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How Would a Federal Cap-and-Trade Climate Policy Affect Profits and GDP?[1]

By Lawrence H. Goulder, Marc Hafstead, and Michael Dworsky

In late June the House of Representatives approved the American Clean Energy and Security (ACES) Act, a federal climate bill sponsored by representatives Henry Waxman (D-CA) and Edward Markey (D-MA). The Senate is now preparing to draft its own climate bill. Many would place good odds on the U.S. enacting a national climate program by the end of the year.

Cap and trade is a central component of the ACES Act and is likely to be a key feature of the Senate bill as well. In the Act's cap-and-trade provisions, total emissions of greenhouse gases (GHG) from major U.S. sources face a declining cap. GHG emissions from covered sources would need to decline by 17 percent relative to 2005 levels by 2020 and by 83 percent relative to 2005 by 2050 (see Figure 1).[2]

The prospect of cap and trade has raised major concerns about its potential impact on industry profits — *continued on inside...*

[1] We thank Zhe Zhang for excellent research assistance related to the preparation of this policy brief.

[2] The "bumpy" pattern of covered-sector emissions prior to 2016 reflects aspects of the gradual phase-in of the overall cap.

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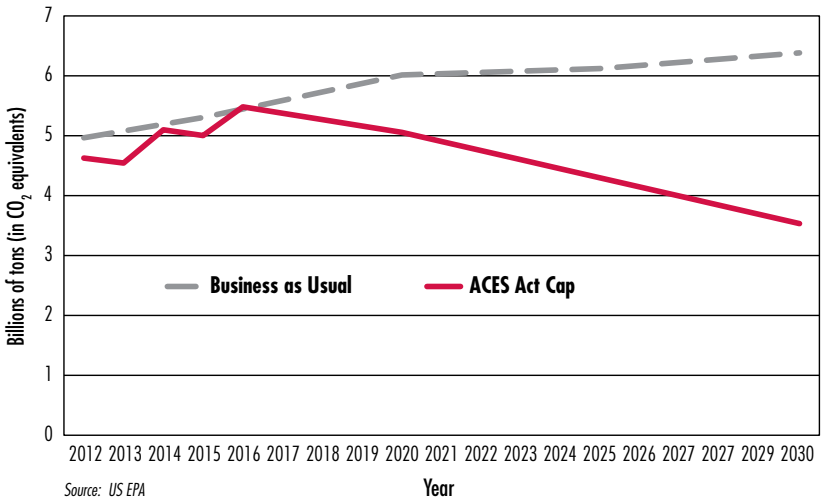
Figure 1

Greenhouse Gas Emissions, 2012-2030, for Covered Sectors



Source: US EPA

especially in industries that supply primary carbon-based fuels (such as coal mining and crude petroleum extraction) and those that use these fuels intensively (such as petroleum refining, electric power generation, primary metals production, and chemical processing).

This policy brief examines the potential profit impacts of a U.S. cap-and-trade program. Drawing on previous analytical and numerical work[3], it shows that these impacts depend crucially on the program's method of allocating emissions allowances (permits). In fact, the method of allocation can determine whether cap and trade causes major industries to suffer significant losses or enjoy large windfalls. This brief also shows that the uses of policy-generated revenues critically affect the policy's economy-wide costs. We relate these general findings to the specific design of cap and trade in the ACES Act.

Rationale for Allowance Trading and Methods of Allowance Allocation

Under cap and trade, a certain number of emissions allowances are put in circulation in each year.[4] Each allowance entitles the holder to a given quantity of emissions, and thus the total number of allowances in circulation in a given year corresponds to the overall cap for that year.

Allowance trading is the key to cap and trade's potential to achieve desired emissions reductions at lower cost than is possible under less flexible regulatory approaches such as fixed emissions quotas or mandated technologies. Firms with especially high costs of reducing emissions will find it advantageous to purchase additional emissions allowances, as it will be cheaper to purchase additional allowances (and thus avoid some abatement costs) than to reduce emissions all the way to the level implied by the initial allowance holdings.

[3] See Goulder, Hafstead, and Dworsky (2009).

[4] For simplicity, we focus on a simple program in which allowances are allocated annually and are redeemable only in the year in which they are allocated. Allowances need not be allocated annually, and in some programs allowances can be banked and redeemed in years after they are allocated.

Symmetrically, firms with especially low abatement costs will find it profitable to sell some of their allowances, as the revenues from these sales will exceed the additional abatement costs necessitated by giving up allowances. In principle, trades bring about emissions reductions where they can be accomplished most cheaply, thereby enabling the economy's overall emissions-reduction targets to be met at the lowest cost.[5]

The way that the government allocates (puts in circulation) the total allowances can crucially determine how the cost of a cap-and-trade program is distributed across industries and between producers and consumers. One way to allocate is via an auction. In this case, firms must purchase allowances for every ton of emissions generated. Alternatively, the government could give out allowances free to firms.

The allowance allocation method makes very little difference to allowance prices or to a firm's employment and output decisions. Even if a firm receives many free permits, it faces an opportunity cost for each unit of its emissions. This is because each additional ton of emissions either implies the need to purchase another allowance or (if it has more permits than it needs) reduces the number of allowances it can sell. At the margin, the cost of emissions is the same as in the case where allowances are auctioned.

Profit Impacts Vary Dramatically Depending on the Method of Allocation

However, the method of allocation can dramatically affect firms' profits. When points of regulation (the entities that must submit allowances to validate their emissions) receive allowances free rather than by having to purchase all of them through an auction, they are burdened less by cap and trade. Indeed, several studies[6] have shown that under a system with free allocation, the points of regulation can enjoy higher profits than in the absence of cap and trade!

How can this be?[7] First, note that one way that firms accomplish needed emissions reductions is by reducing the level of production. (They also can reduce emissions through changes in the production process, but in general output reduction plays a significant role.) When firms scale back production, output prices rise to bring demand into balance with supply. The higher prices yield rents (above-normal returns) to the firms, much like those enjoyed by a cartel. These rents may have a value far exceeding whatever loss of profit might otherwise have been caused by a cap-and-trade program.[8]

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[5] A carbon tax shares several of the cost-effectiveness attractions of cap and trade. For comparisons of a carbon tax and cap and trade see, for example, Metcalf (2008), Stavins (2007), and Goulder (2009).

[6] See Bovenberg and Goulder (2001), Smith, Ross, and Montgomery (2002), and Goulder, Hafstead, and Dworsky (2009).

[7] Here we offer an informal explanation. For a more technical treatment, see Goulder, Hafstead, and Dworsky (2009).

[8] Firms do not enjoy policy-generated rents when allowances are auctioned. In this case, firms compete with each other to purchase the scarce allowances, and their payments for the allowances deplete what they otherwise would retain as rents.

The prediction that 100 percent free allocation leads to large profit increases was borne out in Phase I of the European Union's own Emissions Trading Scheme, where nearly all the allowances were given out free and many firms enjoyed significant windfalls (see Ellerman and Buchner, 2008).

How Much Free Allocation Is Just Enough to Preserve Profits?

Rather than auctioning or freely allocating the entire supply of allowances, policymakers can choose to give out some allowances free and allocate the remainder through an auction. One approach that may appeal on grounds of fairness is to limit free allocation to a level just sufficient to prevent any loss of profit among industries that would be harmed if all the allowances were auctioned. Less free allocation allows other parties to benefit more from cap and trade since it implies more auction revenue — revenue that can benefit the general public by reducing the deficit (thereby lowering future interest payments and the taxes needed to finance them), financing cash payments to households, or financing various public investments. Limiting free allocation might also appeal because of its potential efficiency advantages; as will be discussed below, expanding free allocation reduces options to contain the overall GDP costs of cap and trade.

But how much free allocation is just enough? How many allowances would a given industry need to be just made whole?[9]

We have investigated the issue of profit-preserving allocation using a dynamic computable general equilibrium model of the U.S. economy.[10] The model divides U.S. production into 25 industry categories, giving close attention to energy supply and use. The model offers a unique treatment of capital dynamics, enabling it to assess the extent to which firms' assets would be stranded by cap and trade and the associated implications for profits.

We applied the model to compare cap-and-trade programs with three alternative allocations of allowances: (1) 100 percent auctioning of allowances, (2) 100 percent free allocation of allowances, and (3) a combination of auctioning and free allocation, with just enough free allocation to prevent a profit loss in industries that would lose profit under 100 percent auctioning.

In all cases, the points of regulation roughly correspond to the cap-and-trade provisions

[9] Several factors affect the needed quantity of free allowances, but a crucial determinant is the ability of firms to pass on to customers the costs of the regulation. This ability is expanded to the extent that demand for the firm's product is inelastic. It is also expanded insofar as firms can easily adjust their capital stocks, so that supply is elastic. In contrast, if demand is very elastic (as in the case where firms face steep foreign competition) or supply very inelastic (as when capital is very industry-specific and easily "stranded"), firms will be more limited in the ability to transfer costs to customers. In this case profit-preservation would require more free allocation.

[10] The model and cap-and-trade policy experiments are described in detail in Goulder, Hafstead, and Dworsky (2009).

of the ACES Act. They are electric power generators, petroleum refineries, natural gas distribution companies, and energy-intensive manufacturing industries (chemicals and primary metals). The time-profile of emissions reductions also matches that of the ACES Act.

Table 1 displays the results from these simulations. It shows, for each industry, the percentage change in the present value of profits over the period 2009-2030. Under 100 percent auctioning (column 1), the carbon-intensive industries experience significant losses of profit. Coal mining and coal-fired electricity generation endure the largest percentage losses, in keeping with the high carbon content of their output (for coal mining) or fuel input (for coal-fired electricity generation). Other carbon-intensive industries also experience significant profit losses. Note that the losses of profit are not confined to the points of regulation: Coal mining (not a point of regulation) suffers the largest proportional profit loss.

Under 100 percent free allocation (column 3), the results are very different. For the industries that would suffer the largest percentage losses in profit under 100 percent auctioning, 100 percent free allocation yields increases — and often very large increases — in profit. For coal-fired electricity generation, for example, the 28.4 percent profit loss under 100 percent auctioning converts to a 108.4 percent increase under 100 percent free allocation. Free allocation creates windfall profits by transferring rents to industry far in excess of what otherwise would be the loss in profit.

The middle column displays the impacts when there is just enough free allocation to preserve profits in industries that would lose profits under 100 percent auctioning. By construction, the profit impacts are zero for these industries. The numbers in parentheses are the required free allowances as a percentage of the total allowances issued under the cap-and-trade system. The coal mining and coal-fired electricity generation industries require the largest numbers of free allowances: Each would need about 3 percent of all the covered emissions (or all the allowances) in the system.

The other vulnerable industries require smaller shares of the system's total allowances. In total, the allowances needed to compensate *all* industries that would lose profits under 100 percent auctioning add up to less than 21 percent of the cap-and-trade system's allowances. These results suggest that almost four-fifths of the allowances could be auctioned out while insulating every industry in the economy from any loss of profitability.

Does Profit Preservation Add to Overall Economic Cost?

Beyond affecting firms' profits, the method of allocation can dramatically affect the overall economic (GDP) cost. Auctioning allowances yields opportunities to contain the GDP costs because it yields a particularly efficient (non-distortionary)

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Table 1

Profit Impacts under Alternative Allocation Methods, 2009-2030*

	(1)	(2)	(3)
	100% Auctioning	Profit-Preserving Free Allocation	100% Free Allocation
Industry			
Agriculture	-0.7	0 (0.6)	3.0
Oil/Gas Extraction	1.1	1.2	1.5
Coal Mining	-28.7	0 (3.2)	109.5
Non Coal Mining	-1.0	0 (0.1)	4.4
Water Utilities	-3.4	0 (0.1)	14.1
Electricity Transmission/Distribution	-2.5	0 (2.5)	10.0
Coal Fired Electricity Generation	-28.4	0 (3.2)	108.4
Other Fossil Electricity Generation	18.4	18.5	18.7
Non Fossil Electricity Generation	28.3	28.3	28.4
Natural Gas Distribution	-2.8	0 (0.4)	12.3
Construction	-0.5	0 (0.3)	1.8
Food/Tobacco	-0.3	0 (0.1)	1.7
Textiles	-1.4	0 (0.2)	5.7
Wood/Paper Products	-0.7	0 (0.2)	3.0
Petroleum Refining	-4.7	0 (0.6)	18.1
Chemicals	-3.2	0 (2.4)	12.8
Primary Metals	-3.5	0 (0.8)	13.9
Machinery	-1.1	0 (1.6)	4.7
Motor Vehicle Production	0.9	0 (0.4)	0.2
Transportation	-1.9	0 (1.9)	7.9
Railroads	-2.5	0 (0.6)	10.2
Information	-0.4	0 (0.5)	1.9
Services (excl. Owner-Occupied Housing)	-0.1	0 (0.7)	1.1
Owner-Occupied Housing Services	0.1	0.1	0.2
Percent of Allowances Allocated Free	**0**	**20.6**	**100**

* Percentage changes in the present value of profits over the interval 2009-2030. In the column labeled "Profit-Preserving Free Allocation," the numbers in parentheses are the percentage of economy-wide allowances that need to be freely allocated to the industry in question in order to preserve its profits. In the simulations involving 100 percent or partial auctioning, the auction revenues are used to finance cuts in the rates of individual income taxes.

Table 2

GDP Costs[A] under Alternative Methods For Allowance Allocation and Revenue Use

	2015		2020		2009-2030 Average[B]	
	GDP Loss[C]	Pct. Decrease from Business as Usual	GDP Loss[C]	Pct. Decrease from Business as Usual	Pct. Decrease from Business as Usual	Pct. Cost Increase from Case 1(a)
1. 100% Auctioning						
revenue use:						
a. Cuts in Personal Tax Rates	12.9	0.08	63.1	0.35	0.47	n.a.
b. Lump Sum Rebates	69.7	0.42	139.1	0.76	0.81	72
2. Profit-Preserving Free Allocation						
revenue use:						
a. Cuts in Personal Tax Rates	24.3	0.15	78.2	0.43	0.54	15
b. Lump Sum Rebates	69.1	0.41	138.3	0.76	0.80	70
3. 100% Free Allocation	66.9	0.40	134.7	0.74	0.79	68

[A] These costs do not account for the environment-related benefits to GDP from the cap-and-trade program.

[B] Based on comparisons of present values of GDP over the interval 2009-2030 between the policy and business-as-usual cases.

[C] in billions of 2005 dollars.

source of government revenue. To the extent that the government exploits this revenue source, it can reduce its reliance on less efficient revenue sources (holding government expenditures fixed) such as income and payroll taxes. Thus, greater use of auctioning expands opportunities to reduce the costs of the tax system and thereby minimize GDP costs. This potential advantage of auctioning is realized only if the revenues are used to cut the marginal rates of prior distortionary taxes. If, instead, the revenues are used to finance lump-sum transfers to households (e.g., through rebate checks), the GDP cost of auctioning is nearly identical to the GDP cost of 100 percent free allocation.

The implications of alternative allocation methods and revenue uses for GDP are displayed in Table 2. Again the policy stringency and points of regulation follow the ACES Act. Some cost-containing provisions of the act such as allowance banking and borrowing and

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the use of carbon offsets are not included in the experiments reported in this brief.[11]

The table reveals that different choices about how allowances are initially allocated and how any auction revenues are used can yield very large differences in GDP costs. Auctioning the allowances and using the revenues to cut marginal tax rates for individual income taxes (Case 1a) minimizes GDP costs. Under 100 percent free allocation (Case 3), there is no auctioning and thus no possibility of marginal rate cuts. In this case, the GDP costs over the interval 2009-2030 are on average 68 percent higher than in the most cost-effective case (1a), as shown in the far-right column of the table. Likewise, when there is auctioning, but revenues are devoted to lump-sum rebates rather than tax cuts (Case 1b), the GDP costs are again considerably higher (by 72 percent) than in the case of auctioning combined with tax cuts (Case 1a).

Importantly, a policy involving just enough free allocation to preserve profits need not be much more costly than 100 percent auctioning. Policy 2a in Table 2 involves profit-preserving free allocation and devotes the revenues from its auction component to cuts in personal tax rates. As shown in the table's far-right column, this policy raises GDP costs by only 15 percent relative to the most cost-effective policy (1a). This reflects the fact that just a small share (21 percent) of the allowances must be freely allocated to preserve profits, leaving room for a heavy reliance on auctioning and creating the opportunity to reduce marginal tax rates almost as much as in the most cost-effective case. Thus, maintaining profits under a cap-and-trade system need not increase substantially the system's GDP costs.

What Do These Findings Imply about the Recent ACES Act?

The ACES Act sets aside 19 percent of allowances for free allocation directly to industry in years prior to 2025.[12] Specifically, up to 13 percent are allocated to trade-vulnerable manufacturers, up to 3.5 percent to merchant coal generators, and 2 percent to oil refineries. Our results in Table 1 suggest that free allocation up to the ACES Act's limits would be more than sufficient to insulate these industries from losses of profit. For example, in the profit-preserving allocation reported in column 2 of Table 1, the industries designated as trade-vulnerable manufacturers collectively would require 5.7 percent of allowances, as compared with

[11] See Goulder, Hafstead, and Dworsky (2009) for results that account for these provisions. These provisions imply somewhat lower GDP costs but do not alter our main findings. In fact, they reinforce the result that relatively little free allocation is needed to preserve profits, as well as the finding (to be described presently) that judicious use of policy revenues can dramatically lower the GDP costs.

[12] Percentages reported in this section are shares of the total supply of allowances over the period 2016-2025. Compliance obligations under the ACES Act are phased in gradually over the interval 2012-2016, so the cap-and-trade system does not take full effect until 2016. Many of the allocation provisions in the ACES Act phase out between 2026 and 2030.

maximum of 13 percent offered under the ACES Act.[13]

Under the ACES Act, additional free allocation is provided to serve other purposes, some of which provides additional, indirect compensation to industry. Through the year 2025, the bill awards 42 percent of the allowances to utilities to finance reductions in electricity and natural gas bills. These reductions would benefit all retail ratepayers of these utilities, including commercial and industrial as well as residential users. Thus, most industries will receive additional compensation through this channel. A further 21 percent of allowances are freely allocated to provide additional incentives for energy research, technology deployment, and greenhouse gas abatement.

The remaining 19 percent of the allowances issued through 2025 would be allocated via auction. Most of these auction revenues (15 percent of total allowances) would be used to fund lump-sum rebates to low-income households, with another 2 percent dedicated to adaptation programs. As a result, just 2 percent of allowances can be used for efficiency-improving reductions in marginal tax rates. In contrast, our numerical model suggests that 79 percent of allowances could be auctioned while preserving industry profitability, and therefore that 79 percent of the total value of emissions allowances could be devoted to cuts in marginal income tax rates to maximize cost-effectiveness.

These figures will relieve those concerned about the potential adverse impacts of cap and trade on profits. However, they indicate that direct and indirect transfers to industry in the ACES Act go beyond what is necessary to preserve profits. There is less reliance on auctioning than what would occur if free allocation were just sufficient to make firms whole, and a relatively small fraction of the (limited) auction revenue is devoted to cuts in marginal tax rates.

These aspects of the bill suggest a sacrifice of cost-effectiveness. However, some of the ways the ACES Act employs allowance value (e.g., to promote new, energy-saving technologies) could yield significant net social benefits. It remains an open question whether such alternative revenue uses justify the costs associated with limited auctioning and the even more limited use of revenues to reduce existing taxes.[14]

Conclusions

We find that freely allocating a relatively small fraction — less than 21 percent — of the emissions

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[13] Figures in this section reflect the statutory maximum allocations to each industry group. The industries in Table 1 that correspond to the ACES Act definition of trade-vulnerable industries are the following: Food/Tobacco, Textiles, Wood/Paper Products, Chemicals, Primary Metals, Machinery, and Motor Vehicle Production.

[14] Several of the specific social objectives of the ACES Act currently achieved through lump-sum payments could be accomplished more cost-effectively through marginal rate cuts. For example, the goal of providing assistance to low-income households could be realized through an auction-revenue-financed expansion of the Earned Income Tax Credit. This

allowances generally suffices to prevent profit losses among the U.S. industries that would suffer profit losses without free allocation. Allocating 100 percent of the allowances would substantially overcompensate these industries, in many cases causing more than a doubling of profits.

We have performed additional policy experiments to test whether these results are sustained under cap-and-trade programs with other features. Space limitations prevent us from displaying the results from these other experiments here, but we can report that under a wide range of policy designs — differing according to the presence or absence of provisions for offsets or intertemporal banking of allowances — the percentage of free allowances needed to maintain profits remains small. This is the case even under more stringent policies that raise policy costs.[15]

Profit-preservation is therefore consistent with substantial use of allowance auctioning in a wide range of cap-and-trade policies. This has important implications for economy-wide policy costs, since auction revenues can reduce policy costs by financing reductions in the marginal rates of distortionary taxes such as income and payroll taxes. Our simulations indicate that with the maximal use of auctioning consistent with preserving profits, and the use of auction revenues to finance cuts in individual income taxes, GDP costs can be reduced by about a third relative to the case where all allowances are freely allocated and no auction revenue is generated.

Our results indicate that the ACES Act is likely to prevent profit losses for the major suppliers of carbon-based fuels and the industries that use these fuels intensively. However, we find that the act freely allocates more allowances to these industries (directly and indirectly) than is necessary to preserve their profits. Auctioning plays a minor role. This significantly constrains opportunities to use auction revenue to finance reductions in current or future (via deficit-reduction) tax rates or to finance certain investments that might have particularly high social returns. We consider the ACES Act a major step forward on the road to a federal climate policy, and we find that it can achieve its environmental objectives without great cost to the economy. At the same time, our analysis indicates that, consistent with preserving industry profits, efficiency would be enhanced if auctioning of emissions allowances were to play a more substantial role in federal cap-and-trade policy than what is called for under the Act.

[15] Under more stringent policies, firms need to receive free a higher value of allowances to maintain profits. However, greater stringency also leads to higher allowance prices (the value of each allowance is greater). Hence the number of free allowances that firms require to attain needed allowance value does not change much with the stringency of cap-and-trade policy.

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