

**Motor Fuel Taxation, Energy Conservation,
and Economic Development:
A Regional Approach**

Richard England
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Abstract

Combustion of motor fuels has a variety of environmental impacts on local, regional and global scales. Taxing motor fuels more heavily would mitigate those environmental impacts. However, many governments are reluctant to increase motor fuel taxes because they fear that the tax incidence will be regressive and that economic development will be impeded. Using data for the New England region of the United States, this paper argues that an oil-importing region can conserve energy, avoid regressive impacts and encourage economic development by taxing motor fuels more heavily and rebating the incremental revenues to owners of motor vehicles.

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Table of Contents

Introduction	1
Crafting an Appropriate Policy Response	2
Motor Fuel Taxation and Regional Development	6
Policy Simulation for New England	8
Projected Regional Impacts of Gas Tax Reform	10
Conclusions	11
References	12
Appendix	16

Motor Fuel Taxation, Energy Conservation, and Economic Development: A Regional Approach

Introduction

Without doubt, the motor vehicle is central to daily life in the United States. In 2003, the nation's fleet of autos, trucks and buses numbered 231.4 million. There was nearly one auto for every two Americans (FHWA, Table MV-1). In order to service this vehicle fleet, governments at the federal, state and local levels had constructed 3.97 million miles of public roads by 2003, almost 23.7 percent of that mileage in urban regions (FHWA, Table VM-1).

This enormous fleet of vehicles and extensive network of streets and highways permits an unprecedented degree of mobility in the contemporary United States. In 2003, vehicles logged 2.89 trillion miles of travel (op. cit.), the equivalent of more than 6 million round trips between our planet and its moon. Along the way, those vehicles burned 169.6 billion gallons of gasoline and diesel fuels (FHWA, Table MF-21).

Mobility of people and freight carries a high price tag, however. In 2001, the private cost of operating an automobile (fuel, depreciation, maintenance, etc.) ranged from 20 to 50 cents per mile (Harrington and McConnell 2003: 21). Of greater relevance to this study are the numerous external costs associated with the nation's dependence on motor vehicles to transport drivers, passengers and cargo. Soil and groundwater contamination from leaking fuel storage tanks is a widespread problem, for example. The US EPA (2005) has confirmed nearly 449 thousand leaks from underground tanks.¹

The operation of vehicles results in highway fatalities and injuries, noise pollution, and urban road congestion. In 2000, more than 40,000 people died in traffic accidents and 3.1 million received injuries (Parry 2004: 346).² Road congestion led to 3.7 billion hours of travel delay in 85 metropolitan areas during 2003 alone (Schrank and Lomax 2005: 1).

During their operation, motor vehicles also emit a wide variety of combustion products into the atmosphere. Several of these emissions contribute to health problems at the local and regional scale. McCubbin and Delucchi (1999), for example, find that vehicles are a primary source of small suspended particles and that particulate matter contributes to asthma attacks and other respiratory problems. Neidell (2004) reports that as much as 90 percent of carbon monoxide in California cities comes from vehicle tailpipes and that this air pollutant apparently elevates the hospitalization rate of young children.

In the presence of heat and sunlight, two types of auto emissions contribute to the formation of ground-level ozone. Hubbell et al. (2005) estimate that if all locations in the U.S. were to

¹ Many, but not all, of these tanks contained gasoline and diesel fuel stored at retail locations.

² Not all of the costs of highway accidents are borne by parties other than the vehicle operator, however. Parry (2004) estimates that the accident costs imposed on other parties total 56 to 163 billion dollars per annum.

comply with the EPA 8-hour standard for ozone exposure, there would be 800 fewer premature deaths, 4 thousand fewer hospital admissions and 900 thousand fewer school absences per year.

Another category of external cost associated with vehicle emissions is reduced atmospheric visibility. Although sulfates discharged from power plants and industrial plants are a major source of haziness during summer months, nitrous emissions from autos also play a substantial role (US EPA 2005).³ Survey research by Crocker and Shogren (1991) revealed that visitors to a Cascades wilderness site were willing to pay for improvements in visibility. In a more recent study of house prices in four California counties, Beron, Murdoch and Thayer (2001) found that, after controlling for ozone and suspended particle concentrations, a one-mile improvement in mean visibility was associated with a 3 to 8 percent increase in sales price. Visibility is an environmental amenity that people value and are willing to pay for.

Still another external cost of vehicle emissions is damage to forests, agricultural crops and other forms of plant life. Murphy et al. (1999) have estimated that eliminating ozone precursor emissions from vehicle tailpipes would have increased U.S. agricultural output by 3.5 to 6.1 billion dollars in 1990.

These and other empirical studies suggest that there are significant external costs at the regional and local scales associated with the use and storage of motor vehicles. Two surveys of empirical estimates suggest that these external costs could total as much as 66 cents per vehicle mile (Harrington and McConnell 2003: 23).⁴ This implies that the external costs of motor vehicle transport could be substantially higher, at the margin, than the private costs incurred by the operators of those vehicles.

Crafting an Appropriate Policy Response

This difference between the private and social costs of motor vehicle transport points to a major misallocation of resources within the U.S. economy. What is to be done? The theory of optimal taxation points to a variety of specific levies, each intended to reduce the external costs associated with a particular dimension of motor vehicle use. Road congestion, for example, could be tackled by a road use fee tailored to the time of day on a particular roadway (Mills 1998: 77).⁵ Traffic accidents could be reduced by a vehicle mileage fee tailored to driver age and vehicle characteristics (Parry 2004: 350). Air pollution resulting from tailpipe emissions could be abated by spatially differentiated emissions charges (Tietenberg 1994: 58-70). Although theoretically attractive, proposals such as these are unlikely to result in adoption of a set of optimal taxes on vehicle-related externalities. Political opposition to new tax instruments, heavy information requirements and high administrative costs pose serious

³ The Region 1 office of US EPA reports that 56 percent of the nitrous oxides discharged during 2002 in New England came from motor vehicle tailpipes.

⁴ This estimate is the sum of the high estimates for each category of external cost in Harrington and McConnell (2003, Table 3), excluding the (suspiciously low) estimated costs of global climate change.

⁵ A simple version of this theoretical proposal was adopted in central London in 2003.

obstacles to implementation of optimal levies on the various externalities associated with motor vehicle use and storage.

The second-best, but politically feasible, alternative would be to reform and increase the existing excise tax on retail purchases of motor fuels. In a study of California, for example, Fullerton and West (2003: x) have found that using the gas tax to reduce vehicle emissions could achieve 62 percent of the maximum gain in social welfare via an emissions charge. Grabowski and Morrissey (2004: 588) report that the long-run elasticity of traffic fatalities with respect to the real price of gasoline is -0.34 . This finding supports the comment of Parry (2002: 30) that the gas tax is the “next-best response for curbing...accidents.” Mills (1998: 79) argues that road use tolls are the preferred policy tool to control highway and street congestion but that “[a]s a practical matter, there is much to be said for fuel taxes. They are by far the cheapest taxes to collect...[and] are almost impossible to evade....” Finally, Brueckner (2001: 77) has stated that a higher gas tax could be “a practical means of remedying ... sprawl.”⁶ If raising a single tax has the potential to reduce air pollution, highway fatalities, traffic jams and metropolitan sprawl, then this fiscal policy deserves serious consideration.

Although an increase in federal excise taxes on gasoline and diesel fuel should be considered, this paper argues that a state or regional approach to motor fuel taxation is warranted in the United States.⁷ One reason is that the U.S. Congress shows little inclination to raise taxes of any sort.⁸ Another reason is that federal policy to restrain automotive energy use has focused since 1975 on fuel-efficiency, or CAFE, standards for newly manufactured vehicles, not on taxation of fuel use by the entire vehicle fleet.⁹

In addition to pointing out the limitations of federal policy in the United States, one can also make an affirmative case for higher motor fuel taxes at the state and regional level. Oates (1999: 1132), for example, has argued that there are “potential gains from experimentation with a variety of policies for addressing social and economic issues. And a federal system may offer some real opportunities for encouraging such experimentation and thereby promoting ‘technical progress’ in public policy.” That is, successful experiments in some states can provide empirical evidence favoring future changes in both state and federal policy. According to Fisher and Costanza (2005), state and local governments representing a quarter of the U.S. population have already undertaken policies to reduce carbon emissions.

⁶ McGibany (2004) provides some empirical evidence that heavier state taxation of gasoline is associated with more densely populated urban areas. The econometric technique employed, however, does not allow the author to distinguish between cause and effect.

⁷ Although the following arguments focus on the United States, one could make similar arguments for Canada, Brazil, Germany, Australia and other nations with federal political systems.

⁸ The federal tax on gasoline was last increased in 1994, when its nominal rate reached 18.4 cents per gallon. During the next decade, the inflation-adjusted tax rate fell by 21.6 percent. This decline in the real value of the federal tax rate means that national policy today provides weaker protection from detrimental externalities associated with motor vehicle operation than a decade ago.

⁹ A number of researchers have concluded that the gas tax is superior to fuel-efficiency standards as a tool of public policy. See, for example, CBO (2003) and West and Williams (2005).

But are some regions within the United States better suited as sites for policy experiments than others? Regional diversity within the nation suggests that the answer is yes. As Lang and Dhavale (2005) have shown, 2/3 of the U.S. population now resides in ten megapolitan regions covering 1/5 of the nation's land area.¹⁰ These regions have distinctive cultural features and physical environments, have coalesced around stretches of interstate highway and are distinguished by their signature industries. Table 1 provides some evidence that regions can vary substantially in population density, land cover, motor vehicle ownership and use, and energy production. Because of these and other interregional differences, Nicol (2003: 210) finds that the price and income elasticities of demand for gasoline also differ among U.S. regions. Hence, the economic impacts of higher fuel taxes could vary substantially across the nation's landscape.

Table 1
Regional Differences in the United States

	Texas	New England
Population, 2004, millions	22.49	14.24
Land area, 2000, thousands sq. miles	261.80	62.81
Percent Land Area Forested, 1997	6.5	76.6
Motor vehicles, 2003, millions	14.89	11.96
Highway fuel use, 2003, billions gallons	14.39	7.98
Vehicle miles traveled, 2003, billions	223.42	129.91
Percent VMT in urban areas, 2003	64.7	73.8
Crude oil output, 2004, millions barrels per day	1.07	0
Oil refining capacity, 2005, millions barrels per day	4.63	0

Sources: Energy Information Administration, "State Data," Natural Resources Conservation Service, "Summary Report 1997 National Resources Inventory" and U.S. Census Bureau, "State and County Quick Facts."

This paper argues that the New England states, either individually or as a regional coalition, are prime candidates for higher motor fuel taxes. One reason is that refined oil products are an

¹⁰ For example, the most populous of these regions is the Northeast, ranging from southern Maine to eastern Virginia. It encompasses major metropolitan areas such as Boston, New York, Philadelphia, Baltimore and Washington.

import into the region because New England neither produces nor refines petroleum. Hence, most of the revenues from retail fuel purchases flow to other states or regions of the world.¹¹ A second reason is that southern New England is a highly urban region and offers commuters relatively good public transit service.¹² This suggests that the price elasticity of demand for gasoline is higher in parts of New England than the national average. Hence, a gas tax hike would likely induce a relatively large amount of energy conservation, even in the short run.

Still another reason is that the New England states, with the exception of Maine, have relatively high per capita incomes (Aghdasi et al. 2005). Despite their relative affluence, these states have been experiencing slow population growth, with the exception of New Hampshire. As Partridge and Rickman (2003:33) have observed, this could reflect some combination of “congestion, environmental, or weather-related disamenities.”¹³ Because county-level rates of employment growth are positively associated with environmental quality (Pagoulatos 2004), reducing the external costs of motor vehicle transportation could help New England to attract and retain skilled employees who could easily locate in other regions (Partridge and Rickman 2003:35). A final reason for considering New England is that the region’s governors have already stated that they seek “to reduce ... [greenhouse gas] emissions ... [and] to implement actions that result in higher efficiency in the transportation of passengers and goods” (NEG/ECP 2001: 5).

Of course, a major political obstacle to higher motor fuel taxation is the widespread perception that the gas tax imposes a regressive burden on the commuting public. There is substance to this fear but, as Chernick and Reschovsky (1997) have noted, the use of annual household incomes instead of multi-year average incomes to measure tax incidence tends to exaggerate the regressive effects of gasoline taxation. In addition, as West (2005) has pointed out, regressivity is dampened by lower vehicle ownership rates among poor households. At the same time, however, a larger portion of the gas tax is shifted to motorists in less populous states like Vermont and Maine, thereby increasing its regressive tendencies in those jurisdictions (Chouinard and Perloff 2004).

However regressive the gas tax might tend to be, those tendencies can be erased by a simple feature of tax policy design: As a higher gas tax rate is introduced in a state, *the incremental revenues from that tax hike could be rebated in equal shares to its registered vehicle owners.* This idea is hardly new: Shepard (1976) and President Gerald Ford (1975: 33) advanced similar plans during the first oil price shock thirty years ago. West and Williams (2004: 551)

¹¹ Iledare and Olatubi (2004) note that higher petroleum prices tend to lower unemployment rates and raise both personal incomes and state tax revenues in Alabama, Louisiana and Texas. The same cannot be said of New England.

¹² Connecticut, for example, has an extensive network of intercity rail and bus routes. The public transit authority in the Boston area serves 175 cities and towns and provides almost 800,000 one-way trips per day.

¹³ During 2003, the per capita travel delay because of road congestion was 51 hours in Boston, 33 hours in Providence and 32 hours in Bridgeport-Stamford. From 1982 to 2003, those traffic delays per person increased by 37, 28 and 27 hours per year, respectively (Schrank and Lomax 2005: Tables 1 and 4).

find that a one-dollar increase in the federal gas tax combined with a lump-sum transfer of the extra revenues to households would have a decidedly progressive incidence.

Motor Fuel Taxation and Regional Development

Could it be that an oil-importing region of a national economy, New England for example, would gain economically from a gas tax hike combined with a rebate provision? There are a number of theoretical reasons for answering in the affirmative. In the first place, households are geographically mobile within the United States and make residential location choices based upon regional differences in labor market opportunities, state and local tax and public expenditure policies, and environmental amenities. As McGranahan (1999) has shown, nonmetropolitan counties with better climates, water access and variable topographies have enjoyed rapid population growth during recent decades. Unfortunately, state and local policymakers are unable to alter those characteristics of their regions. However, Bayer, Keohane and Timmins (2005) have documented that metropolitan areas in the U.S. with lower air pollution levels tended to enjoy a net flow of migrants from 1990 to 2000. Hence, if a region were to improve its relative environmental quality by restraining its motor fuel consumption, it could expect a positive impact on labor supply growth, especially for more educated labor, after a time lag.

Another economic development argument for increasing motor fuel taxes within an importing region is that a reduction in automotive emissions could help to prevent tighter federal regulations on factories, power plants and other stationary emitters of ozone precursors. In June 2004, the U.S. Environmental Protection Agency designated all of Connecticut, Massachusetts and Rhode Island and parts of New Hampshire and Maine as nonattainment areas under its 1997 eight-hour ozone standard. The Region 1 EPA office estimates that 56 percent of nitrous oxide and 27.4 percent of the volatile organic compound emissions in 2002, both precursors to atmospheric ozone formation, came from vehicle tailpipes. However, the mobile source control strategies required by the 1990 Clean Air Act amendment are likely to have had a negligible impact on vehicle use and fuel efficiency.¹⁴ Hence, as regional fuel consumption grows, the political pressure builds to tighten federal emissions standards on stationary sources, thereby threatening a region's future industrial competitiveness in national and global markets (Heninger and Shah 1998). A higher motor fuel tax at the state or regional level could help to reduce that risk associated with federal environmental policy.

For oil-importing jurisdictions, higher taxation of motor fuels can have another competitive benefit for the regional economy. As Chouinard and Perloff (2004) have reported, higher fuel taxes are usually shared by motorists, on the one hand, and retailers, refiners and crude oil producers, on the other hand. They estimate that less than half of a federal tax hike is borne by the retail customer because market supply is less than perfectly elastic. In California, only three-quarters of a state tax hike can be shifted to motorists by station owners. Admittedly, a tax hike by a small state like Vermont is likely to be fully shifted to vehicle operators.

¹⁴ These strategies include mandating intensified vehicle inspection programs, enhanced gasoline vapor recovery at retail outlets, and the use of reformulated gasoline within the nonattainment region. For more details, see www.epa.gov/region1/airquality/index.html.

However, if several New England states were to raise their fuel taxes simultaneously, they could function as a buying cartel and thereby lower the import price of refined oil products shipped into the region.¹⁵ Lowering both the import price and quantity consumed of motor fuels would improve the region's trade balance with the rest of the world and also reduce its vulnerability to the growing volatility of gasoline prices in the U.S. market (Akarca and Andrianacos 1998).

Because the price elasticity of demand for motor fuels increases with time, that improvement in the trade balance of an importing region would tend to grow, the longer that a gas tax hike is in effect. Some producers within the region would enjoy higher sales as households reallocated a portion of their after-tax-and-rebate incomes from imported motor fuels to products of the region. Admittedly, higher retail pump prices would tend to increase operating costs for vehicle-dependent businesses within the region, but those cost increases would tend to abate as enterprises invested in fuel-efficient vehicles and eliminated low-value trips from their travel schedules.¹⁶ As summarized in Table 2, the theoretical case is strong, although not conclusive, that the economy of an importing region would benefit from a gas tax hike-and-rebate policy.

Table 2
Economic Development Impacts of Gas Tax Hike-and-Rebate Plan for
Region Importing Motor Fuels

	Short run	Long run
Reallocation of household spending to regionally produced goods and services	+	++
Labor supply growth induced by regional amenity improvements		+
Avoidance of stricter stationary-source emissions regulations within the region		+
Higher fuel prices for vehicle-dependent businesses within the region	--	-
Lower import price for motor fuels and reduced vulnerability to global price shocks	+	+

¹⁵ Liski and Tahvonen (2004) have made the theoretical argument that an international coalition of oil-consuming nations could lower the import price that they pay to oil-exporting nations by introducing a tax on carbon emissions in a coordinated fashion. A coalition of oil-importing states could pursue a similar strategy, albeit with more modest results.

¹⁶ Opposition of vehicle-dependent business owners (taxi operators, parcel delivery firms, etc.) could be reduced if the gas tax increase were phased in over several years and if the first rebate checks to vehicle owners were mailed before the first phase of the tax increase. This form of financial assistance to vehicle owners would require some short-term borrowing by participating state governments.

Policy Simulations for New England

In an effort to learn whether a gas tax hike-and-rebate plan could have favorable economic impacts on an oil-importing state or region, I have performed a number of tax policy simulations using a regional econometric model of the six New England states. REMI Policy Insight is a proprietary model that combines a regional input-output table with econometrically estimated investment, migration and other behavioral equations. Although similar in structure to computable general equilibrium models, the REMI forecasting and simulation model incorporates various stock-adjustment time lags and does not require product and factor markets to clear continuously.¹⁷

Using the empirical assumptions detailed in the appendix to this paper, I have simulated the economic impacts of enacting a permanent excise tax increase of 50 cents per gallons during 2003 in each of the six New England states individually or by all six states simultaneously. Once enacted, the nominal tax rate is assumed to increase in later years so that the real tax hike is preserved.

After taking into account differences in supply and demand elasticities among the states of the region, I have calculated the probable increases in retail pump prices following the tax hike. Table 3 reports the rough magnitudes of those retail price adjustments.

Table 3
Retail Price Changes in 2003 after Gas Tax Hike
(cents per gallon)

CT	ME	MA	NH	RI	VT	All six states
47.5	48.5	47.5	49.5	47.5	48.5	45.0

Using the short-run price elasticities reported in appendix Table 1A, these retail price hikes allow one to forecast the immediate decline in gasoline consumption in each jurisdiction following the enactment of a stiffer tax on motor fuel purchases. In the case of Connecticut, for example, a 50-cent per gallon tax hike in 2003 would have increased the average pump price by 47.5 cents per gallon, or by 24.7 percent. A retail price hike of that magnitude would have lowered quantity demanded by 7.9 percent in 2003, an amount equal to 136.5 million gallons. After accounting for a loss of state tax revenue resulting from fewer gallons sold, one finds that the net gain in Connecticut tax revenue following a 50-cent tax hike would have been \$761.3 million.¹⁸ By assumption, this net revenue gain would have been distributed in equal

¹⁷ For another use of the REMI model to generate regional tax simulations, see England (2003). For still other examples of REMI-based policy research, go to www.remi.com.

¹⁸ To be specific, the net gain in Connecticut motor fuel revenue in 2003 would have been $(\$0.50 \text{ per gallon} * 1591.3 \text{ million gallons}) - (\$0.2513 \text{ per gallon} * 136.5 \text{ million gallons}) = \761.3 million .

shares to the owners of more than 2.9 million registered motor vehicles. Tables 4 and 5 summarize these calculations for each of the states in New England.

Table 4
Short-run Adjustments in Motor Fuel Use after State Tax Hike
(millions gallons per year)

CT	ME	MA	NH	RI	VT
-136.5	-65.5	-258.1	-51.9	-34.3	-28.5

Table 5
Tax Rebates to Vehicle Owners in 2003

	Total rebates (millions \$)	Rebate per vehicle (\$)
CT	761.3	260.46
ME	427.7	414.39
MA	1,416.0	261.31
NH	358.0	317.51
RI	195.1	245.38
VT	185.0	366.19

The differences among the six states in projected rebates per vehicle are quite striking, ranging from \$245 in Rhode Island to \$414 in Maine. One can explain these potential differences by recognizing two facts about the states of northern New England: (1) they have lower population densities and hence the typical vehicle trip covers more miles; and (2) they attract significant numbers of out-of-state tourists who purchase motor fuels and who could generate rebate dollars for in-state vehicle owners.

In addition to inducing energy conservation and generating tax revenue for transfer payments to vehicle owners, a state gas tax hike of 50 cents per gallon could generate substantial amenity benefits for the residents of the region. Utilizing conservative assumptions about the magnitude of those benefits¹⁹, I arrive at the estimates summarized in Table 6.

Table 6
Amenity Benefits in 2003 Resulting from Tax Hike (millions \$)

	Internal to State	Spillovers to Other States
CT	116.1	13.6
ME	55.7	
MA	219.4	25.8
NH	44.2	2.6
RI	29.2	
VT	24.2	1.4

¹⁹ Those assumptions are detailed in the appendix to this paper.

Projected Regional Impacts of Gas Tax Reform

Imagine that a single state government in New England had implemented a 50 cent per gallon gas tax hike in 2003 and rebated the net increase in tax revenues to that state's vehicle owners. As reported in Table 7, my tax policy simulations project that every state in New England would have enjoyed a boost to both employment and per capita income in the years after the change in state tax policy. Over time, the positive employment effect would have strengthened but, with the exception of Massachusetts, the impact on per capita income would have weakened. Partial dissipation of the immediate income gain is understandable because early gains in employment and amenity benefits would have attracted more immigrants to the state, some of whom would have augmented labor supply and restrained earnings growth.

Note that the magnitude of the projected employment and income gains would have varied substantially among the New England states. Connecticut could have expected the most modest stimulus to its state economy, probably because of expenditure leakages to its western neighbor, New York. Maine and Vermont, on the other hand, could have expected significant boosts to employment and disposable incomes because of a transfer of purchasing power from nonresident tourists to resident vehicle owners.

Table 7
Projected Impacts of Single-State Motor Fuel Tax Reform in 2003
(percent difference from baseline forecast)

	CT	MA	ME	NH	RI	VT
Employment						
2005	.08	.11	.47	.19	.13	.28
2015	.08	.12	.46	.22	.14	.28
2025	.12	.15	.56	.29	.17	.35
Real disposable income per capita						
2005	.10	.13	.74	.31	.16	.55
2015	.09	.13	.44	.21	.13	.34
2025	.08	.13	.44	.18	.13	.34

What if the governments of the six New England states had agreed in 2003 to simultaneously raise their gas tax rates by 50 cents per gallon? As detailed in Table 8, all six states would have experienced greater boosts to employment (compared to the baseline forecast) than they could have enjoyed from a single-state tax hike. Because Connecticut would have received a small additional boost to employment from a regional tax hike, its incentive to join a regional coalition would have been weak. New Hampshire, on the other hand, would have enjoyed a substantially larger boost to employment if all of the New England states had joined a tax hike-and-rebate coalition. There are several reasons for the stronger employment impact of a multi-state tax reform: (1) Environmental quality and amenity benefits would increase in each state because of its own tax hike but by even more because of tax hikes in neighboring states; (2) There would be a smaller increase in retail motor fuel prices within each state if the region's states acted as a buying cartel, thereby exporting more of the additional tax burden to parties

outside the region; and (3) A higher portion of the fiscal stimulus from import-substituting consumption choices would remain within the region as a whole.

Coordinated action by the six state governments would provide a very modest additional boost to per capita income in the short run. However, over the course of ten or twenty years, the income gains from coordinated adoption of a tax hike-and-rebate plan, although positive, would be somewhat lower than those from single-state adoption. The apparent reason is that more rapid job growth and environmental quality improvements would accelerate net migration to New England and thereby dampen growth of real wage rates.

Table 8
Projected Impacts of Coordinated Adoption of Fuel Tax Reform
by Six New England States in 2003(percent difference from baseline forecast)

	CT	MA	ME	NH	RI	VT
Employment						
2005	.10	.16	.50	.27	.18	.32
2015	.10	.17	.49	.33	.23	.29
2025	.14	.22	.67	.44	.29	.40
Real disposable income per capita						
2005	.12	.16	.74	.34	.17	.58
2015	.10	.12	.33	.14	.09	.33
2025	.10	.12	.34	.10	.08	.34

Conclusions

In a recent interview, the chief economist of the International Energy Agency declared that heavy dependence on petroleum to operate an economy “is not a sustainable energy future” (Williams and Bahree 2005). In a similar fashion, the International Climate Change Taskforce (co-chaired by Senator Olympia Snowe) has bluntly stated, “Governments [should] remove barriers to and increase investment in renewable energy and energy efficient technologies and practices through such measures as the phase-out of fossil fuel subsidies....”

Although national governments certainly need to take coordinated action to reduce the carbon-intensity of the global economy, governments at the state and regional scale should not hesitate to take action, especially if their economies are heavy net importers of petroleum products. This paper has argued that regional economies like that of New England could enjoy environmental quality improvements, faster job growth and higher real incomes if state governments enacted higher taxes on motor fuels and rebated the incremental tax revenues to motor vehicle owners within their jurisdictions.

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Appendix: Simulation Assumptions

Any policy simulation embodies empirical assumptions of various kinds.

In this appendix, I describe several assumptions used to generate the policy impact forecasts reported in the body of this paper. The short-run and long-run price elasticities of demand for motor fuels used to predict the amounts of energy conservation induced by higher pump prices are summarized in the Table 1A.

Table 1A

Price Elasticities of Demand for Motor Fuels

	Short run	Long run
Connecticut	0.32	0.8
Maine	0.27	0.7
Massachusetts	0.32	0.8
New Hampshire	0.25	0.7
Rhode Island	0.32	0.8
Vermont	0.27	0.7

These elasticities are based upon surveys of econometric research found in Nicol (2003) and Crawford and Smith (1995). U.S. averages are then adjusted informally for population densities and availability of public transit in the New England states. Short-run elasticities are assumed to increase exponentially to the long-run value after a decade.

Following the findings of Storchmann (2005), it is assumed that the income elasticity of demand for motor fuels is unitary in each New England state. This assumption is used to calculate the expected increase in fuel consumption and the associated increase in total transfer payments to vehicle owners as economic growth occurs.

In order to simulate the economic impacts of a gas tax hike, one needs to make assumptions about what portion of the tax increase is shifted to motorists and what portion is shouldered by retailers within the state and by outside oil producers and refiners. This study assumes that the retail markup per gallon remains unchanged after the tax hike and equals 10.37 cents per gallon (1996 \$). Following Chouinard and Perloff (2004), I assume that the proportion of the tax increase borne by oil producers, refiners and other firms outside a state or broader region increases with the region's share of national gasoline consumption and with the its price elasticity of demand, as summarized in Table 2A. Note that the immediate cut in import price is assumed to be larger if a coalition of states enacts the 50 cents per gallon tax hike simultaneously.

Table 2A
Short-Run Change in Import Price at Regional Boundary
(2003 cents per gallon)

CT	ME	MA	NH	RI	VT	All New England
-2.5	-1.5	-2.5	-0.5	-2.5	-1.5	-4.5

Because of rising price elasticity of demand, the cut in import price is assumed to reach six cents per gallon after a decade in the southern New England states and 5.25 cents per gallon in the northern states of the region.

According to Parry (2002), the average externality from the air pollution, traffic congestion and highway accidents associated with motor fuel use is approximately \$1.70 per gallon in the U.S. I make the conservative assumption that the amenity benefit per gallon conserved is equal to half that amount (85 cents per gallon) in the taxing jurisdiction. A spillover benefit of 5 cents per gallon in downwind states, if any, is also assumed. That is, a gas tax hike in Connecticut is assumed to generate modest amenity benefits for residents of Massachusetts and Rhode Island. A tax hike in Maine, on the other hand, is assumed to benefit only the residents of that state.

Finally, I assume that there is no net increase in production costs in Connecticut, Massachusetts, New Hampshire, and Rhode Island following the imposition of a higher motor fuel excise. The reason is that the calculated rebates to the owners of business vehicles are at least as large as the estimated incremental expense of fueling those vehicles. Only in Maine and Vermont are the rebates insufficient to compensate business owners for higher pump prices. Hence, I assume that the net change in production costs would have been \$30.3 million in Maine and \$10.3 million in Vermont in 2003. In those two states, the extra production costs are allocated equally among the forestry, public utility, construction, manufacturing and transport industries.

The REMI Policy Insight model forecast public policy impacts by comparing the trajectory of a regional economy after a hypothetical change in public policy to a standard forecast of that region's trajectory in the absence of a public policy change. Five policy variables provided entry points into the REMI model for the purpose of simulating a gas tax hike-and-rebate plan: consumer price (share), exogenous final demand (retail trade, amount), transfer payments (amount), amenity value (amount), and production cost (amount). All amounts were adjusted to the price level of 1996.

In each state or region, an estimate of the percentage change in retail pump price in 2003 following a 50 cent per gallon excise tax hike was calculated. This percentage change in retail price was then allowed to decline over a decade as the price elasticity of demand increased to its long-run value. Exogenous final demand (1996 \$ amount) was used to account for the loss of gross revenues of fuel retailers within a state or region because of a reduction in gallons sold. This revenue loss to the retail sector grows over the course of a decade because of the

increase in price elasticity of fuel demand as vehicle owners discover and adopt methods to conserve motor fuels.

Transfer payments (amount) is used to account for the total rebates to owners of registered noncommercial vehicles within a state or region. The standard region control model forecast about growth of real disposable income plus an assumption of unitary income elasticity of demand for motor fuels are used to project the growth of total rebates after 2003. Amenity value (amount) is used to account for the net immigration of households and workers to the state or region because of environmental quality and other amenity improvements resulting from the tax policy change. Finally, production cost (amount) is used to account for the net increase in business costs in Maine and Vermont because rebates to commercial vehicle owners are insufficient to offset higher fuel costs associated with the operation of those vehicles for business purposes.