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Economic Ideas for a Complex Climate Policy Regime

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Abstract

The parsimony of economic theory provides general insights into an otherwise complex world. However, 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, with a US focus: 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 the conventional regulatory framework. In a complex policy regime, incentives can be shaped by shadow prices as well as market prices.

Key Words: institutions, federalism, subsidiarity, shadow prices, incentives, regulation

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1. Introduction

An idea at the core of microeconomics is that incentives affect behavior and thereby ultimately affect material outcomes. In shaping environmental policies, for a variety of practical reasons economic ideas suggest that targeting incentives is expected to be more cost-effective than prescribing mandates. The preferred approach to influencing incentives is to introduce prices on environmental services. It is almost axiomatic as policy advice 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 subject to criticism because it creates incentives that do not necessarily align with the policy goal and often evoke unintended consequences. 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, which may have the unintended effect of increasing emissions in the short run, the opposite of the regulation's intent. To remedy this problem while using prescriptive policy requires layers of additional fixes and associated new challenges.¹

Compared to the unintended consequences and complexities of regulation, setting prices to equal the social cost of environmental damages appears simple. Since Pigou (1920), this

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¹ A standard on new sources is intended to ratchet up the average environmental performance 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 these problems a regulator might institute a provision requiring upgrades of 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.

economic idea has made a large intellectual contribution, yet it has rarely been adopted in environmental policy. One reason that is sometimes offered for the limited influence of environmental prices in environmental policy is the multitude of market failures that prevent a single price from solving the problem (Hepburn 2010).

This paper argues that another reason for limited influence is the failure to anticipate the institutional context in which economic ideas will take shape. We use the term institutions broadly to describe the set of laws, rules, organizations and relationships that pre-exist a policy intervention; that is, features of the empirical context of a policy problem. Institutions often introduce friction in the transmittal of incentives because they impose constraints and costs on changes to behavior. Barbier (2011) offers a transactions cost perspective to describe the intransigence of institutions themselves to change. Vested economic interest in the status quo helps to explain *institutional inertia* and reluctance to change. In any context, a change in the rules will create losers who will act to obstruct such a change, and we invoke this explanation at some points.² However, we have a more general case in mind where institutions may have strong justifications as solutions to historic problems and serve as watchtowers that protect the precedents of values of previous social decisions. By design or evolution, they affect how change will occur.

The influence of institutions that we review is threefold. The first is the political context of policymaking, which not only influences its design but also its timing, an important aspect of which is the ability and authority to update policy in response to new information. Because the climate problem will span several decades, policy responses have to find a way to be durable yet flexible and able to assimilate new information. Various approaches to price-based policies and other types of regulation are typically implemented with different characteristics in this regard. A second is the multiple layers of regulatory authority that exist 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 third institutional relationship that follows is the ability of prices to affect all the relevant margins of

² An example outside the US context is presented by Del Rio and Labandiera (2009), who examine Spanish climate policy and find that existing non-market policies are favorable to several large and highly visible interest groups. Because voters do not prioritize global climate change, replacing the status quo with market-based climate policy would be difficult and met with confrontation. Similarly, Pearce (2006) discusses the political economy of the United Kingdom's climate change levy, which is far from a textbook carbon tax due to political considerations.

economic behavior that influence environmental outcomes especially those relating to infrastructure investment, which is especially important in the context of climate policy.

Viewed from within the economic paradigm, the advice to get the prices right is straightforward. Sometimes this advice is translated verbatim as a recommendation for social policy with the expectation that it would be sufficient to enable efficient outcomes.³ However, the performance of prices as a coordinating mechanism for social activity hinges on the successful transmittal of price signals and the unconstrained ability of decision makers to respond, which we argue is not guaranteed. Institutions can undermine the effectiveness of a simple price-based approach to 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 stemming from large industrial sources to local land use decisions.

The next section of the paper considers how the existence of a political environment shapes the performance of various policy instruments; the primary political context we consider is the United States. We find the grand policy experiment of emissions trading for sulfur dioxide (SO₂), a flagship policy for the use of economic instruments in environmental policy, has produced less emissions reductions than have other measures pursued under the regulatory authority of the Environmental Protection Agency (EPA) over the same time frame. Looking forward, we predict that greater permanent carbon dioxide (CO₂) emissions reductions will be achieved in the U.S. by 2020 under what we describe as the Clean Air Act regime than if the proposed Waxman-Markey legislation enacting cap and trade had passed.⁴ These examples illustrate that the performance of economic instruments in an institutional context can differ over time from what is anticipated in theory.

Section 3 examines policies enacted at different jurisdictional levels and how they might interact. Section 4 considers how well policy at the national level may transmit incentives through other jurisdictional levels to influence decisions within their institutional domain.

³ This view is summarized by Nordhaus (2006): “To a first approximation, raising the price of carbon is a necessary and sufficient step for tackling global warming.” In contrast Hanemann (2010) argues that a price on carbon is necessary, but will need to be accompanied by complementary regulatory measures.

⁴ We emphasize below that globally emissions may be lower under cap and trade due to offsets.

We conclude with the assertion that the imagined performance of economic ideas within an institutional setting is not guaranteed to match theory. In much of the discussion about climate policy, as well as in the teaching of economics, a dichotomy is presented posing market-based policies versus regulation. This dichotomy suggests policymakers should dismantle regulatory institutions and replace them with markets. We argue that in most cases this suggestion is implausible and in any event not helpful. Moreover, it undermines the contribution that economic ideas can make. We suggest that economic ideas can have their greatest influence not through the substitution of purportedly simple market functions for complex institutions, but by influencing the way those institutions function. Sometimes this approach will involve the introduction of market prices, but many times it will involve the introduction of regulatory reforms and shadow prices that align incentives under various rules and constraints with policy goals. After all, prices serve as a vehicle to deliver incentives, but incentives are the core of the economic approach to shaping behavior.

Economic ideas can increase their influence on environmental outcomes by influencing existing institutions to move toward the greater use of incentives in place of prescriptive regulations. This possibility is anticipated in President Obama's June 2013 memorandum that directed EPA "...to ensure, to the greatest extent possible, that you develop approaches that allow the use of market-based instruments, performance standards, and other regulatory flexibilities."⁵ This approach 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.

2. Political Context of Policymaking

Policies are the products of the political context through which they are created and enacted. One example is the way the political context shapes how the policy can be changed over time. Economic ideas suggest that policies should be updated over time to assimilate new information.

⁵ <http://www.whitehouse.gov/the-press-office/2013/06/25/presidential-memorandum-power-sector-carbon-pollution-standards>

2.1. The Experience of Sulfur Dioxide Emissions Trading

Prior to the EU's CO₂ 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 SO₂ 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 an ambiguous evaluation.

In 1990 the National Acid Precipitation Program forecast that SO₂ 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), but soon thereafter subsequent economic analysis 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 has been unable to reach political agreement (Schmalensee and Stavins 2012; Evans and Woodward 2013).

McCray et al. (2010) observe that "... if the overall public objective is to link policy with factual knowledge, this is only a fleeting victory." In a review of 39 regulations promulgated under four presidents the authors find few examples of "planned adaptation" to reflect new scientific or economic information built into the design of regulations. However, foremost on their list is the Clean Air Act and fortunately, from a public health perspective, the statute implementing the SO₂ 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 SO₂ such that the emissions cap is now slack and the trading program is not relevant.⁶ With implementation of the Mercury and Air Toxics Standard, emissions of SO₂ from sources covered under the cap will fall to 2.1 million tons by 2016 (EPA 2011). Coupled with other regulations affecting minor emissions sources, EPA's regulatory authority under the Clean Air Act will yield greater emissions reductions than what was achieved by the seminal cap-and-trade program.

⁶ See Hanemann (2010) for a recent discussion of how emissions reductions were achieved.

2.2. U.S. Climate Policy

The flaw of the SO₂ cap-and-trade program was its inability to adapt to new information that benefits were substantially greater than anticipated and that costs were substantially less. Emissions trading policy for CO₂ in the United States would likely face many of the same issues as SO₂ emissions trading including the inability to update the policy over time. Similarly, under a carbon tax, economic efficiency would require the carbon price to be adjusted to assimilate new scientific information. However, it is hard to imagine how this would occur, since the tax level is established by congressional action and revisiting the technical basis for this legislative decision might be just as fraught or flawed as the initial implementation of a tax, as seen by the inability of Congress to update the SO₂ cap. One approach to assimilating new information might be to delegate authority to adjust the carbon tax to an expert agency such as EPA (Richardson and Fraas 2013; Burtraw 2013). However, the authority to tax is the exclusive domain of Congress, and this is one power the legislative branch guards jealously and rarely delegates.

An example is the comprehensive climate legislation proposed in the 111th Congress, known as the Waxman–Markey bill (HR 2454) that 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. Although this legislation was not adopted it was passed by the House of Representatives, so it provides an example of price-based climate policy that is feasible in the U.S. given political constraints. One important provision of the Waxman-Markey bill was to strip the EPA of its authority to regulate greenhouse gases from most of the economy, retaining with Congress the ability to change or update the emissions cap to reflect state-of-the-art scientific information.⁷ However, for the reasons discussed above and noting the most recent revision to the Clean Air Act occurred in 1990, it is unlikely that any updating would occur on a timely basis. Thus the cap levels set in

⁷ EPA authority to regulate mobile sources would have been preserved but authority to regulate pre-construction permitting or performance standards stationary sources in sectors covered by the emissions cap would have been preempted, along with future potential regulation of greenhouse gases under other portions of the Clean Air Act (Richardson and Fraas 2013).

2009 specifying targets through 2050 would have likely persisted for decades despite new scientific and economic information that would become available during the intervening years.⁸

With the failure of the U.S. Congress to adopt a market-based (cap and trade) policy to reduce carbon emissions, the alternative is the regulatory system already in place under the Clean Air Act and a collection of policies at the subnational level that are facilitated by the regulatory setting established under the act, which are achieving meaningful emissions reductions in the absence of comprehensive federal climate policy. We describe this existing policy framework as the *Clean Air Act regime*. We conclude that domestic emissions in the U.S. in 2020 are expected to be lower than if cap and trade had been enacted, although emissions globally would have been lower with cap and trade due to the extensive purchase of emission reduction offsets.

2.2.1. Cap-and-Trade Policy vs. Clean Air Act Regime

We noted above that meaningful emissions reductions are already being achieved in the absence of federal climate legislation. 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 CO₂ emissions of about 10 percent relative to 2005 levels in 2020 (Burtraw and Woerman 2012; EIA 2012; Bloomberg 2013; Bianco et al. 2013).⁹ 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 to some degree 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. Another secular change is the Mercury and Air Toxics Standard regulating emissions of conventional and hazardous air pollutants from the electricity sector, imposing annual costs of about \$7 billion (2009\$) on coal-fired power plants. It is not expected to directly result in extensive retirement of coal plants, but it reinforces the changing

⁸ Similar examples appear in international climate negotiations, where the ability to assimilate new information emerged as an early challenge with recognition of a gap between official national-level emissions ceilings and business-as-usual emissions levels among the former Soviet Bloc countries, referred to as “hot air.” Woerman (2004) concludes that economic analyses either neglect institutional features such as hot air or else see it as an unproblematic solution to the initial distribution of property rights (allocation) within cap and trade.

⁹ Bianco et al. (2013) are less optimistic when considering all greenhouse gases. On this metric, they anticipate reductions of about 5 percent.

business environment favoring the use of natural gas in the electricity sector (Burtraw et al. 2012a).

A second factor that helps to explain the change in emissions is actions taken by state and local governments. These actions 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 actual mechanism of the Clean Air Act. In 2007 the US Supreme Court affirmed the authority of the EPA to regulate greenhouse gases under the Clean Air Act. Under threat of private lawsuits against the agency, EPA initiated an investigation culminating in a formal finding that greenhouse gas emissions endangered human health and the environment. Under pressure from subsequent lawsuits EPA initiated regulations. Tighter vehicle emissions standards that took effect in 2011 implement a 5 percent per year improvement in the vehicle fleet resulting in an average miles per gallon of 35.5 in 2016. A second set of standards will take effect in 2017 and will require efficiency improvements to reach 54.5 miles per gallon by 2025. Preconstruction (design) permitting of new and modified sources for greenhouse gas emissions is also now in effect. The stringency and influence of this regulation are still being determined, but it about 100 permits addressing greenhouse gas emissions from new sources have been issued at the time of this writing. The most important regulation, which is yet to be finalized, will be operating performance standards for existing stationary sources.¹⁰

Differences in institutional structure between a cap-and-trade policy and the Clean Air Act regime cause the regulatory systems to vary in two important ways in how they would react to these changes. One way is the ability to update the emission cap or regulation. If secular or regulatory changes occur that make achieving emissions reductions cheaper and if the cap or regulation is set to approximately equalize marginal costs and marginal benefits, then the availability of cheaper reductions suggests that the cap level or regulation should be tightened to achieve additional reductions.¹¹ As we have argued, this is unlikely to occur in a timely manner.

¹⁰ Burtraw et al. (2011) survey a set of technical measures focusing on energy efficiency at existing stationary sources in six sectors identified by the U.S. Environmental Protection Agency that tally additional emissions reduction opportunities of 6.2 percent of 2005 emissions.

¹¹ A price floor would have had an automatically adjusting program stringency in response to changes in costs in the SO₂ program (Burtraw et al. 2010). The existence of a price floor under the Waxman-Markey cap-and-trade proposal, set initially at \$10 per metric ton and increasing at 5 percent per year plus inflation, would have constricted supply if price declined to this level.

The Clean Air Act regime, however, requires the EPA to regularly update regulations to ensure new information such as new market conditions or scientific information (depending on the relevant portion of the act) is assimilated into the stringency of the regulation. A second way is the natural ability of the regulatory mechanism to react to these changing market conditions. Detailed simulation modeling of these institutional differences described in the next section indicates the Clean Air Act regime is projected to yield greater permanent domestic emissions reductions than would have occurred under the Waxman-Markey legislation.¹²

2.2.2. Modeling of U.S. Carbon Dioxide Emissions under Regulatory Alternatives

Modeling by EIA in 2009 of the proposed Waxman-Markey 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 deposited in the emissions bank. If one considers deposits 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 cap and trade. For example, the change in relative fuel prices stemming especially from the expanded supply of natural gas and 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 reduce demand for emissions allowances and thereby reduce their price, yielding a rebound effect. Agents will undertake actions that shift emissions among

¹² Greater detail on the modeling approach is found in Burtraw and Woerman (2012).

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), adding to the model 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.¹³ These results are reported as the 2012 RFF Forecast under the Cap-and-Trade Implementation section of Table 1.

Secular changes would have occurred with Waxman–Markey, but because the emissions cap also serves as an emissions floor (if allowances retain a price above a price floor) they would not have directly resulted in equivalent emissions reductions. We find a rebound 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 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 scheduled to take effect in 2017 might not have been implemented

¹³ 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.

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 these factors 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.¹⁴ 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, however, 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 the table, 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.

¹⁴ 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
<i>Clean Air Act Regime</i>					
2012 RFF Forecast	9.1	0.0	0.0	0.0	9.1
2012 RFF Forecast with projected standards for existing sources	16.3	0.0	0.0	0.0	16.3
<i>Cap-and-Trade Implementation</i>					
2009 EIA Forecast	10.2	4.7	15.8	3.0	33.6
<i>Adjusted for Banking</i>	5.6	2.6	8.8	3.0	20.0
2012 RFF Forecast (with secular trends and subnational policies)	13.6	4.2	11.6	3.0	32.4
<i>Adjusted for Banking</i>	7.9	2.4	6.7	3.0	20.0
2012 RFF Forecast (above with fuel economy standards)	15.9	3.8	10.4	3.0	33.0
<i>Adjusted for Banking</i>	9.0	2.1	5.9	3.0	20.0
2012 RFF Forecast (with risk-adjusted discount rate)	12.3	3.7	7.9	3.0	26.9
<i>Adjusted for Banking</i>	8.7	2.6	5.6	3.0	20.0

Sources: EIA (2009) and authors' calculations.

We examine several sensitivity analyses. 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. If we include domestic offsets, 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, Waxman–Markey yields domestic reductions of 10.3 percent, relative to 2005 levels.

It is possible the tighter mobile source standards taking effect in 2017 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.

Finally we examine an alternative banking scenario. In our central estimate of Waxman–Markey, we use a discount rate of 7.4 percent representing the opportunity cost of capital to calculate the required return on holding allowances; this is the same rate used by EIA in its 2009 analysis of the Waxman–Markey legislation. However, risk associated with policy interactions at the domestic and international level would lead investors to require a greater annual return in order to hold the allowances (Salant and Henderson 1978). To represent this risk premium, we 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.

Under each of these sensitivities, domestic emissions reductions by 2020 under the Clean Air Act regime are less than under the counterfactual cap-and-trade policy after adjusting for banking. If the regulation of existing stationary sources is accomplished according to EPA technical documents the domestic emissions reductions would be greater even than what is actually observed in 2020 (not adjusting for banking). However, in every case global emissions reductions are less under the Clean Air Act regime, if offsets are counted fully. The range of possible interpretations might give policy makers concern, introducing some risk aversion with respect to the use of market-based policy and contributing to an explanation for its limited adoption heretofore.

2.2.3. Introducing a Shadow Price in Regulation

The most important uncertainty 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 EPA using its established regulatory authority. This pending climate policy decision is the most important that has been faced by a U.S. administration, and economic ideas have a great opportunity to influence the outcome.

EPA will propose standards by June 2014 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 would introduce an incentive-based regulation through the use of a shadow price within the existing regulatory structure by averaging of emissions rates across facilities through the implementation of 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 CO₂ 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, and this institutional detail provides a transition to our next topic.

3. 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 under-provision of mitigation effort at a global level is expected. This understanding of the problem motivates efforts to develop an international framework for emissions mitigation.

As Keohane and Victor (2013) point out, international coordination is inherently difficult. Intense distributional conflict and high uncertainty erode incentives for states to make commitments. In the absence of global hegemony around mitigation of climate change, there is substantial mitigation activity at the local level.¹⁵ 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. But there is a growing appreciation that the effects of a changing climate are felt locally and differ geographically, and 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, as reflected in the now 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. Ostrom (2009) describes this as a polycentric approach to climate mitigation. 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

¹⁵ 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>.

change, and unlikely to be sufficient to generate trust that is necessary for an effective global effort.

A similar alignment of interests applies in microcosm among state or provincial governments within a federal system such as the United States. As noted above, in the absence of national policy, efforts by state and local governments have contributed to emissions reductions of about 2.5 percent nationally 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.¹⁶ Moreover, many policies now in place at the national level including appliance standards and mobile source standards were first introduced at the state 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.

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. 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 established using market-based policies and balancing benefits and costs then local initiatives can only raise costs. However, Williams (2012) analyzes a variety of possible interactions between national and state-level policies and finds in general state discretion will improve economic efficiency. Local governments also usefully differentiate themselves through experimentation and policy differences that enable citizens to sort themselves into communities that offer attractive amenities. 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.

¹⁶ 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>.

State and local governments also have a crucial role to play in the long-run in achieving mitigation goals, once the goals are decided, that is not anticipated in economic models. 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. 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 institutional and political realities at the subnational level. Borrowing a metaphor from labor negotiations, it takes three negotiations to achieve one agreement—that is, one across the table and one on each side of the table (Dunlop 1944). Analogously, interactions between governments require negotiations between various levels of jurisdiction.

Most applications of economic theory to environmental problems not only confuse the role of jurisdictional authority but ignore multi-layers of government altogether. 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. 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 (Burtraw and Shobe 2009; Goulder and Stavins 2011). The result is the effective preemption of additional actions by other governments or individuals. Effective preemption in the European Union under its Emissions Trading System is a relevant concern as member states have considered further measures at the national level. A similar dilemma in public finance occurs 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 usually such consideration is missing.

4. 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 policy that is apparently so difficult to establish in the first place can be readily changed to respond to new information.

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 transparent. 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. The activities of state and local governments are over-determined. 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 climate-friendly development patterns such as greater density and pedestrian- and transit-oriented development forms. The inadequate supply of these features 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 and street alignments and architectural features. There is compelling evidence to indicate that a moderate market price signal that might promote more energy efficient land use and transportation infrastructure planning might not penetrate this process in a meaningful way.

On the other hand, local governments can be extremely responsive to nonmarket economic incentives from higher levels of government, as illustrated in the following case study. Where developers in California's Orange County sought to increase density, they were prohibited from doing so by local planning officials. As a consequence housing values were very high and moderate-income workers in this growing area had travel times to work of up to two hours each way. The attendant air quality problems prompted the State of California to issue 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 incumbent homeowners. This resulted in the introduction of the nation's largest inclusionary housing program at the time in famously conservative Orange County, an example of jurisdictional relationships accomplishing what market signals could not (Schwartz et al. 1982).

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 CO₂ 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.

5. 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 commodity price for CO₂. 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 especially in the short term 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 and imperative for an efficient outcome 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 fails to distinguish among types of price-based incentives and among types of regulation. Incentives delivered through markets and through regulatory apparatus are intricately related; one cannot supplant the other in achieving efficient long-run climate policy. 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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