite-derived $PM_{2.5}$ concentration*

	Log ($PM_{2.5}$)		
	All	Urban	Rural
Election year	0.12***	0.12***	0.10***
	(0.03)	(0.04)	(0.01)
Mean log ($PM_{2.5}$)	2.56	2.83	2.50
Municipality FE	Y	Y	Y
State FE x year FE	Y	Y	Y
Controls	Y	Y	Y
Observations	34,935	5,250	29,685

Sources: TEPJF; INEGI; van Donkelaar et al. 2015; van Donkelaar et al. 2019.
Note: Clustered standard errors appear in parentheses.
* indicates significance at the 10% level.
** indicates significance at the 5% level.
*** indicates significance at the 1% level.

TABLE 7.2 *Relationship between gubernatorial election year and per capita vehicle ownership and per capita electricity consumption*

	Vehicles	Electricity
Election year	−0.14***	−1.10
	(0.02)	(0.86)
Municipality FE	Y	Y
State FE x year FE	Y	Y
Controls	Y	Y
Observations	29,211	26,533

Sources: TEPJF; Comisión Federal de Electricidad; INEGI.
Note: Clustered standard errors appear in parentheses.
* indicates significance at the 10% level.
** indicates significance at the 5% level.
*** indicates significance at the 1% level.

rural municipalities, the electoral effect appears to be stronger in urban than in rural areas.

I next turn to assessing the relationship between gubernatorial election year and private forms of consumption that reflect some aspects of economic development, namely, vehicle ownership and electricity consumption. The results in Table 7.2 suggest no positive relationship, meaning that neither vehicle ownership nor electricity consumption is likely to have been responsible for the peak in $PM_{2.5}$ pollution in state-level election years.

To further explore whether public projects and spending, which generate both economic growth and air pollution, could explain the political pollution wave, I conduct similar regression analyses, using investments in road and housing and municipal spending as the outcome variables. All five outcome measures are normalized by the population size of the municipality. The results in Table 7.3 suggest that the association between the timing of gubernatorial elections and public investments and expenditure is statistically insignificant across models, providing further evidence that the political pollution wave was unlikely the result of economic expansion.[37]

Since granular data on environmental enforcement is unavailable for the municipal level, a direct examination of the association between election year and enforcement efforts is not possible. However, I contend that regulatory forbearance is the most likely candidate to account for the political regulation wave. As mentioned in earlier chapters, pollution is the result of two major conduits: economic

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[37] This does not suggest that political business or budget cycles do not exist in Mexico. Such cycles are well documented at the federal level (Coutino 2017). The argument here implies that these cycles work differently at the local level and may not manifest in the types of observational data used in the analysis here.

TABLE 7.3 *Relationship between gubernatorial election year and public investments and expenditure*

	Federal road	State road	Rural road	Housing	Spending
Election year	−0.17	0.16	−0.96	−123.92	−973.10
	(0.16)	(0.30)	(0.65)	(547.54)	(721.68)
Municipality FE	Y	Y	Y	Y	Y
State FE x year FE	Y	Y	Y	Y	Y
Controls	Y	Y	Y	Y	Y
Observations	22,401	21,423	21,312	29,312	30,648

Sources: TEPJF; INEGI.
Note: clustered standard errors appear in parentheses.
* indicates significance at the 10% level.
** indicates significance at the 5% level.
*** indicates significance at the 1% level.

growth and environmental regulation (Ringquist 1993). Results exhibited in Tables 7.2 and 7.3 suggest that the economic pathway that may produce $PM_{2.5}$ pollution is highly unlikely, making regulatory forbearance the mechanism to explain the political pollution wave.

The finding of regulatory forbearance as the primary mechanism to explain political pollution waves in Mexico is akin to China's. The difference is that tenure length is flexible in China but fixed in Mexico. In the presence of fixed terms, it is possible to time economic activities strategically, but why did state governors in Mexico opt for regulatory forbearance over an economic boom? Likely because changing regulatory stringency can involve fewer actors, is more straightforward to implement, and is likely more palpable to a larger segment of the population than trying to induce actual changes in economic outcomes. For instance, most families own cars. The convenience of not having to go through frequent smog checks and saving money that would otherwise be spent on pollution treatment would make many voters happy. As a result, they would be more approving of the political party of the incumbent governor.

7.1.4 *The Tradeoffs of Political Pollution Waves in Mexico*

Creating a political pollution wave entails both social costs and benefits, creating complex tradeoffs. The main social benefit is protecting household finances. Families can be spared fines when they are not compliant with emissions standards, and factory owners can save on pollution treatment. On the other hand, the less perceivable air pollution can bring substantial health consequences for inhabitants. To assess the extent of the human costs, I follow a similar approach as in the China

TABLE 7.4 *Estimated premature deaths due to election-induced* PM$_{2.5}$ *emissions based on satellite-derived measures in the gubernatorial election year*

Sample	Counterfactual mortality	Actual mortality	Percentage increase (%)
All municipalities	35,345	38,290	8.33

Sources: WHO 2004; Wu et al. 2017; van Donkelaar et al. 2015; van Donkelaar 2019; INEGI; coefficient estimate from my regression analyses.

case and seek to construct a credible counterfactual for pollution levels in the absence of gubernatorial elections. I presume that the counterfactual level of pollution in gubernatorial election years is the average of actual pollution levels in nonelection years. The average difference between the actual and the counterfactual PM$_{2.5}$ concentration, from Table 7.1, is 1.12 μg/m^3 in gubernatorial election years. Based on the results shown in Table 7.4, the election year was on average associated with an 8.33 percent increase in mortality from the increase in PM$_{2.5}$ alone.

7.2 SUMMARY AND IMPLICATIONS

7.2.1 *Summary of Results*

Regulatory governance operates in two primary modes: regular activities and campaigns. According to Max Weber's seminal work on bureaucracy, regular activities in bureaucratic agencies are carried out as official duties. The rule-bound authority to pursue these duties is distributed in a *stable* way. By contrast, top-down implementation campaigns are usually short-lived, disruptive of regular activities, tough in sanctioning, and demanding in the mobilization of high levels of resources and attention, making them quite effective at achieving results in a short time. These characteristics of campaigns give rise to the conventional wisdom that campaigns are the main political driver of local policy waves at the implementation stage.

The perspective advanced in this book diverges sharply from many of the existing works on top-down, campaign-style policy implementation. The book challenges the assumption that regular, Weberian-style regulation delivers consistent policy outcomes and that local policy waves result from campaign-style regulation. It seeks to tackle two interrelated puzzles in public policy. Can local bureaucratic enforcement activities also generate local policy waves? If so, how?

In the first empirical case study, I draw on evidence from a policy shift in China to control SO$_2$ emissions during the 10th FYP (2001–5) and the 11th FYP (2006–10), the latter of which made reduction targets binding. Based on evidence from prefectures

that received high reduction targets, I document a gradual relaxation of industrial regulation during the top prefectural leaders' tenure during 2001–5, as the leaders gradually prioritized other, more "critical" goals such as stability and growth to maximize their career payoffs. The regulatory pattern became much more consistent during a given tenure over the 2006–10 period, approximating Weberian-style regular enforcement. Both official and satellite-based statistics concur on these trends.

In the second empirical case study, I use satellite-derived and official monitor-based readings of $PM_{2.5}$ concentrations. $PM_{2.5}$ has diverse emissions sources spanning several sectors and complex formation processes. Even until the time of this writing, scientists are still discovering new and unexpected sources of $PM_{2.5}$ (Xing et al. 2020). The difficulty of effectively managing $PM_{2.5}$ creates much more ambiguity for local regulators. During 2000–10, before reduction targets of the pollutant became binding, I find that top local leaders were incentivized to increasingly order laxer regulation during their tenures, which generated copious amounts of byproduct $PM_{2.5}$ pollution. During 2013–17 under the Clean Air Action Plan, political pollution waves continued in both treated and untreated prefectures, though officially reported local monitor readings seem to suggest much-attenuated pollution waves in treated prefectures. Furthermore, the strength of the pollution waves is positively correlated with the lack of connection between the prefectural party secretary and their direct superior.

In the third empirical case study, I shift the regional focus to Mexico to demonstrate that the political regulation wave is also observed in democratic contexts under the scope conditions of the theory. Based on empirical data from Mexican municipalities between 2000 and 2015, I identify a statistically significant $PM_{2.5}$ pollution peak in gubernatorial election years compared to nonelection years. This increment is substantial because it is equivalent to about 11 percent of the annual average concentration threshold set by the WHO. Based on a very conservative estimate, that increment in $PM_{2.5}$ induces an 8.33 percent increase in mortality from $PM_{2.5}$ alone – not accounting for the mortality consequences of the synergistic effects of $PM_{2.5}$ and other pollutants like SO_2. All of this shows that the political pollution wave in Mexico results from regulatory forbearance, rather than economic growth – the same as the China case.

7.2.2 *Implications and Contributions: Narrow and Broad*

Theoretical Implications

Theoretically, the book illuminates a new driver of local policy waves by showing how local political incentives can shape policy outcomes in plausibly predictive ways, reflected in both reported statistics and actual implementation. Such incentive-based local political regulation waves exist independently of top-down implementation

campaigns, the latter of which have been extensively theorized and documented as the drivers of local policy waves.

What do these findings on local governance imply about political accountability across regimes? The local leader or politician's strategic prioritization of policy goals may affect political accountability by inducing political superiors or voters to make decisions based on performance indicators at crucial times (i.e., toward the end of their term or tenure). While political promotion and election schemes are designed to select the good and competent types, the political regulation waves fostered by strategizing local leaders or politicians suggest that the types that end up being advanced by the existing political selection institutions are not necessarily those who are the most public interest minded.

Findings in this book also offer new insights into the study of a regime-based dichotomy between democracies and autocracies in public goods provision. Public goods provision is a critical component of good governance. Existing works have theorized extensively that in democracies, where power is more evenly distributed across groups, more spending is devoted to public goods than in autocracies (McGuire and Olson 1996; Niskanen 1997; Lake and Baum 2001; Bueno de Mesquita et al. 2003; Deacon 2009; Hamman, Weber, and Woon 2011). However, findings from the Mexico case suggest that electoral responsiveness can reduce one critical type of public goods provision – air quality – around election time and that democracies and autocracies may not be that different in providing that specific public good. Part of the reason stems from a lack of voter awareness of the negative health effects of poor air quality. This finding joins a thin pile of works that report null effects of regime type on public goods provision (Lott 1999; Mulligan, Gil, and Sala-I-Martin 2004).

Furthermore, findings in the book provide new insights into the conditions under which the right incentives can contribute to public goods provision. Existing literature suggests that politicians/political leaders and bureaucrats coproduce public goods; politicians/political leaders allocate funds, and bureaucrats use those funds to produce public goods. Thus, the quality of public goods provision would hinge upon politicians' or leaders' competence in making things happen – which would require effective monitoring of bureaucrats – and also bureaucratic quality in effectively and efficiently delivering public goods. However, the results from this book suggest that while those factors are critical, the characteristics of a particular public good also matter. Clean air is a critical type of public good that one cannot live well without, and it requires the absence or low concentration of different types of air pollutants. A caveat is that the regulation of different air pollutants involves dealing with varying levels of ambiguity. For pollutants like $PM_{2.5}$ that carry a relatively high level of ambiguity and are therefore difficult to regulate, the provision of clean air can be jeopardized even when politicians/leaders and bureaucrats are presented with the right incentives and adequate monitoring.

Empirical Implications: Environmental Policy Implementation in China and Beyond

Using more advanced pollution data that became available recently, the empirical findings provide new insights into environmental policy implementation in China in three regards, which can plausibly be extrapolated to broader contexts under scope conditions of the theory. First, the results suggest that environmental policies are not always sacrificed at the altar of economic development, and that this is true even when the economy and stability are principal objectives. Instead, as the evidence shows, local leaders implemented environmental policies relatively well early on in their tenure.

Second, the findings challenge the usual claim that poor environmental policy implementation reflects a lack of funding and state capacity to regulate. Instead, results in this book suggest that even when there are sufficient resources and capacity to control pollution, strategizing local leaders may opt for laxer regulation of pollution. In China, local leaders extended such forbearance to achieve economic and stability goals when both were top priorities. In Mexico, the aim was to protect household finances, as was the case in China.

Third, this book demonstrates that systematic changes in environmental quality over time is influenced by changes in regulatory stringency rather than economic growth. When regulation is relaxed, polluters may resort to consuming dirtier fuels or halting their pollution treatment facilities, resulting in more pollutant emissions per unit of economic output or consumption. Hence, *the political pollution wave is not the by-product of the political business cycle; instead, it originates from strategic regulatory forbearance.*

Empirical Implications: Central-Local Relations, Without the Principal-Agent Dilemma

With regard to the study of Chinese politics, this book makes the first comprehensive effort in the subdiscipline to highlight and document the dynamic nature and temporal patterns of local political behavior in the pursuit of multiple goals under *nomenklatura* control. This book calls into question the current assumption about local implementation in only one policy area – be it full or minimal – by studying a multigoal scenario where there is a systematic trend in and range of implementation over time. While existing works have documented the *static* fact that political behavior alters with changing incentives (van Rooij et al. 2017; Zhang 2017), this book shows that in the pursuit of multiple policy goals strategic local leaders change their prioritization over time to augment their prospects for career advancement. Such political behavior is rewarded by their superiors, indicating that it is *not* a misaligned principal-agent scenario. This finding reminds China scholars to consider this timing factor in interpreting the level of implementation at the local level.

In contrast to the vast existing literature on central-local relations in Chinese politics that argue a principal-agent dilemma exists, the political regulation wave

represents a case where political superiors and subordinates share aligned prefer-
ences. A rich and important literature almost invariably employs the principal-agent
framework to discuss agent compliance under *nomenklatura*. Many argue that cadre
evaluations are effective at weeding out problematic agents who overtly defy rules
and expectations, just like government agencies in the USA use security checks to
screen out prospective employees who may cause problems if hired (Huang 1996;
Landry 2008; Oi 1989, 1999). Nevertheless, scholars have pointed out the inefficacy
of *nomenklatura* in controlling agent behavior when the agent complies at or just
above the minimal level without disobeying the principal openly and attracting
negative attention (Oi 1989, 1992, 1999). The assumptions are that there is
a misalignment of interests between the principal and the agent and that informa-
tion asymmetry exists, contributing to policy distortion on the ground. However, the
phenomenon of the political regulation wave analyzed in the book suggests that the
preference gap between the political superiors and their subordinates may be
considerably narrower than previously thought. The results show that the subordin-
ate caters to their superior's preferences by creating a political regulation wave to
demonstrate their control of their localities and their ability to make gradual
improvements in critical policy areas.

Normative Implications
The political pollution wave bears significant normative implications and entails
difficult tradeoffs. It raises new questions about local governance and political
accountability in autocracies and democracies alike. Several scholars have ques-
tioned politicians' accountability in democracies in cases such as the political
business and budget cycles. Such studies suggest that those advanced by the selec-
tion scheme may have their own self-interest, rather than the public interest, in
mind. The study of political selection yields more significant normative conse-
quences in authoritarian regimes, where local leaders are more powerful and less
constrained than their counterparts in democracies. The documentation of
a political regulation wave provides a prime example of *when* the zeal for high-
level compliance in the most critical policy areas can yield enormous welfare
consequences. When regulation is relaxed, the gains in (reported) economic pros-
perity and job stability are offset by excessive air pollution that kills and harms many
people. When regulations are more stringently implemented, local governments
shut down factories in large numbers, leaving many workers who are breadwinners
for their households unemployed and unable to pay off mortgages. Cleaner air does
not necessarily make the residents better off. Local leaders' rush to please their
superiors can bring about some desirable outcomes but can also unintentionally
threaten the livelihoods of millions of people.

Is it better to have a political environmental protection wave or a political pollu-
tion wave? I believe neither is necessarily better, as each entails a set of hard
tradeoffs. As documented in Chapter 6, while beneficial for the economy and job

security, having a political pollution wave may be much more lethal than not having one. Based on a very conservative estimation, the last year in a prefectural party secretary's tenure in China may be associated with a 0.42 percent increase in mortality due to $PM_{2.5}$ pollution alone, compared to one plausible counterfactual. In Mexico, the political pollution wave is associated with at least an 8.33 percent increase in premature deaths from additional $PM_{2.5}$ pollution alone. On the other hand, a political environmental protection wave can be valuable and perilous at the same time. A beautiful blue sky bodes well for respiratory, cardiovascular, and emotional health. Compared to one plausible counterfactual, the avoided mortality for prefectures under the mandated $PM_{2.5}$ reduction policy in China could reach 0.49 percent. However, heavy-handed regulation of factories and households means that workers are stripped of their jobs and income; factory managers incur tremendous financial and resource losses; and families freeze through cold winters without heating furnaces.

Contributions to Interdisciplinary Environmental Studies
Finally, this book contributes to environmental studies by illuminating a new, critical dimension of environmental policy implementation. Specifically, it documents systematic temporal variation that is explained by local political incentives.

Methodologically, the book showcases the application of remote sensing, atmospheric modeling, and the geographic information system (GIS) in generating granular and large-scale pollution and economic measures. It also demonstrates the application of a box model and transboundary pollution transportation matrices to understanding pollution spillover effects – arguably the first of its kind in social sciences research.

7.3 POLICY RECOMMENDATIONS AND THE FUTURE OF ENVIRONMENTAL GOVERNANCE

7.3.1 *Policy Recommendations*

Political regulation waves can involve two types of inconsistencies: (1) inconsistency in regulatory stringency over time within the same tenure (i.e., within the wave) and (2) inconsistency in regulatory stringency across different tenures (i.e., between waves). As in the case of a political pollution wave, regulation is relatively strict early on and becomes relaxed gradually over time. Thus, political pollution waves are inconsistent both within and between waves. While having consistency within a wave, a political environmental protection wave can still differ from the preceding and succeeding waves. The ideal type of implementation, in the Weberian sense, should be free of such inconsistencies.

No single policy reform can completely prevent political regulation waves and maintain political accountability once and for all. However, fostering a bureaucracy

(largely) insulated from political influence and fruitful collaboration between natural and social scientists can help.

Toward a More Insulated Bureaucracy

Weakening the first scope condition of the theory of the political regulation wave – that local leaders or politicians enjoy discretion and control over the bureaucracy – can help minimize inconsistencies within and between waves. On this, it is important to recognize that decentralization and local discretionary power are good because local actors can be more empowered to use their superior local knowledge to design suitable local development strategies (Hayek 1945). Thus, a promising solution is to shield regulatory bureaucracies from political control, so as to be more consistent with the Weberian ideal of an impenetrable bureaucracy.

With the decoupling of local political influence and local bureaucracies, upper-level bureaucracies can monitor subordinate bureaucracies in the same vertical system. The verticalization of environmental management and monitoring systems will, in theory, make environmental enforcement teams on the ground answerable only to their principals within the vertical system, thereby shielding them from the pressure of local leaders who may have a different set of priorities. Fortunately, such reforms are taking shape. At the 5th Plenum of the 18th Party Congress in October 2015, President Xi Jinping vowed sweeping changes to the nation's environmental management and monitoring system. To make environmental supervision more independent, Xi backed vertical management to alleviate the two-principals-one-agent problem – to be tested and implemented gradually across the country in the following five years (Xinhua 2015). In September 2016, the General Office of the Central Committee and the General Office of the State Council (2016) jointly issued the Guidelines on the Pilot Program for the Vertical Management Reform of Environmental Monitoring, Inspection, and Law Enforcement below the Provincial Level (关于省以下环保机构监测监察执法垂直管理制度改革试点工作的指导意见). Under the guidelines, the prefectural-level EPB is to be primarily under the management of the provincial EPB, including in budget allocation; however, it is still to be under the management of the prefectural government, though to a lesser extent than before the reform. County-level EPBs are to become subbureaus of prefectural-level EPBs, thus coming under the direct management of the latter. These measures bring the EPBs closer to becoming Weberian environmental regulatory bureaucracies and have the potential to substantially weaken the top prefectural leadership's ability to influence regulatory stringency.

Synthesizing the Expertise from the Natural and the Social Sciences

In addition to making the bureaucracy more Weberian, the regulatory activities of bureaucracies can hardly be efficient if the level of ambiguity is high, as is the case in controlling $PM_{2.5}$. I contend that bridging knowledge from the natural and the social sciences can help. After $PM_{2.5}$ was assigned binding reduction targets, localities in China expressed strong determination to meet the targets, and their drastic measures to

contain $PM_{2.5}$ were well-documented. The continuation of political pollution waves was much more likely due to a lack of regulatory effectiveness than a lack of regulatory effort. Policy ambiguity is manifested in the goals or the means (Matland 1995, 157). For $PM_{2.5}$ pollution reduction, the goal to reduce $PM_{2.5}$ concentration by a specified percentage was unambiguous. However, the means to achieving that can be ambiguous because $PM_{2.5}$ is generated from fuel burning and chemical reactions that span numerous sectors.

Researchers and practitioners are still gradually uncovering new contributors to $PM_{2.5}$. Between September 2020 and March 2021, seventeen major haze incidents occurred in northern China, and it all happened despite having in place the world's strictest emissions standards for coal-fired power-generating units, massive coal-to-gas transformations, and frequent halting or restriction of production. While the northern economy suffered tremendously as a result, why did large-scale haze still occur? A recent study finds that water vapor (H_2O) from combustion and desulfurization can also contribute to the formation of secondary aerosols (Xing et al. 2020). Furthermore, at a September 2020 State Council meeting convened by Premier Li Keqiang, scientists also attributed the overuse of NH_3 in treating and achieving ultralow emissions of NO_x as a cause for haze. The inconvenient fact, and unintended consequence, is that while NO_x, a precursor to $PM_{2.5}$, is reduced, excess NH_3, also a precursor, is emitted. Given its alkalinity, NH_3 reacts with acid-forming compounds like SO_2 and NO_x to form particulates containing ammonium sulfate $[(NH_4)_2SO_4]$ and ammonium nitrate (NH_4NO_3) (Kirkby et al. 2011). The process is illustrated in Figure 7.2.
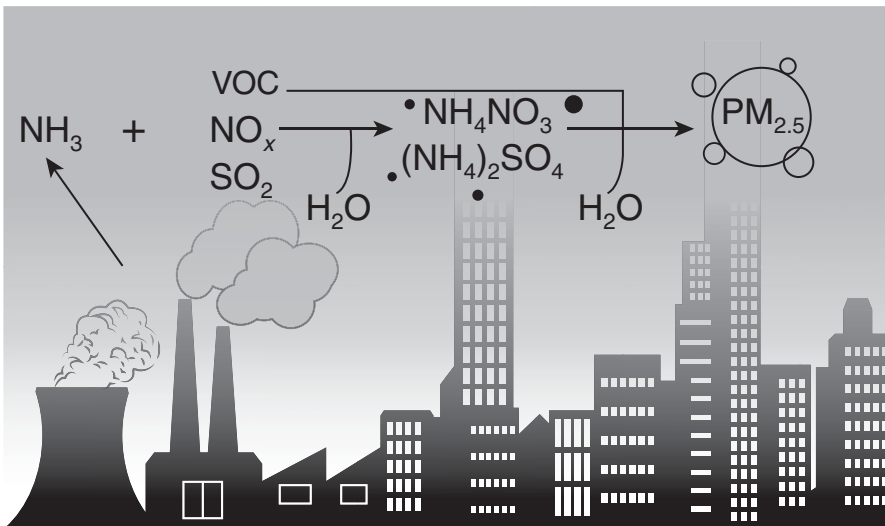

FIGURE 7.2 Schematic diagram showing the formation of $PM_{2.5}$ from NH_3, water vapor, and other air pollutants. Adapted from Gu et al. (2014).

Without detailed information about the concrete sources of $PM_{2.5}$ and their emissions patterns, both spatially and temporally, which differ from locality to locality, $PM_{2.5}$ reduction can be tricky, and efforts made in good faith like the overuse of NH_3 to treat NO_x can sometimes yield unintended consequences and prove counterproductive. This calls for more frequent and more engaged collaboration between natural and social scientists to reduce regulatory ambiguity and design locally tailored strategies to effectively reduce pollutants like $PM_{2.5}$ whose emissions and formations are challenging to manage. Atmospheric modelers could help better identify the sources of $PM_{2.5}$ for each locality, which could aid local leaders in ordering regulation of targeted sectors at the right time of the day and at strategically critical times, especially when a prefectural party secretary is further along in their tenure, to prevent future pollution waves.

7.3.2 *The Future of Environmental Governance*

The existence of political regulation waves reveals that local politicians or leaders are apt to adjust their regulatory policies to gratify the preferences of their constituencies or political superiors under scope conditions. That can be good news for the global combat against climate change. As of the time of writing, a series of countries across the globe have declared their goals to achieve net-zero carbon emissions in the coming decades, including the largest emitter – China. Speaking to the United Nations General Assembly in New York in September 2020, President Xi Jinping declared that China would peak its carbon emissions by 2030 and achieve carbon neutrality by 2060 – a pledge widely considered the most ambitious of any country by this writing (UN 2020).

What lessons can China's experience with containing SO_2 and $PM_{2.5}$ offer to its ongoing efforts to curb carbon emissions? On the bright side, the *nomenklatura* system will likely once again prove useful in incentivizing local leaders to take action to achieve national goals. China has already recognized the synergistic effects of reducing carbon emissions and air pollution, so local climate actions can be built on top of the existing war on air pollution efforts. However, for local efforts to be effective, it is critical to reduce ambiguity in two forms – the ambiguity of goals and the ambiguity of means. First, integrating climate goals into short-term plans and clearly assigning concrete responsibility can set up the desired incentive structure for local leaders and reduce the ambiguity of goals for individual actors. Second, reducing the ambiguity of means would require clearly stipulated procedures and methodologies in inventorying carbon emissions, specifying how reduction happens for individual sectors, and having accountability mechanisms.[38]

In conclusion, we may recognize that the political regulation wave theory can apply beyond the topic of air pollution regulation. It plausibly explains

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[38] For explanation of these points in greater detail, see Shen 2021b.

a much broader range of policy issues in a variety of geographies under scope conditions. Future research can apply the theory to explain patterns in implementing regulatory policy in areas like food and drug safety in decentralized political systems where political influence permeates bureaucratic activities. These will be worthwhile efforts, as clean air, safe food, and medication, among other public policy topics, concern the quality of our everyday life.