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Using Tax Expenditures to Achieve Energy Policy Goals

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Abstract

Tax expenditures are a major source of support for energy related activities in the federal budget exceeding direct budget support for energy by a factor of nearly six. Focusing on the policy goals of reducing greenhouse gas emissions and petroleum consumption, I find these tax expenditures highly cost ineffective at best and counterproductive at worse. The tax credit for ethanol is an example of a cost ineffective subsidy. The cost of reducing CO_2 emissions through this subsidy exceeded $1,000 per ton of CO_2 avoided in 2006. A change in the way the subsidy is administered provides an opportunity to measure its incidence. I find that the entire subsidy is passed backward to ethanol producers and possibly farmers. Consideration of market structure suggests that farmers receive little of the subsidy.

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Gilbert E. Metcalf*

Energy related tax expenditures are an important element of federal budget policy towards energy. Nonna A. Noto (2004) points out that the outlay equivalent for energy tax expenditures in the federal budget in FY 2002 was nearly nine times actual outlays for energy activities in that year, the highest ratio of tax expenditures to outlays for any of the budget functions in that year.[1] The comparable ratio in FY 2008 is 3.4 though it rises to 5.8 if the alcohol fuels tax credit is included as a tax expenditure. This paper considers the following questions. Can these tax expenditures be justified by important policy goals? If so, are they cost-effective instruments for achieving those goals? Finally, who benefits from these tax expenditures?

I. Tax Expenditures for Energy

Table 1 lists the energy-related tax expenditures grouped by fuel category. Note that the grouping is imperfect since some tax expenditures are available for multiple fuels. I have allocated the tax expenditure by the predominant fuel. Not included in Table 1 is the 51¢ per gallon ethanol credit on the excise tax for the use of ethanol in motor vehicle fuels. Technically this is not a tax expenditure, a point I return to below. Including it would add $3.46 billion in fiscal year 2008 and $14.17 billion over the period 2008 to 2012.

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[1] Strictly speaking one cannot sum tax expenditures due to interactions among them. But the main point would be unaffected were one to make a more accurate measure of all energy tax expenditures taking into account interactions: federal energy policy is driven more by off-budget subsidies than by on-budget spending. This point is only reinforced if one takes into account implicit subsidies such as the Price-Anderson Act for nuclear power.

Table 1. Energy-Related Tax Expenditures		
	2008	2008-2012
Alternative Fuels		
New technology credit	960	5,530
Credit for holding clean renewable energy bonds	80	480
Other: energy facility bonds, clean-burning vehicles, fuel cell, microturbine, and solar investments	400	800
Total: Alternative Fuels	1,440	6,810
Coal		
Capital gains treatment of royalties on coal	170	840
Credit for investment in clean coal facilities	50	690
Partial expensing for advanced mine safety equipment	20	20
Total: Coal	240	1,550
Energy Conservation		
Exclusion of utility conservation subsidies	110	540
Allowance of deduction for certain energy efficient commercial building property	170	270
Credit for energy efficiency improvements for new and existing homes	180	210
Total: Energy Conservation	460	1,020
Oil and Gas		
Excess of percentage over cost depletion, fuels	790	3,860
Expensing of exploration and development costs, fuels	840	2,910
Other: alternative fuel production credit, partial expensing for new refinery investment, accelerated depreciation for certain natural gas pipelines and other investments	1,110	2,550
Total: Oil and Gas	2,740	9,320
Source: Office of Management and Budget (2007). Amounts are in millions of dollars. Note that tax expenditures should not be summed due to interactions among them. The summing is done for illustrative purposes to indicate the relative importance of tax expenditures across different fuel sources.		

The first thing to note is that the largest share of tax expenditures for energy go to the oil and gas industry to encourage domestic production.[2] Renewables are the second

[2] If the alcohol fuels tax credit were included as a tax expenditure, the renewables category would have the largest share.

largest. The allocation is imperfect. The new technology credit, for example, refers to a collection of investment and production tax credits for renewable power sources (solar power, fuel cells, wind power, etc.). In addition to subsidizing electricity production from renewable sources, credits are available for advanced coal-based projects, refined coal, nuclear power, hydropower, and coal extracted in Indian land. This is the single largest tax expenditure category for energy.

The second largest tax expenditure is for percentage depletion. As natural resources are extracted from booked reserves, the value of those reserves is diminished. This is a legitimate cost of business and a Haig-Simons income tax would allow a deduction for the value of the resource extracted. Rather than take deductions for the value of the extracted resource, oil, gas, and coal producers are allowed to deduct a fraction of the revenue arising from sale of the resource. Currently percentage depletion is allowed for independent producers at a 15 percent rate for oil and gas and 10 percent for coal. Percentage depletion is allowed on production up to 1,000 barrels of average daily production of oil (or its equivalent for natural gas). In addition, the depletion allowance cannot exceed 100 percent of taxable income from the property (50 percent for coal) and 65 percent of taxable income from all sources.

The third largest item also applies to oil and gas production. Producers may expense intangible drilling expenses (labor and material costs associated with drilling wells). Normally the non-capital expenses associated with oil exploration and drilling would be capitalized and the costs allocated as income is earned from the well over its useful life. Corporations may only deduct 70 percent of the costs and must depreciate the remaining 30 percent over five years. Additionally, geological and geophysical costs associated with exploration can be amortized over a two year period.[3]

II. The Economic Rationale for Energy Tax Expenditures

I briefly review three arguments for energy-related tax expenditures: energy externalities, national security, and market failures and barriers in energy conservation markets.[4]

A broad array of externalities is associated with our consumption of energy. Burning fossil fuels contributes to air pollution (sulfur dioxides, nitrogen oxides, particulates) and generates greenhouse gases. In addition, our use of petroleum in transportation contributes to roadway congestion, accident externalities, and other traffic related market failures (see Ian Parry and Kenneth A. Small (2005) for a fuller discussion of driving related externalities). Economic theory suggests that we should tax externalities directly. Alternatively one can subsidize clean alternatives to fossil fuels through production and investment tax credits. This is an inefficient way to correct the externality. While the subsidy lowers the price of renewable energy production relative to the price of fossil fuels, it also lowers the price of energy on average and so encourages increased consumption.

A second broad rationale for government intervention in energy markets is national security concerns. In 2006, the United States imported 66 percent of the 20.6 million barrels per day of the petroleum that it consumed (Energy Information Administration (2007a)). Reducing oil imports, it is argued, will reduce our vulnerability

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[3] The Energy Independence and Security Act of 2007 extended the period to seven years for the major integrated oil companies.

[4] Gilbert E. Metcalf (2007) provides a more in-depth critique of federal energy tax policy.

to unstable governments in the Middle East and other oil rich areas. The difficulty with this argument is that oil is a commodity priced on world markets. Even if the United States were to produce all the oil it consumes, it would still be vulnerable to oil price fluctuations. A supply reduction in the Middle East would raise the price of domestic oil just as readily as it raises the price of imported oil.

Even if the United States were able to reduce its consumption of oil to zero, the United States would not be fully insulated from oil price shocks elsewhere in the world. First, an oil price shock that drives up the price of oil for Europe and China would lead those countries to increase consumption of fuels that substitute for oil. Crops used to produce biofuels would be in greater demand in world markets thereby driving up the price of biofuels. Second, a slowdown in the world economy following a price shock would likely have negative spillover effects for the United States.

A third argument for government intervention in energy markets is the existence of market barriers to energy efficient capital investment. A long-standing "energy paradox" claims that consumers need very high rates of return on energy efficient capital (appliances, housing improvements, lighting, etc.) and a variety of market barriers have been proposed to explain this paradox and to motivate market interventions.[5] Many have argued that consumers are poorly informed about the potential for energy savings (as well as the value of the savings) associated with new more expensive technologies. This is a reasonable point given the public good nature of information acquisition and suggests the value of government information programs. Programs such as energy efficiency labeling on new appliances can help overcome information failures at low cost. This argument does not, however, justify using the tax system to support these investments.

[5] Gilbert E. Metcalf (2006) critiques this market barriers literature.

In summary, it is difficult to justify current energy-related tax expenditures on economic grounds. In fact, policies that encourage increased domestic production of oil and natural gas work at cross-purposes with the goals identified above.

III. Defining Tax Expenditures

Tax expenditures are defined as losses in federal revenue arising from provisions of the tax code that allow a credit or deduction or some other exclusion that would not arise in a "normal" tax code. Tax expenditures, however, only are counted if they lead to a reduction in corporate or personal income tax receipts. The ethanol tax credit is not officially a tax expenditure because it reduces revenue for the federal motor fuels excise tax rather than the income tax despite the fact that the impact on a business income balance sheet is unaffected by providing the credit against the excise tax or against the income tax. This raises the broader point that the limitation of tax expenditures to income tax reductions is an arbitrary limitation. Only 60 percent of federal receipts come from the personal and corporate income tax. Defining tax expenditures in terms of taxes that comprise less than two-thirds of federal receipts suggests that we are missing potentially important revenue losses elsewhere in the federal budget.

A subtler point arises in the treatment of the ethanol tax credit. This credit was originally provided as an exemption from excise tax payments for gasoline in which ethanol was blended (typically at a 10 percent mixture). In 2004 the law was changed from an excise tax exemption to an excise tax credit. The exemption, which had been slated to be reduced from 5.2¢ per gallon of gasoline blended with ethanol (gasohol) to 5.1¢ on January 1, 2005, was changed to a credit of 51¢ per gallon of ethanol. At first blush, these appear to have the same impact on federal revenues since ethanol is generally blended at a ten percent rate. There are, however, two important differences. First, the change in law effectively changed a deduction into a credit. Under the old law, blenders took a deduction on their income tax of 13.3¢ (equals the 18.4¢ excise tax rate less the 5.1¢ exemption) per gallon of gasohol thereby reducing their marginal costs of production by 5.1¢ per gallon. Under the new law, blenders deduct the full excise tax of 18.4¢ on their income tax but take a credit of 5.1¢ per gallon. The pretax value of this credit at a 25 percent income tax rate is 6.8¢ per gallon. The subsidy has been increased by one-third as a result of this change.

The second difference is a budgeting change. The shift from an exemption to a credit means that the Highway Trust Fund is credited with more revenue at the expense of the General Fund. The gain to the Highway Trust Fund is $3.46 billion in FY2008 while the loss to the General Fund is $5.23 billion (after accounting for the loss in income tax revenue from the larger deduction taken for the motor fuels excise tax).

IV. An Economic Assessment of the Ethanol Tax Expenditure

Are tax expenditures a cost-effective way to achieve our energy goals? Here I present some results for the alcohol fuels tax credit focusing on carbon dioxide (CO_2) emissions and oil consumption. Table 2 presents information on ethanol and gasoline consumption in 2005 and 2006 as well as CO_2 reductions.

Corn-based ethanol has a modest CO_2 emissions impact leading to roughly 13 percent fewer CO_2 emissions than gasoline (see studies by Alexander E Farrell et al. (2006) and Jason Hill et al. (2006)). CO_2 emissions from gasoline were 1,182 million metric tons in 2005 (Energy Information Administration (2007b)). Given gasoline consumption of 137 billion gallons in 2005 of which 4 billion were ethanol, CO_2

emissions were reduced by 4.5 million metric tons.[6] The increase in ethanol demand in 2006 led to greater emission reductions but the reduction is still small as a percentage of total emissions.

Table 2. Ethanol and Greenhouse Gases		
	2005	**2006**
Ethanol Consumption (billion gallons)	4.0	5.4
Gasoline Consumption (billion gallons)	137	142
CO_2 Emissions from Gasoline (million tons)	1182	1186
Emission reductions (million tons)	4.5	5.9
Percentage Reduction in Emissions	0.4%	0.5%
Source: Ethanol consumption from Renewable Fuels Association (2007). Gasoline consumption from Energy Information Administration (2007a). CO_2 emissions from Energy Information Administration (2007b). See text for description of CO_2 emission reduction calculation.		

Petroleum consumption is reduced nearly gallon for gallon by substituting ethanol for gasoline.[7] Thus ethanol use reduced gasoline consumption by just under 3 percent in 2005 and oil consumption more generally by about 1.5 percent. For 2006 the comparable percentage reductions are 3.8 percent and 1.9 percent.

How much of the decline in emissions and gasoline consumption can be attributed to the alcohol fuels tax credit? Probably very little. Ethanol demand is likely driven almost entirely by its use as an oxygenate in reformulated and oxygenated gasoline as well as state mandates for E10.[8] Adding oxygen to gasoline improves its combustion properties and reduces CO emissions. Starting in 1992 the Clean Air Act Amendments

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6 The emissions per billion gallons of gasoline consumption (x) is given by the solution to the equation $(.87x)(E)+(G-E)x = C$ where E is ethanol demand, G is gasoline consumption, and C is motor vehicle related carbon dioxide emissions. The reduction in emissions due to ethanol use is then equal to $.13Ex$. A similar answer is obtained by assuming EIA's estimate that a gallon of gasoline contains 19.5 pounds of CO_2.

7 Other energy sources are used to generate ethanol, primarily natural gas and coal in the refining process. Ethanol production can be viewed as a process to convert coal and natural gas into a liquid transportation fuel using corn as an input. In addition, ethanol has less energy content than gasoline. An E10 blend reduces fuel mileage by approximately 3 percent.

8 The Energy Policy Act of 2005 set annual ethanol use requirements in gasoline beginning FY 2006. This requirement is unlikely to be binding in the near term.

of 1990 required the use of oxygenated gasoline with minimum oxygen levels of 2.7 percent during winter months. This could be achieved by adding Methyl Tertiary Butyl Ether (MTBE) at a 15 percent mix or ethanol at an 8 percent mix.[9] Most states in the mid-west mandated the use of ethanol as an oxygenate while other states used MTBE.

Subsequent to the introduction of oxygenated gasoline, EPA mandated the use of reformulated gasoline (RFG) in specified non-attainment areas of the country. Unlike oxygenated gasoline, RFG was mandated on a year-round basis. RFG is used in parts of California, much of the eastern seaboard from Virginia up to Southern New Hampshire and a few major metropolitan areas in other parts of the country.[10] RFG gas must meet a variety of environmental criteria, one of which is a minimum oxygen standard of 2 percent. Historically the two percent standard could be met with ethanol blended at a 5.6 percent rate by volume or with MTBE. Increasingly states are banning MTBE because of concerns over groundwater contamination. As of August 2007 twenty-five states have banned MBTE statewide (Environmental Protection Agency (2007)). Other states have mandated the use of ethanol as an oxygenate in RFG.[11] As a result of concerns about potential liability to litigation, the petroleum industry phased out the use of MTBE in refining by mid-2006. Finally, a number of states are beginning to mandate the sale of E10 or gasohol, gasoline blended with 10 percent ethanol. As of 2007, only Minnesota's mandate was in effect requiring all gasoline sold in the state to be E10 gasoline.

[9] This information is taken from Erich J. Muehlegger (2004) who provides an excellent description of environmental regulations and their impact on fuel additives.
[10] A map showing current RFG coverage is at http://www.epa.gov/otaq/rfg/whereyoulive.htm.
[11] EIA's state energy profiles indicates which states mandate the use of ethanol as an oxygenate.

For 2005, I assume that mandated ethanol blended RFG is blended at a 5.6 percent rate and Wisconsin mandates E10 for all its gasoline.[12] Given these state rules, 2.9 billion gallons of ethanol were required in 2005. This estimate is conservative as some states require RFG with ten percent blend rates for ethanol. If the average ethanol blend rate for RFG in 2005 was 7.7 percent then all of the demand for ethanol could be explained by ethanol mandates.

Assume that the remaining demand for ethanol (one-fourth of demand) was attributable to the alcohol fuels tax credit in 2005. What was the 2005 cost of the reduction in CO_2 and petroleum consumption from foregone tax revenue? The first column of Table 3 provides the answer. Given the CO_2 and petroleum reductions measured above, the cost of CO_2 emissions avoided due to the use of ethanol is over \$1,700 per ton and the cost of reducing petroleum consumption is \$85 per barrel. This is the cost to the federal treasury due to lost tax revenue. It does not include the private cost of producing ethanol nor any savings from displaced oil. Note that if the ethanol induced by the tax credit is less than one-fourth of total demand, the costs go up considerably. The costs for reductions in CO_2 far exceed the price of CO_2 emission permits in the EU Emissions Trading Scheme and any reasonable measure of the marginal damages from carbon emissions. These high costs arise from the large inframarginal aspect of the policy.

[12] According to the Energy Information Administration, states mandating use of ethanol in RFG in 2005 were Arizona, California, Connecticut, Delaware, Illinois, Indiana, Kentucky, Maryland, Massachusetts, Missouri, Nevada, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Texas, Virginia, and Wisconsin.

The cost of reducing CO_2 through the tax credit is quite high even if *all* ethanol production is driven by the credit. In that case the cost would be over $450 per ton CO_2, a cost that still exceeds the cost of an EU permit by over a factor of ten.

The second column provides calculations for 2006. Here I assume that all RFG is produced with ethanol at the 5.6 percent rate and add to that Minnesota's mandate that all gasoline in that state be E10. The RFG mandate follows the decision by US refineries to stop producing RFG with ethanol. Despite the fact that over forty percent of ethanol is not mandated by blending rules, the cost of CO_2 reductions through the tax credit still exceeds $1,000. If RFG had to be produced with a ten percent ethanol blend rate in 2006 the cost rises to nearly $8,000 per ton CO_2.

Table 3. Cost to U.S. Treasury of Achieving Energy Goals Through Ethanol Tax Credit

	2005	2006
Share of Ethanol Demand Induced by Tax Credit	26.6%	43.8%
CO_2 Saving Due To Credit (million metric tons)	1.2	2.6
Total Savings In Crude from Ethanol use (mby)	90.5	121.7
Crude Saving Due To Credit (mby)	24.1	53.3
Cost Of Credit ($ millions)	2040.0	2743.8
Cost per ton CO_2	$ 1,703	$ 1,066
Cost per barrel of Crude	$ 85	$ 51

Source: Author's calculations. See text for details. I assume that .95 gallons of gasoline are saved per gallon of ethanol produced.

V. The Incidence of Energy-Related Tax Expenditures

Who benefits from energy-related tax expenditures? Consider first oil and natural gas production. The favorable treatment accorded oil producers and refiners lowers the cost of oil and could affect prices of final petroleum products. But since oil (and increasingly natural gas with the penetration of LNG) is priced in world markets and to a great extent is a homogenous product, it is not clear that the domestic tax incentives would have a large impact on the price of gasoline or other petroleum products. In this case, the benefits largely accrue to producers in the form of higher wages for specialized workers in oil and gas production and refining and higher dividends to shareholders.

The change in the treatment of the alcohol fuels tax credit in 2005 provides an opportunity to assess the incidence of this credit. Recall that the change in treatment of the tax exemption from a deduction to a credit increased the pre-tax value of the credit. For blenders in the 25 percent tax bracket, the value increased by one-third from 51¢ per gallon of ethanol to 68¢ per gallon. Some preliminary analysis suggests that blenders did not receive the benefit of this increased tax exemption. Equation (1) below presents the results from a regression of weekly ethanol spot prices in Chicago (P_{Et}, dollars per gallon) on a number of variables for the years 2004 and 2005. I include corn prices (P_{Ct}, cents per bushel) as well as natural gas prices (P_{NGt}, dollars per million BTUs) both lagged four weeks to control for input costs in ethanol production.[13] I include the current price of gasoline (P_{Gt}, New York Harbor price in dollars per gallon) to reflect ethanol's potential as a gasoline substitute and the spot price of crude oil (P_{Ot}, WTI in dollars per barrel) as a leading indicator of future gasoline prices. I also include dummy variables

[13] I thank Alan May, Extension Grain Marketing Specialist at South Dakota State University, for providing me with weekly corn prices.

for months (M_t) to capture seasonal effects. Finally I include a dummy variable for 2005 (I_{2005t}) to capture the tax effect of changing the ethanol tax expenditure in 2005 (see Table 4).

Table 4. Ethanol Price Regressions		
Indicator for 2005	0.366 (0.173)	0.280 (0.158)
Gasoline	0.009 (0.001)	0.007 (0.001)
Natural Gas	-0.027 (0.020)	-0.054 (0.019)
Corn	0.007 (0.001)	0.004 (0.001)
Crude Oil	-0.018 (0.010)	-0.024 (0.009)
Indicator for July through December 2005		0.393 (0.088)
Adj R^2	0.791	0.827
Weekly data. Prices for gasoline and natural gas are lagged four weeks.		

Standard errors are reported in parentheses.[14] The fit is reasonably good with an adjusted R^2 of 0.791. The signs on the corn and gasoline price variables are of the expected sign and highly significant. The sign on the natural gas price variable is negative but statistically insignificant. Crude has an unexpected sign but is only significant at the 10 percent level. The dummy variable for 2005 is significant at the 5 percent level and indicates that after controlling for prices and monthly effects, the price of ethanol rose by 36.6¢ in 2005. A marginal tax rate of 30 percent would provide a pre-tax increase in the value of the ethanol credit to the blender of this amount. This increase in the spot price

[14] Coefficients on the month dummies are available on request. The price data appear to follow an I(1) process. Augmented Dickey-Fuller tests support the hypothesis that the price data are cointegrated.

suggests that the entire increased tax benefit accrues to either producers or farmers. Given the large number corn farmers and the small number of producers, it is more likely that producers receive the benefit of the tax expenditure than do farmers. Brent D. Yacobucci (2007) reports that the top-five ethanol producers accounted for over one-third of the production capacity at the beginning of 2007 and the top-ten accounted for nearly one-half.

One concern with the regression is that the dummy variable for 2005 may be picking up other important demand effects that occurred in that year. For example a few states enacted or tightened MTBE bans in 2005.[15] These states all put their MTBE rules into effect after July 1, 2005. To test whether these bans are driving the results for the 2005 dummy variable, I added a second dummy variable for post-July 1 weeks. Column 2 of Table 4 presents those results. The dummy variable for 2005 drops from 0.36 to 0.28 and its p-value rises to 8 percent. The results suggest that the state bans on MTBE enacted in 2005 are not entirely driving the results and that the tax benefit is partially or fully passed back to producers and/or farmers. Daily data may be better suited to pinning down the tax effect and I am currently collecting those data for that analysis. While preliminary, the regression results are encouraging that the change in the tax treatment of the ethanol tax exemption can be used to identify the incidence of this tax benefit.

VI. Conclusion

Tax expenditures for energy provide over seventy-five percent of federal support for energy in this country. It is unlikely that they contribute much to national security goals by reducing petroleum and natural gas consumption. In fact, tax expenditures for

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[15] Most large states (e.g. CA, NJ, and NY) had MTBE bans in effect prior to 2005. Ohio and Missouri implemented a ban in 2005 and Minnesota tightened its ban.

the oil and natural gas industry probably contribute to increased consumption of those fuels. These tax expenditures may contribute to a reduction in greenhouse gas emissions through their support for the use of non-carbon based renewable fuels. An examination of the alcohol fuels tax credit, however, suggests that this credit is a particularly expensive policy instrument for reducing CO_2 emissions. The credit is likely inducing an expansion in refining capacity for ethanol.

In addition, I provide a preliminary econometric analysis of the incidence of the ethanol fuels tax credit. Taking advantage of a change in the tax treatment of the excise tax in 2005, I find that the entire credit is passed back from fuel blenders to ethanol producers and/or corn growers. Further research is required to allocate the benefit of the tax credit between these two groups. Given the concentrated nature of the ethanol producing industry and the large number of corn growers, it is likely that most if not all of the benefit of the credit goes to ethanol producers. With roughly two-thirds of ethanol production capacity owned by private companies, many of them large agricultural conglomerates, this raises the possibility that the ethanol tax credit is not only expensive but also regressive.

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