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Economic Ideas for a Complex Climate Policy Regime

Dallas Burtraw and Matt Woerman

1616 P St. NW
Washington, DC 20036
202-328-5000 www.rff.org

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Abstract

The parsimony of economic theory provides general insights into an otherwise complex world. However, even the most straightforward organizing principles from theory have not often taken hold in environmental policy or in the decentralized climate policy regime that is unfolding. One reason is inadequate recognition of a variety of institutions. This paper addresses three ways the standard model may inadequately anticipate the role of institutions in the actual implementation of climate policy: multilayered authority across jurisdictions, the impressionistic rather than deterministic influence of prices through subsidiary jurisdictions, and the complementary role of prices and regulation in this context. The economic approach is built on the premise that incentives affect behavior. We suggest an important pathway of influence for economic theory is to infuse incentive-based thinking into existing institutions and the conventional regulatory framework. In a complex policy regime, incentives can be shaped by shadow prices as well as market prices.

Key Words: climate change, institutions, federalism, subsidiarity, efficiency, shadow prices, incentives, regulation

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Introduction

An idea at the core of microeconomics is that incentives affect behavior and thereby ultimately affect material outcomes. Moreover, for a variety of practical reasons, targeting policies at incentives is expected to be more cost-effective than trying to directly mandate behavior.

Why might an incentive-based approach be relatively cost-effective? One factor is that incentive-based approaches are simpler. Indeed it is almost axiomatic as policy advice in environmental economics to *simply* get the prices right; that is, to set prices equal to social marginal cost. If policy makers can accomplish that, socially desirable behavior is expected to follow.

In contrast, prescriptive regulation is expected to evoke unintended consequences, because it creates incentives that do not necessarily align with the policy goal. A familiar example is the influence of a performance standard for new emissions sources, a common policy with respect to both mobile sources and stationary sources. The standard is intended to ratchet up the average environmental performance of a group of sources over time as relatively clean new sources replace dirty older sources. However, an emissions standard raises the cost of new sources and thereby creates an incentive to extend the life of older ones. As a consequence, a new source performance standard might actually cause a delay in new investment (Gruenspecht 1982; Nelson et al. 1993) and increase emissions compared with the no-policy baseline, at least in the short run (Maloney and Brady 1988; Evans et al. 2008; Patino Echeverri et al. 2013). This unintended consequence results from the imperfect or indirect alignment of incentives created by the prescriptive regulation with the ultimate policy goal.

To remedy this problem while using prescriptive policy requires layers of additional fixes and associated new challenges. A regulator might institute a provision requiring upgrades of

* Burtraw is the Darius Gaskins Senior Fellow and Matt Woerman is a research associate at Resources for the Future. This paper is based on a talk given at the 5th Atlantic Workshop on Energy and Environmental Economics, June 25–26, 2012, in A Toxa, Galicia (Spain). Financial support for this research was received from FORMAS. Direct correspondence to burtraw@RFF.org.

older facilities at a specific age. However, the regulator is not assured of the age at which it is cost-effective to upgrade an older facility. In fact, that age may vary across facilities, and a facility manager may have an incentive to hide its true costs and opportunities to avoid additional investments.

In contrast, setting prices to equal the social cost of environmental damages appears simple. Since Pigou (1920), this economic idea has made a large intellectual contribution, yet it has had relatively little influence on actual policy outcomes. One reason that is sometimes offered for the limited influence of economic ideas in environmental policy is the multitude of market failures that prevent a single approach from solving the problem (Hepburn 2010).

This essay argues that another reason for limited influence is the failure of many economists to anticipate the institutional context in which their ideas will take shape. The influence of institutions that we review is threefold. One is the multiple layer of regulatory authority that exists across different levels of governmental jurisdiction. The separation of authority and information across jurisdictions creates problems analogous to those between principals and agents in market contexts. A second institutional relationship that follows from the first is the ability of prices to affect all the relevant margins of economic behavior that influence environmental outcomes. This is especially important in the context of climate policy, because greenhouse gas emissions are ubiquitous throughout the economy. Third, new economic ideas do not enter a vacuum but instead encounter the preexisting regulatory institutions. The focus here is on the policy context in the United States and the role of the Clean Air Act, but similar challenges can be found across the globe. We briefly examine the performance of the sulfur dioxide emissions trading program in the United States in comparison with regulation under the Clean Air Act as a lesson for the application of economic ideas to climate policy.

Viewed from within the economic paradigm, the conclusion and advice that it is sufficient to simply get the prices right is straightforward. Sometimes this advice is translated verbatim to social policy with the expectation that it is sufficient to achieve efficient outcomes.[1] However, the performance of prices as a coordinating mechanism for social activity hinges on the successful transmittal of price signals to decision makers, which we suggest is not guaranteed. Institutions can undermine the effectiveness of a simple price-based approach to

[1] This view is famously summarized by Nordhaus (2006): “To a first approximation, raising the price of carbon is a necessary and sufficient step for tackling global warming.”

environmental policy, which helps explain its limited penetration in policy. We describe important ways in which conventional economic tools may not work as expected in addressing emissions from local land use decisions to large industrial sources.

Sometimes one hears the suggestion to dismantle regulatory institutions and replace them with markets. We argue this view is in many cases naïve (Burtraw 2013) and undermines the contribution that economic ideas can make especially with respect to climate policy. We propose that economic ideas can have their greatest influence not through the substitution of purportedly simple market functions for complex institutions, but by influencing those institutions directly. Sometimes this approach will involve the introduction of market prices, but many times it will involve the introduction of shadow prices or other regulatory reforms that align incentives under various rules and constraints with policy goals. After all, prices serve as a vehicle to deliver incentives; incentives are at the core of the economic approach to shaping behavior. We argue that economics can increase its influence on environmental outcomes by looking within existing institutions and finding ways to suggest the greater use of incentives in place of prescriptive regulations. This promises to improve the cost-effectiveness of regulations in the near term. Over time, one can hope for an expanding role for market-based prices, which has the added promise of achieving greater efficiency in the allocation of resources across sectors.

Subsidiarity, Federalism, and Potential Preemption of Subnational Roles in Climate Policy

Meaningful climate mitigation must involve efforts across the globe. However, the implicit coordination problem is characterized fundamentally by an incentive to free ride; that is, individual nations may perceive an incentive to do little while they capture the benefits of the actions of their neighbors. If all nations perceive similar incentives, an underprovision of mitigation effort at a global level is expected. This understanding of the problem motivates efforts to develop an international framework for emissions mitigation, but progress in this direction has been halting.

The changing climate is a global concern. However, as Keohane and Victor (2013) point out, international coordination is inherently difficult. The intense distributional conflict and high uncertainty erode incentives for states to make commitments. In this vacuum of coordinated policy, there is a growing appreciation that the effects of a changing climate are felt locally and differ geographically. Perhaps then it should not be surprising that in the absence of global hegemony around mitigation of climate change, there is substantial mitigation activity at the local level.[2] Nonetheless, the contribution of mitigation actions by seemingly independent actions taken at the national and subnational levels appears paradoxical, because their efforts should have a negligible effect on emissions. Keohane and Victor suggest the solution to the global coordination problem may lie in making the problem more manageable by working in small coalitions. The authors expect “decentralized complexes of networked institutions” to be more successful than integrated, hierarchical treaties. They predict the emergence of a “regime complex” rather than a coherent set of actions or agreement. This appears to be reflected in what is now the pervasive view that we are increasingly living in a bottom-up world for climate policy (Purvis 2012; Bodansky 2012). This decentralized framework offers the advantage of flexibility across issues and adaptability over time. In contrast, a binding climate regime may strip the sovereignty of an individual jurisdiction and bind it to a framework that is inherently hard to change.

The same incentives apply among state or provincial governments within a federal system such as the United States. Efforts by state and local governments have contributed to emissions reductions of about 2.5 percent expected in 2020 from 2005 levels (Burtraw and Woerman 2012). Ten states have cap-and-trade programs, 29 states have renewable portfolio standards, and well over half the states have energy efficiency programs.[3] Many policies, including appliance standards and mobile source standards, began at the state level before adoption at the national level. Although most policy advocates at the state level call for coordinated national action, and a majority of Americans have consistently supported such action at the national level (Krosnick and MacInnis 2013), states argue they should retain the discretion to exceed national policy ambitions.

A central question for policy design and political negotiation in the United States is whether the role for subnational action should be overruled or preempted under a coordinated national policy. The argument in favor of doing so is that once national policy goals have been

[2] A compilation of efforts to introduce a price on carbon and broader commitments under the Cancun Agreements is provided at http://www.climatechange.gov.au/government/~/media/government/international/CarbonExpo-Combet-Presentation-20121109.pdf.

[3] A catalogue of subnational efforts to cap emissions and promote energy efficiency and renewable sources of energy is provided at http://www.c2es.org/us-states-regions/policy-maps.

established using market-based policies and balancing benefits and costs then local initiatives can only raise costs. Williams (2012) analyzes a variety of possible interactions between national and state-level policies and finds in general state discretion will improve economic efficiency. Coupled with recognition of the role for state and local governments in policy implementation and innovation, the suggestion to eclipse them from climate policy governance would appear disadvantageous.

However, beyond their roles as instigators, state and local governments have a crucial long-run role to play in achieving climate mitigation goals. They have vast authority for planning and permitting that grants to investors the license to develop and capture economic value. State and local governments are responsible for building standards, planning for land use and transportation, and permitting for industrial and residential facilities. These decisions determine the physical infrastructure and the opportunities for carbon mitigation that will be available for the next century. States also have the central role in the implementation and enforcement of national environmental laws.

These essential functions of state and local governments are excluded from virtually all economic models, which instead implicitly assume harmonization of governmental activities within a unitary actor model of government (Shobe and Burtraw 2012). Even when addressing the challenge of international coordination, the usual economic framework will ignore the institutional and political realities at the subnational level. International negotiations involve multiple parties in the same way as do labor negotiations where it takes three agreements to achieve one universal agreement—that is, one agreement across the table and one on each side of the table (Dunlop 1944). Similarly, the negotiations that occur at the subnational level constrain the ability of individual nations and international negotiators.

Many observers assume terms such as "subsidiarity" and "federalism" describe deference to higher levels of authority. But in the European Union and the United States the terms describe a shared responsibility between local or state and higher levels of authority. Specifically under the U.S. Constitution, authority rests originally with the states, where it remains unless explicitly assumed by Congress. Given the demonstrated role of leadership that subnational jurisdictions play in policy innovation, their effective preemption could be expected to have a negative influence on policy outcomes in the long run.

Most applications of economic theory to environmental problems not only confuse the role of jurisdictional authority but ignore multi-layers of government altogether. By failing to recognize the institutional setting of overlapping jurisdictional authority economic approaches can misalign incentives invoking their own unintended consequences. The vast literature on emissions cap and trade exhibits this failing. Cap and trade is expected to achieve a given emissions target (the cap) at least cost. However, it is rarely appreciated that an emissions cap is also an emissions floor in that if the cap is binding (allowances retain a nonzero price) it determines not just the maximum allowable emissions but also the minimum emissions that will occur (Burtraw and Shobe 2009). Under an emissions cap, the incremental actions of a subsidiary governmental entity, a business or a household to reduce emissions have no effect on aggregate emissions. Rather, they result in 100 percent leakage and lower the price of emissions allowances and cost of mitigation for other parties covered under the cap (Goulder and Stavins 2011). The result is the effective preemption of the incentive for additional actions by other governments or individuals. Although not apparent in discussions preceding the initiation of the European Union's Emissions Trading System, effective preemption is a relevant concern as member states have considered further measures at the national level. A similar dilemma is familiar in public finance through fiscal cushioning, whereby a jurisdiction reduces one tax as another tax is applied to the same industry. These interactions among jurisdictions at different levels of government are essential considerations in the design of policy, but often such consideration is missing entirely in economic thinking about climate policy.

Transmitting Incentives through Multiple Layers of Government

If prices were set at an efficient level, one might think that incremental efforts or innovations by subnational governments or households should not matter. This conjecture hinges on extremely strong and typically unspecified assumptions that the problem is static, information is complete, and the policy that is apparently so difficult to establish in the first place can be readily changed to respond to new information.[4]

Another assumption is that the price signal will effectively touch every relevant margin of decision making in society. The transmission of price signals, or lack thereof, through levels of government is unlikely to be achieved perfectly. Regulatory activities at the state and local levels are governed by a confluence of strong forces stemming from statutory requirements imposed by law at the level of their own jurisdiction or from higher-level jurisdictions, constrained by judicial review and pressured by economic and citizen interests. In a meaningful

[4] "[I]f the overall public objective is to link policy with factual knowledge, this is only a fleeting victory" (McCray et al. 2010).

sense, the activities of state and local governments are overdetermined. The addition of a new influence such as a modest change in relative prices may change the incentives of some actors, but it is unlikely to influence the direct incentives and constraints of governmental decision makers and may not change the regulatory process at the local level.

A canonical example is the process of local land-use decision-making that is central to climate impacts in developed nations. This process is organized to be insulated from market forces, not to be responsive to them. Levine and Inam (2004) report on extensive surveys with developers indicating the perception that there is considerable market interest in development patterns such as greater density and pedestrian-and transit-oriented development forms. There is an inadequate supply that is attributed to local government regulation that protects the vested interest of the existing community through planning standards that are consistent with the incumbent infrastructure resulting in uniformity in housing styles and street alignments. There is compelling evidence to indicate that a moderate price signal would not penetrate this process in a meaningful way.

On the other hand, local governments can be extremely responsive to nonmarket incentives from higher levels of government. For example, in the 1970s developers in California’s Orange County sought to increase density but were prohibited from doing so by local planning officials under the strong influence of incumbent landowners. As a consequence housing values were very high and moderate-income workers in this growing area commuted up to two hours each way to work. The attendant air quality problems were so severe that the State of California issued a moratorium on development by restricting sewer hookups until densities were increased to provide housing for moderate-income families and reduce commuting. Development in the county was a powerful economic engine and the economic pressure of the moratorium overcame the objection of incumbents and forced the introduction of the nation’s largest inclusionary housing program at the time in famously conservative Orange County (Schwartz et al. 1982). This case study is an example of jurisdictional relationships accomplishing what market signals could not.

.Similar incentives are embedded in California’s contemporary Sustainable Communities and Climate Protection Act of 2008, which requires regional planning to promote greenhouse gas emissions reduction targets for passenger vehicles. The policy combines the provision of financial incentives for local government with fast-track processing of road, water, and sewer construction that must be approved by higher levels of government. It is noteworthy that this policy is implemented concurrently with a carbon dioxide (CO_2) cap-and-trade program in the state precisely because it is anticipated that the modest carbon price is not likely to have a sufficient long-run effect on infrastructure planning. In this case, California has adopted regulatory policy that is unlikely to yield additional emissions reductions in the short run but enables the possibility of lower-cost emissions reductions in the long run.

Perhaps the most noteworthy observation to take away from historic experience is the central role given to shared responsibility and cooperative federalism. This framework is based on the expectation that the national government cannot achieve its environmental goals without taking advantage of state-level authority, information, and proximity to the economic interests of regulated entities. Economic ideas about environmental regulation generally do not appear to be informed by this relationship. An emissions cap effectively preempts state efforts altogether. A price-based approach such as a carbon tax would preserve the additionality of actions by lower-level governments, but it may not adequately incentivize them.

In sum, for economic ideas to have their deserved impact on environmental policy, their proponents must account for the institutional relationships in which these ideas will take life. A core idea of microeconomics is that incentives govern behavior. Even those institutions that are insulated from market signals nonetheless respond to incentives. The contribution from economics in this setting can be to identify mechanisms to transmit incentives and to change incentives to influence outcomes.

The Clean Air Act Regime

With the failure of the U.S. Congress to adopt comprehensive climate change legislation, many observers thought climate mitigation efforts in the United States were stopped. However, a collection of policies at the national and state levels is achieving meaningful emissions reductions. We describe this policy framework as the *Clean Air Act regime*, although, as noted, it includes policies at the subnational level that are facilitated by the regulatory setting established under the act. We then favorably compare the emissions reductions that can be expected with those that likely would have resulted under the counterfactual of comprehensive climate change legislation. Finally, we discuss the pending decision about how to regulate emissions from existing stationary sources starting with fossil fuel–fired power plants. We compare the prospect of incentive-based regulation with the experience of the sulfur dioxide emissions allowance-trading program.

CO_2 Emissions Reductions under the Clean Air Act Regime

Several studies have estimated that the United States now has in place technology and market trends and policies that are expected to achieve reductions in carbon dioxide emissions of about 10 percent relative to 2005 levels in 2020 (Burtraw and Woerman 2012; EIA 2012; Bloomberg 2013; Blanco et al. 2013).[5] Three factors explain this trend. One is secular change in the economy that would have occurred independent of climate policy initiatives, including the expanded supply of natural gas and an expanded role of energy efficiency. For the first time, natural gas has achieved approximate parity with coal as a fuel source in electricity generation, while electricity demand is anticipated to be roughly 5 percent lower in 2020 under EIA forecasts made in 2012 compared with its forecast in 2009, the combined effect of which we estimate constitutes a reduction of more than 3 percentage points in forecast economywide emissions in 2020. The reduction in demand is coincident with an expected 8 percent reduction in electricity price (Burtraw et al. 2012b). Another component of what we consider secular trends is regulation concerning emissions of conventional and hazardous air pollutants from the electricity sector. The most important is the Mercury and Air Toxics Standard, which will impose annual costs of about $7 billion (2009$) on coal-fired power plants. It is not expected to directly result in retirement of coal plants, but it reinforces the changing business environment favoring the use of natural gas in the electricity sector (Burtraw et al. 2012a). Other environmental rules anticipated in the future that would also affect the economics of coal-fired generation include the Coal Combustion Residuals Rule (ash) and cooling water regulations under the Clean Water Act.

A second factor that helps explain the change in emissions is actions taken by state and local governments. We noted already that actions by state governments are expected to achieve emissions reductions of 2.5 percentage points from 2005 levels by 2020. Under the Clean Air Act regime, these actions are additional, meaning that they do not directly crowd out other mitigation efforts.

The third factor is the mechanism of the Clean Air Act. One important source of emissions reductions is the tighter vehicle emissions standards. The first set of standards was developed in 2007 and took effect in 2011, implementing a 5 percent per year improvement in the vehicle fleet resulting in an average miles per gallon of 35.5 in 2016. The second set was

[5] Blanco et al. (2013) are less optimistic when considering all greenhouse gases. On this metric, they anticipate reductions of about 5 percent.

adopted in 2011 and will take effect in 2017 and will require efficiency improvements to reach 54.5 miles per gallon by 2025, with projected additional reductions of approximately 220 million tons in 2020, or 3 percent of emissions in 2005. Another measure is preconstruction permitting of new and modified sources for greenhouse gas emissions, but the stringency and influence of this regulation are yet to be determined. The most important regulation, which we discuss further below, will be operating performance standards for existing stationary sources. Those regulations are still in development.[6]

CO_2 Emissions May Be Lower Than under Cap and Trade

Comprehensive climate legislation proposed in the 111th Congress, known as the Waxman–Markey bill (HR 2454), would have introduced an emissions cap-and-trade system covering over 84.5 percent of emissions in the U.S. economy. The allowance allocation in 2020 was 17 percent below 2005 levels and was the basis for President Obama's pledge to reduce U.S. emissions at the Copenhagen climate meetings in 2009. Modeling by EIA in 2009 of the proposed legislation suggested the emissions reductions actually would be 33.6 percentage points compared with 2005 levels by 2020 (EIA 2009). Of these reductions, 4.7 percentage points were expected to come from domestic offsets, and more than 15 percentage points were expected to come from international offsets. Another 3 percent of additional reductions would be achieved by the investment in international forestry offsets outside of the cap-and-trade system, which we denote as "nonmarket offsets." Emissions reductions at domestic sources covered by the emissions cap were expected to total 10.2 percentage points. About 45 percent of the overall reductions would have been in excess of the reductions required in 2020 and would have been contributed to the emissions bank. If one considers the contribution to the emissions bank ephemeral and likely to appear as actual emissions in a later year, then the permanent emissions reductions from sources regulated under the emissions cap in the U.S. economy would have been 5.6 percent. Counting emissions from domestic offsets, this number would be 8.2 percent.

Some of the factors contributing to emissions reductions under the status quo Clean Air Act regime also would have had an effect under the cap-and-trade program. For example, the change in relative fuel prices stemming especially from the expanded supply of natural gas and

[6] Burtraw et al. (2011) survey a set of technical measures focusing on energy efficiency in six sectors identified by the U.S. Environmental Protection Agency that tally additional emissions reduction opportunities of 6.2 percent of 2005 emissions.

other secular trends in technology and energy demand of the last four years would for the most part have occurred with or without cap and trade. However, the emissions reductions would have been different. Under an emissions cap, secular changes in the economy or additional policies at the national or subnational level yield a rebound effect. Agents will undertake actions that shift emissions among sources, resulting in fewer emissions reductions in other sectors or states, changes in the contribution to the bank, or the purchase of fewer emissions offsets.

To estimate that portion of the emissions reductions from the three factors we outline that would have been additional under cap and trade, we solve Resources for the Future's Haiku electricity market model (Paul et al. 2009) with a reduced-form representation of emissions reduction opportunities for the rest of the U.S. economy and for the availability of offsets that is calibrated to EIA's National Energy Modeling System. Haiku includes projections of electricity demand and natural gas prices that correspond to the secular trends discussed above as well as the subnational policies.[7] These results are reported as the 2012 RFF Forecast under the Cap-and-Trade Implementation section of Table 1. The table displays the reductions forecast to be achieved by various policy scenarios, as well as the portions of reductions achieved by domestic reductions, domestic offsets, international offsets, and nonmarket offsets.

The secular changes would have occurred with Waxman–Markey, but because of the emissions cap, they would not have directly resulted in equivalent emissions reductions. We find leakage of about one-fifth of these reductions due to an increase in emissions from other sectors of the domestic economy and reduction in the purchase of offsets. Approximately four-fifths of the reductions from secular trends are additional under a national cap.

Waxman–Markey would not have preempted the ability of California or other states to set their own emissions reduction goals or to pursue related goals, such as renewable energy targets or efficiency standards. These policies might still have emerged even if Waxman–Markey had become law, although arguments to rescind them would have been strong. If they were not rescinded, then under the cap-and-trade system, many of these subnational efforts would have become nonbinding and therefore would have provided no additional emissions reductions. For subnational policies that remained binding, again these emissions reductions would have been partially crowded out by emissions increases elsewhere, resulting in a smaller change in

[7] The model is calibrated to fuel supply and demand parameters identified by EIA (2011). Changes in forecasts since that time are small compared with changes that emerged between 2009 and 2011 forecasts.

domestic emissions given the overall national cap. In this analysis we assume none of these policies would be rescinded, but our modeling suggests many of them would become nonbinding.

In contrast to secular changes that would have happened even with cap and trade, the new mobile source standards proposed in 2011 might not have been implemented under the Waxman–Markey cap-and-trade program because a strong policy argument could be made that the price on carbon under the cap should substitute for other regulatory efforts. In our central estimate of emissions reductions that would have been achieved under the cap-and-trade program, we assume that these additional fuel economy standards would not have been finalized.

Accounting for secular trends in the economy that emerged under the 2012 forecast and the contribution of subnational policies, we estimate the comprehensive cap-and-trade program would have yielded emissions reductions in the domestic economy of 13.6 percent in 2020 compared with 10.2 percent based on EIA's 2009 forecast, relative to 2005 levels. Total emissions reductions accounting for offsets would total 32.4 percent, about 1 percentage point less than the EIA's 2009 forecast.[8] As with the EIA analysis of Waxman–Markey, a large portion of these reductions would have contributed to the allowance bank and would have reappeared in later years as emissions. Accounting for the ephemeral nature of these reductions, the cap-and-trade program would have achieved permanent domestic emissions reductions of 7.9 percent in 2020 from 2005 levels, an increase of more than 2 percentage points compared with the earlier forecast.

It is especially noteworthy that the comparison in the first column of Table 1 between the Clean Air Act regime and Waxman–Markey ignores the contribution of emissions reductions, both domestically and abroad, through the purchase of offsets. Under the assumption that offsets represent meaningful emissions reductions, as represented in the rightmost column of Table 1, global emissions would be lower with the passage of Waxman–Markey. In the remainder of this discussion, our attention is limited to the emissions within the domestic economy.

[8] This estimate is slightly smaller than that anticipated in the EIA analysis of Waxman–Markey because we use RFF's electricity model and because of other changes in the economy that are accounted for.

Table 1. Emissions Reductions below 2005 Levels (Percent) in 2020

Scenario	Domestic Reductions	Domestic Offsets	International Offsets	Nonmarket Offsets	Total Reductions
Clean Air Act Regime					
RFF Forecast	9.1	0.0	0.0	0.0	9.1
RFF Forecast with projected standards for existing sources	16.3	0.0	0.0	0.0	16.3
Cap-and-Trade Implementation					
2009 EIA Forecast	10.2	4.7	15.8	3.0	33.6
Adjusted for Banking	*5.6*	*2.6*	*8.8*	*3.0*	*20.0*
2012 RFF Forecast (secular trends and subnational policies)	13.6	4.2	11.6	3.0	32.4
Adjusted for Banking	*7.9*	*2.4*	*6.7*	*3.0*	*20.0*
2012 RFF w/ fuel economy standards	15.9	3.8	10.4	3.0	33.0
Adjusted for Banking	*9.0*	*2.1*	*5.9*	*3.0*	*20.0*
2012 RFF w/ risk-adjusted (10%) discount rate	12.3	3.7	7.9	3.0	26.9
Adjusted for Banking	*8.7*	*2.6*	*5.6*	*3.0*	*20.0*
2012 RFF w/ bank ending in 2035	10.9	3.1	3.0	3.0	20.0
Adjusted for Banking	*10.9*	*3.1*	*3.0*	*3.0*	*20.0*

Sensitivity Analysis

Below, we examine several sensitivity cases with different assumptions about reductions under a national cap, which are also included in Table 1.

Domestic Offsets

Our central estimate of reductions under Waxman–Markey includes 282 million tons of emissions offsets purchased domestically, or 4.2 percent of 2005 emissions. Although these reductions would not have occurred within the covered sectors of the policy, they would have occurred within the domestic economy. Consequently, one may choose to include these offsets when estimating the amount of emissions reductions that would have been achieved domestically. If we include domestic offsets, we find that Waxman–Markey would have achieved domestic reductions in 2020 of 17.8 percent compared with 2005 levels. Again, these emissions reductions can be adjusted to account for reductions that are banked and will reappear as emissions in a later year. If this is done, we find that Waxman–Markey yields domestic reductions of 10.3 percent, relative to 2005 levels.

It is important to note that the 2005 levels, with which these reductions are compared, count only the emissions from the covered sectors and do not include the sectors in which the offsets would occur. Thus the comparison does not have sectoral equivalence, but that is precisely the intent of offsets, to allow for reductions outside of the covered sectors.

Fuel Economy Standards

In our central estimate of Waxman–Markey, we assume that the fuel economy standards proposed in 2011, and set to take effect in 2017, would not have occurred if Waxman–Markey had been enacted. However, it is possible these increased standards would have been finalized even with the passage of Waxman–Markey. In this case, the standards would provide additional emissions reductions within the transportation sector, although some of these reductions would be crowded out by increased emissions in other sectors and the purchase of fewer emissions offsets. We estimate the inclusion of these fuel economy standards would result in domestic emissions reductions of 175 million tons in 2020, equivalent to 15.9 percent of 2005 levels. If these emissions reductions are adjusted to account for reductions that are banked and will appear in later years, we find domestic reductions in 2020 of 9.0 percent, relative to 2005 levels.

Banking Sensitivities

The Waxman–Markey cap-and-trade program allows for the banking of emissions allowances to be used in later years. However, a future session of Congress or regulators could pass additional legislation or rules to weaken or completely abolish the cap-and-trade program, which would have a considerable effect on the value of banked allowances. The evolution of regulations for sulfur dioxide and nitrogen oxides culminating in the proposed Cross State Air Pollution Rule is a precedent for how subsequent regulation can affect the value of banked allowances (Fraas and Richardson 2012). Consequently one would expect firms to anticipate the risk of regulatory change in their banking behavior in future market-based programs.

In our central estimate of Waxman–Markey, we use a discount rate of 7.4 percent to calculate the return on holding allowances; this is the same rate used by EIA in its 2009 analysis of the Waxman–Markey legislation. However, with the risk that banked allowances could become less valuable in the future, investors would likely require a greater annual return in order to hold the allowances (Salant and Henderson 1978). To represent this risk premium, we also modeled Waxman–Markey with a 10 percent risk-adjusted discount rate for allowances, which yields a lower allowance price in the early years of the program and consequently fewer emissions reductions and a smaller purchase of offsets. This 10 percent discount rate results in domestic emissions reductions in 2020 of 12.3 percent compared with 2005 levels. If these reductions are adjusted to account for allowances that are banked in 2020 and will reappear as emissions in later years, we find Waxman–Markey, with a 10 percent discount rate for banking, yields domestic reductions in 2020 of 8.7 percent, relative to 2005 levels.

Another possible result of the risk of banking allowances is that investors may choose to hold allowances for a shorter period of time. In our central estimate of Waxman–Markey, we assume banking persists throughout the life of the program until 2050. However, one might expect that investors will hold a smaller portfolio of allowances with a shorter planning horizon in mind due to the risk of future legislation or rules changing their value. We model this outcome using a 15-year planning horizon so that looking forward from 2020 the bank of allowances would be exhausted in 2035. This results in a lower allowance price through 2035 (and a higher price after 2035), which yields fewer emissions reductions and a smaller purchase of offsets in the early years of the program. With this banking outcome, we estimate domestic emissions reductions in 2020 of 10.9 percent compared with 2005 levels. Coincidentally, we find no incremental contribution to the bank occurs in 2020 in this sensitivity case; allowances are banked in earlier years, and these banked allowances are used in later years, but in 2020 the number of allowances allocated equals the number surrendered for compliance with the policy. Thus no adjustment is needed to account for allowances banked in 2020 in this case.

Regulating Stationary Sources under the Clean Air Act

The most important pending decision with respect to reducing U.S. emissions is the regulation of existing stationary sources of greenhouse gas emissions. In the absence of comprehensive climate policy that would have introduced cap and trade the decision to regulate these sources falls to the Environmental Protection Agency using its established regulatory authority.

Introducing a Shadow Price in Regulation

The Environmental Protection Agency has the authority to regulate greenhouse gases under the Clean Air Act and they have decided to do so under a section of the Act that is technology oriented and traditionally has been applied in a prescriptive manner. However, the predominant legal opinion is that the agency has considerable opportunity to use flexible approaches in place of prescriptive regulation. The traditional approach would be to develop emissions rate performance standards for specific categories of technology. A flexible approach could allow averaging of emissions rates across facilities by implementing a performance standard trading program.

Tradable performance standards have an important history under the Clean Air Act. The approach was used in the first large-scale application of economic ideas for environmental regulation in the phase out of lead from gasoline. In the 1980s, over a three-year period the allowable average lead content of gasoline was rapidly phased down. Through trading, individual refineries could stage their process changes so as to rationalize their own investment plans and not disrupt the gasoline market. Newell and Rogers (2003) find the program achieved cost savings of hundreds of millions of dollars compared to prescriptive regulation. Kerr and Newell (2003) indicate the program did so while stimulating economically efficient technological investment decisions.

Burtraw et al. (2012c) examine the use of a tradable performance standard for CO_2 emissions from coal-fired power plants. The standard would create a price for emissions rate credits and thereby provide an incentive to make efficiency improvements at existing plants while also providing the incentive to increase generation at relatively efficient plants and reduce generation at less efficient plants. A flexible standard, calibrated to achieve the same emissions reductions as an inflexible approach, reduces the increase in electricity price by 60 percent and overall costs by two-thirds compared to a traditional (prescriptive) performance standard. It is noteworthy in view of our interest in jurisdictional relationships that under the Clean Air Act the policy would be implemented and enforced by states. In addition, states would retain the opportunity to set a more stringent standard that would lead to additional reductions. Although this policy does not directly price emissions of carbon or place an explicit cap on emissions, it provides similar incentives using the existing institutional structure.

The Experience of Sulfur Dioxide Emissions Trading

Prior to the EU's CO_2 Emissions Trading System, the flagship example of the economic approach to environmental regulation was the U.S. Acid Rain Program, which instituted cap and trade for sulfur dioxide (SO_2) emissions. The program is a successful example of cost-effective implementation of environmental regulation (Carlson et al. 2000; Ellerman et al. 2000). However, an ex post perspective of its overall economic performance yields a poor evaluation due to its clumsy integration with existing regulations.

In 1990 the National Acid Precipitation Program forecast that SO_2 emissions would be about 16 million tons in 2010 from sources that were to be regulated under the cap. The emissions cap was to reduce emissions to 8.95 million tons. At the time that the trading program was adopted, the cap was thought to approximately balance marginal benefits and costs (Portney 1990). Subsequent economic analysis soon estimated marginal benefits to be about 30 times greater than marginal costs (Burtraw et al. 1998; Chestnut and Mills 2005). The efficient level of the cap was subsequently identified to be about 1 million tons per year (Banzhaf et al. 2004; Muller and Mendelsohn 2009). Unfortunately the courts determined that the emissions cap could be changed only through an act of Congress, which was unable to reach agreement about changing the cap (Schmalensee and Stavins 2012; Evans and Woodward 2013).

Fortunately, from a public health perspective, the statute implementing the cap-and-trade program did not preempt the preexisting regulatory authority of EPA. Using this authority, the agency has implemented rules further reducing emissions of SO_2 such that the emissions cap is now slack and the trading program is not relevant. With implementation of the Mercury and Air Toxics Standard, emissions of SO_2 from sources covered under the cap will fall to 2.1 million tons by 2016 (EPA 2011). EPA's regulatory authority under the Clean Air Act will yield emissions reductions as great as what was achieved by the seminal cap-and-trade program.

The flaw of the SO_2 cap-and-trade program was its inability to adapt to new information. Under the SO_2 program the problem was manifest in the inability to change the cap. Under a price based program such as an emissions tax a similar problem would result from the exclusive authority of Congress in the U.S. to set taxes at the federal level. The point for the design of climate policy is to learn from the important and seminal experience of the SO_2 program that the successful application of economic ideas to environmental policy depends on understanding the institutional setting into which these ideas will take shape.

Conclusion

The economic idea that using prices to transmit incentives will lead to an efficient outcome is a powerful idea, but its potential influence to climate policy is limited when it is interpreted within the simple context of a price within a commodity market for carbon. The more fundamental idea of economics is that incentives shape behavior, and prices are an efficient way to shape incentives. Prices in a market setting and shadow prices in a regulatory context are both necessary to affect the incentives of decision makers in the economy. Market prices are likely to do a good job of affecting private decisions and are likely to do somewhat less well when affecting decisions by institutions, governmental agencies, and perhaps even large organizations. Shadow prices can be useful in these settings and can be expected to outperform prescriptive regulation. We argue that market prices are necessary for an efficient outcome, indeed imperative, but they are not sufficient. The bigger idea is to recognize the economic importance of shaping the incentives of decision makers in all forms of social institutions. This recognition constitutes thinking like an economist within the complex climate policy regime.

In much of the discussion about climate policy, as well as in the teaching of economics, a dichotomy is presented posing market-based policies against regulation. This dichotomy is fundamentally naïve because it assumes one can replace the other, and it fails to distinguish among types of price-based incentives and among types of regulation. The expanded introduction of flexibility and the greater use of incentives within regulatory frameworks can offer important environmental benefits and improvements in economic efficiency.

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