THE POTENTIAL ROLE OF A CARBON TAX IN U.S. FISCAL REFORM

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This paper examines fiscal reform options in the United States using an intertemporal computable general equilibrium model of the world economy called G-Cubed. Six policy scenarios explore two overarching issues: (1) the effects of a carbon tax under alternative assumptions about the use of the resulting revenue, and (2) the effects of alternative revenue sources to reduce the budget deficit. We examine a simple excise tax on the carbon content of fossil fuels in the U.S. energy sector starting immediately at $15 per ton of carbon dioxide (CO_2) and rising at 4 percent above inflation each year. We investigate policies that allow the revenue from the illustrative carbon tax to reduce the long run federal budget deficit or the marginal tax rates on labor and capital income. We also compare imposing a carbon tax to increasing rates of other taxes to reduce the deficit by the same amount. We find that within 25 years of adopting the carbon tax, annual CO_2 emissions are 20 percent lower than baseline levels. We find that using the revenue for a capital tax cut is significantly different than other revenue recycling policies. In that case, investment rises, employment and wages rise, and overall GDP is significantly above its baseline through year 25. Thus, adopting a carbon tax and using the revenue to reduce capital taxes would achieve two goals: reducing CO_2 emissions significantly and expanding employment and the economy.

Keywords: fiscal policy, carbon tax, general equilibrium

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I. INTRODUCTION

One option for introducing a price on carbon emissions in the U.S. would be to include a carbon tax within a broader tax reform or budget deficit reduction package. Such an approach could use the revenue from the carbon tax to improve the economic efficiency of the tax system and/or reduce the federal budget deficit, while also reducing the need for costlier regulatory measures to reduce climate-disrupting greenhouse gases.[1] A further fiscal benefit from a carbon tax is that it would allow reductions in subsidies for clean energy technologies by making low-carbon technologies more competitive with their conventional alternatives.

However, introducing a carbon tax has complex effects on the tax system because it can exacerbate existing distortions. Research suggests this effect, known as the "tax interaction effect," can be even more costly than the direct abatement costs.[2] At the same time, using carbon tax revenue to reduce those prior distortions (i.e., "revenue recycling") could reduce the overall excess burden of the tax system. This could provide a second benefit—or dividend—in addition to the environmental improvement produced by the tax.[3] Some estimates suggest that using carbon tax revenue to lower the deficit or other taxes can lower the overall costs of the program by 75 percent.[4] Alternatively, carbon tax revenue applied to the budget deficit could be efficiency-enhancing by lowering the tax burdens necessary to support the federal debt.

Feldstein (2006) argues that the distortions in the existing tax system are large, resulting in costs of about $0.76 for every dollar the federal government raises. Revenue recycling could

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1 This paper focuses on a carbon tax, but versions of a cap-and-trade program or hybrid that raise revenue could offer fiscal reforms analogous to the carbon tax scenarios in this paper.

2 For example, see Goulder et al (1997).

3 A number of studies have examined the potential for revenue recycling in climate policy. For example: Goulder et al. (1999), Parry et al. (1999), Parry and Oates (2000), Parry and Bento (2000), and CBO 2007.

4 Parry (1997)

improve the efficiency of the tax system most by reducing the most distortionary taxes. Parry and Bento (2000) and Parry and Williams (2011) find that efficiency gains are particularly large when revenue recycling lowers tax provisions that favor some kinds of consumption (such as housing or health insurance) over others. Two other options are to use the carbon tax revenue to reduce labor or capital income taxes. Depending on their design, such tax reforms can offset the regressiveness of the carbon tax and improve the returns to working and saving. For example, a carbon tax could finance a reduction in payroll taxes, as analyzed by Metcalf (2007a). He finds that a carbon tax of $15 per metric ton (MT) of CO_2, imposed in 2005, would have raised $78.5 billion and allowed a rebate of the employer and employee payroll taxes on the first $3,660 of earnings per worker, which would more than offset the regressivity of the carbon tax itself.

Lowering marginal tax rates on corporate income would be particularly efficiency-enhancing. The 2012 President's Framework for Business Tax Reform notes that the U.S. corporate income tax, as a result of its relatively narrow tax base and high statutory tax rate, is "uncompetitive and inefficient." [5] Analyzing a 15 percent cut in emissions from a cap-and-trade program, the U.S. Congressional Budget Office (CBO) estimates that the downward effect on GDP from the program could be reduced by more than half if the government sold allowances and used the revenues to lower corporate income taxes rather than to provide lump-sum rebates to households or to give the allowances away.[6] Metcalf (2007b) analyzes a scenario in which the revenue from a small carbon tax funds corporate tax integration, a reform in which corporate income is taxed only at the personal level. He finds that not only would the tax swap enhance the

[5] Joint Report by the White House and the Department of the Treasury, February, 2012. Downloaded July 23, 2012, from http://www.treasury.gov/resource-center/tax-policy/Documents/The-Presidents-Framework-for-Business-Tax-Reform-02-22-2012.pdf
[6] Elmendorf (2009)

overall efficiency of the tax system, the corporate tax reform could blunt the consumer price impacts of the carbon tax.

This paper examines tax reform options with an intertemporal computable general equilibrium (CGE) model of the world economy called G-Cubed. We investigate policies that allow the revenue from an illustrative carbon pollution tax to reduce the long run federal budget deficit or the tax rates on labor and capital income. We establish a simple excise tax on the carbon content of fossil fuels in the U.S. energy sector starting immediately at $15 per ton of CO_2 and rising at 4 percent above inflation each year.[7] We specify the U.S. carbon tax trajectory *a priori* in this way such that it follows a path that minimizes the cost of the cumulative abatement of emissions. To isolate the effects of the U.S. climate and fiscal policy on the United States, we assume other countries adhere to their baseline emissions trajectories.

II. MODELING APPROACH

A brief technical discussion of G-Cubed appears in McKibbin et al. (2009) and a more detailed description of the theory behind the model can be found in McKibbin and Wilcoxen (1999) and in McKibbin and Wilcoxen (2013).[8] We use a version of the model that divides the world into nine regions: the United States, Japan, Australia, China and five composites: Western Europe, the rest of the OECD (not including Mexico and Korea); Eastern Europe and the former Soviet Union; oil exporting economies; and all other developing countries. Each region is subdivided into 12 industrial sectors (codes used in figures in parentheses): Electric Utilities (Ele), Other Mining (Min), Gas Utilities (GaU), Agriculture (Agr), Petroleum Refining (Ref),

[7] The tax rises until 2050, after which it is held constant in real terms. The choice of a tax that begins at $15 per ton of CO_2 is arbitrary; the authors do not mean to suggest that such a price point is socially optimal.
[8] The type of CGE model represented by G-Cubed, with macroeconomic dynamics and various nominal rigidities, is closely related to the dynamic stochastic general equilibrium models that appear in the macroeconomic and central banking literatures.

Durables (Dur), Coal Mining (Coa), Non-Durables (Non), Crude Oil (Crd), Transportation (Trn), Gas Extraction (GaE), and Services (Srv).

A. The Government's Budget Constraint

To describe the baseline and policy scenarios, we first specify G-Cubed's representation of the federal government's budget constraint, which matches the government's outlays to its revenue. In this study, government outlays include purchases of goods, services, and labor, along with interest payments on government debt. The first simulation also includes lump sum transfers to households. Government revenue comes from sales taxes, corporate and labor income taxes, and sales of new government bonds. We also include an additional lump sum tax that satisfies a condition called the "no Ponzi game" (NPG) condition. It prevents per capita government debt from growing faster than the interest rate forever, in which case the government would be unable to pay interest on the debt.[9] In addition, some of the simulations include a tax on the carbon content of fossil fuels used in the energy sector.

Mathematically, in any given year the following equates government expenditure to government revenue:

(1) $$G_G + wL_G + R_{LS} + rB = T + t_C Q_C + T_{LS} + D$$

The left hand side of the equation sums outflows from the government in value terms where G_G is government spending on goods and services, wL_G is government spending at (tax inclusive) wage w on quantity of labor wL_G, R_{LS} is lump sum transfers to households, and rB is interest payments on the stock of federal bonds B at interest rate r. The right hand side sums sources of

[9] Implicitly we assume that agents will not hold government bonds unless they expect the bonds to be paid off eventually. The binding NPG condition means that at any point in time the current level of debt will always be exactly equal to the present value of future budget surpluses. McKibbin and Wilcoxen (1999) present the equivalent intertemporal constraint: the transversality condition on the stock of debt.

income to the government: T is tax revenue from all taxes other than carbon taxes, $t_C Q_C$ is carbon pollution tax revenue on emissions Q_C, T_{LS} is a lump sum tax to satisfy the NPG condition, and D is net government borrowing via the fiscal deficit. Carbon emissions, Q_C, is the total CO_2 emissions from energy-related fossil fuel consumption, including combustion of coal, natural gas, and oil. This source represents 94 percent of all U.S. CO_2 emissions in 2008, and over 80 percent of gross U.S. greenhouse gas emissions on a CO_2-equivalent basis.[10]

B. The Baseline Scenario

In the baseline, exogenous variables include the deficit D, and the tax rates included in T. The baseline scenario includes no lump sum transfers to households, so R_{LS} is identically zero. The stock of bonds B is determined by the accumulation of past deficits. Wages, prices of goods and services, and the interest rate on government debt are all endogenous. Each region's real government spending on goods and services is exogenous and allocated across inputs in fixed proportions according to their values in 2010. Government labor demanded, L_G , is also exogenous in the baseline.

The model's projections about future emissions and economic activity in the absence of climate policy is our business-as-usual baseline scenario. A detailed discussion of the baseline in G-Cubed appears in McKibbin, Pearce and Stegman (2009). The baseline in this study is broadly consistent with the emissions and GDP growth in the Department of Energy's Updated *Annual Energy Outlook* Reference Case Service Report from April 2011.[11] It sets G-Cubed's projected

[10] U.S. Environmental Protection Agency (2010), *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2008*, p. ES-4, Table ES-2. Accessed on July 8, 2010: http://epa.gov/climatechange/emissions/downloads10/US-GHG-Inventory-2010_ExecutiveSummary.pdf.
[11] The report appears at the DOE's Energy Information Administration website: http://www.eia.doe.gov/oiaf/servicerpt/stimulus/index.html.

productivity growth rates so that the model's baseline results approximate the report's forecasts for U.S. real gross domestic product (GDP) and other key variables.

Along with the baseline for the U.S., we construct a baseline scenario for the other regions in the world that reflects our best estimate of the likely evolution of each region's economy without concerted climate policy measures. To generate this scenario, we begin by calibrating the model to reproduce approximately the relationship between economic growth and emissions growth in the U.S. and other regions over the past decade. In the baseline, neither the U.S. nor other countries adopt an economy-wide price on carbon.

C. The Policy Scenarios

We use the model to analyze six policy scenarios that allow us to compare deficit reductions via a carbon tax and increases in labor and capital taxes as well as deficit neutral tax shifts. In all the policy simulations, we hold the real values of government spending on goods, services, and labor ($G_G + wL_G$) at their baseline levels. As we discuss below, assumptions about how government spending changes (or not) as a result of a carbon tax have important implications for consumption-based measures of household welfare. That's because a carbon tax can lower wages. If the quantity of labor demanded by the government is held constant (as is typically assumed) and wages fall, then the carbon tax induces lower government spending on labor and lower total government consumption. Thus lower wages in the policy simulation effectively shrink the burden of the government and expand consumption by households. This particular beneficial outcome for household welfare doesn't arise directly from the carbon tax but rather by its indirect effects on the overall size of government. To isolate the effect of the carbon tax on welfare independent of changes in the overall burden of supporting government, we hold government spending in these simulations to its baseline by imposing an endogenous lump sum tax that is just the right size to finance baseline government spending.

1. Carbon tax with lump sum rebate

This scenario establishes a simple excise tax on the carbon content of fossil fuels in the U.S. energy sector starting immediately at $15 per ton of CO_2 and rising at 4 percent above inflation each year. In each year of the simulation, government spending, the federal budget deficit, and tax rates on sales, corporate income, and labor income are held at the same levels as in the baseline. The government returns the revenue from the carbon tax to households with the lump sum rebate.

Each year's total rebate to households will be slightly different than the carbon tax revenue due to the general equilibrium effects of the carbon tax. For example, if the carbon tax slows economic activity and lowers the revenue from other taxes, the government must retain some of the carbon tax revenue to finance government spending (held at baseline levels) without increasing the deficit.

The carbon tax can also induce a change in the composition of economic activity across categories with different tax treatment and change the relative prices of different inputs to government spending.

2. Carbon tax with deficit reduction

This scenario imposes the same tax on carbon emissions as Scenario 1, but applies the revenue towards deficit reduction. As in Scenario 1, we hold total government spending and non-carbon tax rates at their baseline levels. A key difference in outcomes between this simulation and Scenario 1 is that this scenario produces lower government deficits and debt owing to the revenue of the carbon tax. It means that the interest payments on the debt fall, and the NPG tax embedded in *T* will be smaller than in Scenario 1. There are no lump sum rebates to households; all of the carbon tax revenue applies towards deficit reduction. However, the decline in the deficit relative to baseline will differ slightly from the carbon tax revenue due to general equilibrium effects.

3. Deficit reduction via an increases in tax rates on labor or capital income

Scenarios 3 and 4 allow us to compare deficit reductions via a carbon tax with other ways to reduce the deficit by the same amount. These simulations exogenously set the deficit to the lower-than-baseline trajectory achieved in Scenario 2. Scenario 3 endogenously determines the (larger than baseline) tax rate on labor income each year such that the increase in labor income tax revenue produces exactly the same (lower than baseline) deficit that obtained in Scenario 2. Scenario 4 does the same thing as Scenario 3 with the tax rate on capital income rather than the tax rate on labor income. There are no carbon taxes or lump sum rebates in Scenarios 3 and 4.

Because these simulations determine tax rates on labor and capital endogenously each year to hit a particular deficit target, they are best thought of as diagnostic scenarios rather than realistic policy scenarios.

4. Carbon tax with reduction in tax rates on labor or capital income.

Scenarios 5 and 6 apply revenue from a carbon tax to finance reductions in the tax rates on labor and capital income. The deficit and government spending are held exogenously to baseline levels. The same carbon tax as Scenario 1 applies. Scenario 5 endogenously determines the (lower than baseline) tax rate on labor income each year such that net result of the decrease in labor income tax revenue and the increase in revenue from the carbon tax produces exactly the deficit in the baseline for that year. Scenario 6 does the same thing as Scenario 5 with decreases in the tax rates on capital income instead of the tax rates on labor income. In these simulations the deficits and debt are the same as in the baseline and Scenario 1. There are no lump sum rebates to households. As in the other simulations, the revenue from the carbon tax and the reduction in other tax revenues would differ slightly due to general equilibrium effects. Table 1 summarizes the key features of the scenarios.

<Table 1 Here>

The comparative general equilibrium effects of these scenarios are of particular interest. For example, the tax swap scenarios (5 and 6) use the carbon tax revenue to reduce other distortions in the economy. This raises the question of whether the net effect of these fiscal reforms on employment, consumption, and GDP will be positive or negative.

III. RESULTS

The six policy scenarios explore two overarching issues: (1) the effects of a carbon tax under alternative assumptions about the use of the resulting revenue, and (2) the effects of alternative measures that could be used to reduce the budget deficit. Simulations 1, 2, 5 and 6 address the first issue and share a common carbon tax. Simulations 2, 3 and 4 address the second issue and share a common reduction in the deficit. Each issue will be discussed in turn below.

A. Carbon Tax with Lump Sum Rebate

Scenarios 1, 2, 5 and 6 all include a tax on CO_2 emissions that begins in 2011 (which we call year 1 for both the baseline and the policy in subsequent discussion and figures) at $15 per metric ton (in 2010 dollars) and rises at a real rate of 4 percent per year. To keep the discussion concise, we will present Scenario 1 in detail and then discuss the key differences that arise with alternative uses of the revenue in simulations 2, 5 and 6.

The carbon tax reduces emissions significantly. By year 25, annual emissions are 1.4 billion metric tons (BMT) of CO_2, or about 20 percent, lower than baseline levels. The cumulative reduction in emissions relative to the base case through year 25 is 20 BMT, or 12 percent lower than baseline. The tax also raises considerable revenue: $83 billion at the outset rising to $210 billion in the long term.

The effects of the tax on prices at the industry level in the medium term (year 15) are shown in Figure 1A. For each sector, three prices are shown: in green are producer prices, which exclude any tax on the producer's output; in red are domestic purchaser's prices, the producer's price plus the carbon tax; and in blue are the final supply prices, which are a composite of domestic and import purchaser's prices.

<Figure 1 Here>

The direct effect of the tax is to raise purchaser's prices for coal (Coa), crude oil (Crd) and natural gas extraction (GaE). The supply price for crude oil rises slightly less than the domestic price because the exchange rate appreciates about 2 percent. Downstream, the increase in purchaser's prices raises costs for electricity (Ele), gas utilities (GaU) and refined petroleum (Ref), and those prices rise as a result. Costs and prices rise very slightly in the remaining sectors.

Changes in domestic production and total supply (including imports) of each good in year 15 are shown in Figure 1B. Output falls by more than 20 percent for coal, by almost 10 percent for natural gas extraction, and by about 5 percent for crude oil. Output of electricity, gas utilities and refined oil falls by 3 to 4 percent. Outside the energy sectors, reductions in output are modest.

Figure 1C shows the impact of price and quantity changes on total revenue to producers (shown in green) and total payments by buyers (shown in red for domestic production and blue for total supply). Revenue falls by almost 20 percent for producers of coal and by 5-10 percent for crude oil and natural gas extraction. Expenditure on domestic supplies of those goods, inclusive of the tax, rises by more than 30 percent for coal and by several percent for crude oil and gas extraction. Interestingly, expenditure on the total supply of crude oil is essentially unchanged from the baseline (blue bar, which is nearly invisible) because appreciation of the exchange rate offsets a significant part of the tax increase.

Figure 1D turns to the economy as a whole and shows the change the policy produces in real GDP and its four components: consumption, investment, government spending, and net exports. Each is shown as a percentage of baseline GDP, which allows straightforward comparisons of magnitudes and easy decomposition of the overall GDP effect. In the long term, the carbon tax lowers GDP by about 0.2 percent relative to the baseline, largely by reducing net exports and investment. In the early years, however, those effects are partly offset by an increase in consumption due to the lump sum transfer of income. Real consumption rises above its baseline because net household cash income rises due to the transfer and liquidity-constrained households consume more. Government spending is fixed at baseline levels by design in all of the policy scenarios.

B. Alternative Uses of Carbon Tax Revenue: Comparing Scenarios 1, 2, 5 and 6

All four of the carbon tax scenarios (Scenarios 1, 2, 5, and 6) achieve similar annual reductions in emissions: in the long term, cumulative emissions in all four scenarios are 18 to 21 billion metric tons lower than the base case. The tax could allow significant reductions in the budget deficit or modest reductions in the tax rates on labor or capital income. In Scenario 2, the deficit is immediately lowered by about 0.5 percent of baseline GDP relative to the baseline. The reduction in the annual deficit as a share of GDP is fairly constant through year 25. In Scenario 5, the carbon tax revenue recycling reduces the labor tax rate by about 0.9 percentage points (while holding the deficit constant). Under Scenario 6, the capital tax rate falls about 5 percentage points in the long term.

Using the revenue from the carbon tax for deficit reduction or tax reform affects the pattern of changes in GDP and its components. Figure 2A shows the change in GDP relative to baseline under all four of the carbon tax scenarios. The first three simulations have similar effects on GDP in the long term but differ in the short to medium term: the lump sum rebate raises GDP slightly in the short term while deficit reduction and the labor tax rebate lower it slightly. The capital tax reduction stands in sharp contrast: GDP is above the baseline in all years and about 1 percent of base GDP higher in the long term. In terms of GDP, the capital tax swap produces a double dividend, i.e. both emissions reductions and an increase in economic activity.

<Figure 2 Here>

Although the scenarios cause distinctly different changes in GDP, these changes are all very small relative to the level of future GDP. Even the policy with the largest negative effect on GDP has impacts equivalent to less than a year of typical growth; that is, the policies would only delay achievement of the GDP in year 25 of the baseline by a couple of months.

The components of GDP vary across scenarios as well, and there the differences between the first three simulations become more pronounced. Figure 2B shows the effects of the policies on real consumption, one measure of household welfare. In contrast to the lump sum case: the labor tax reduction produces little overall effect; deficit reduction lowers consumption by about 0.2 percent of base GDP; and the capital tax reduction produces an initial drop in consumption followed by a significant subsequent rise as the capital stock increases.

Consumption is lower under Scenarios 2, 5 and 6 in part because households do not receive the large lump sum transfer of income that occurs in Scenario 1. In Scenario 2, transfers rise slightly due to reductions in the cost of servicing government debt. Income from government bonds falls as the stock of debt declines relative to the base case. Income from foreign assets rises and dividends increase slightly. Together, the first four changes would raise income in the short term (year 5) by more than $15 billion. However, labor income falls by about $30 billion and the net result is a decline of about $18 billion. As a result, consumption declines as shown in Figure 2B.

The mechanisms at work in the capital tax swap scenario are quite different. The policy induces small changes in transfers and income from bonds, and a modest decrease in income from foreign assets. The main effects, however, are a large reduction in dividends and an accompanying increase in labor income. Overall, household income rises by almost $200 billion in the medium term (year 15). Labor income rises largely because the real wage increases, and to a lesser extent because employment rises, as shown in Figures 2C and 2D. The first three scenarios are very similar to one another but a sharp increase in investment under the capital tax reduction drives up the demand for labor significantly. Investment in the short to medium term rises by about 2 percent of base GDP, and investment in the long term is about 0.5 percent of GDP higher than the baseline.

In sum, a carbon tax will significantly reduce CO_2 emissions, and the environmental performance of the policy is largely independent of the use of the revenue. However, the way in which the revenue is used has important effects on the economy overall and the allocation of GDP across consumption, investment and net exports. For most of the scenarios, the carbon tax tends to lower GDP slightly, reduce investment and exports, and increase imports. The effect on consumption varies by policy and can be positive if household receive the revenue as a lump sum transfer. Using the revenue for a cut in tax rates on capital income, however, is substantially different than the other revenue policies. In that case, investment increases, employment rises, consumption declines slightly in the short term, and overall GDP rises significantly relative to its baseline level. Thus, adopting a carbon tax and using the revenue to reduce capital taxes would achieve two goals: reducing CO_2 emissions significantly and expanding employment and the economy in the short term.

C. Deficit Reduction Policies

Scenarios 2, 3 and 4 all reduce the budget deficit by the amount achieved via the carbon tax in Scenario 2. To achieve this, under scenario 3 the labor tax is about 1.5 percentage points higher in the long term, while under scenario 4 the capital tax rate would need to be about 5 percentage points higher in the long term than in the baseline.

As shown in Figure 3A, the effects of the deficit reduction scenarios on GDP differ significantly. The carbon tax reduces GDP slightly: by about 0.27 percent of its baseline level. An equivalent reduction via an increase in the labor tax produces an even smaller drop in GDP: 0.08 percent of baseline. The capital tax, however, lowers GDP in the medium term by almost 2 percent of its baseline and lowers it in the long term by slightly 1.1 percent.

<Figure 3 Here>

Of the three policies, only the carbon tax has a meaningful effect on CO_2 emissions. Annual emissions under the capital tax increase fall very slightly relative to the base case due to the reduction in economic activity reflected in the GDP results shown in Figure 3A. Emissions under the labor tax increase are essentially unchanged.

None of the policies improve long term GDP. The reasons are threefold: (1) the risk premium on government securities in the model is unaffected by reductions in the deficit (and therefore the debt); (2) international capital out-flows limit crowding in of private investment;

and (3) a large share of households are forward-looking and exhibit Barro-neutrality (Barro, 1974).

The risk premium is unaffected due to two interlocking features of the simulations. First, our baseline scenario does not include explosive growth in transfer payments under federal entitlement programs. As a result, baseline government debt stabilizes as a share of GDP. Second, and consistent with the first point, we treat the risk premium associated with U.S. government debt as exogenous and constant. Thus, deficit reduction has only minor general equilibrium effects on the interest rate paid by the government.

The evolution of consumption, investment and net exports over time are shown in Figures 3B through 3D. Consumption is generally about 0.2 percent of base GDP lower than its baseline under the carbon or labor tax cases. In the capital tax case, it rises above baseline briefly but then falls to about 1 percent of GDP below baseline in the medium term. The effects on investment are also roughly comparable between the carbon and labor taxes—small declines relative to baseline—while the capital tax produces a large decline in the short term and a smaller but still significant decline in the long term. Finally, all three policies increase net exports by lowering imports significantly.

In sum, we find that raising taxes on labor or carbon would be the best approach for reducing the deficit with minimal disturbance to overall economy. In both cases, GDP remains close to its base case level, consumption is reduced slightly and net exports expand slightly. Investment remains essentially unchanged. In contrast, increasing tax rates on capital income to reduce the deficit causes a significant and persistent drop in investment and much larger reductions in GDP. A carbon tax is thus an attractive option for deficit reduction because it provides a very significant reduction in CO_2 emissions as well as reducing the deficit with minimal disturbance to overall economic activity. It would also be a far better option than raising taxes on capital.

IV. CONCLUSION

This paper examines fiscal reform options in the United States with an intertemporal computable general equilibrium (CGE) model of the world economy. The six policy scenarios explore two overarching issues: (1) the effects of a carbon tax under alternative assumptions about the use of the resulting revenue, and (2) the effects of alternative measures that could be used to reduce the budget deficit. We examine a simple excise tax on the carbon content of fossil fuels in the U.S. energy sector starting immediately at $15 per ton of CO_2 and rising at 4 percent above inflation. We investigate policies that allow the revenue from the illustrative carbon tax to reduce the long term federal budget deficit or the marginal tax rates on labor and capital income. We also compare the carbon tax to increases in labor and capital income taxes that reduce the deficit by the same amount.

We find that the carbon tax will significantly reduce CO_2 emissions, and the environmental performance is largely independent of the use of the revenue. In the long term (year 25), annual emissions fall by 1.4 billion metric tons (BMT) of CO_2, a reduction of about 20 percent relative to baseline. The cumulative reduction in emissions relative to the base case through year 25 is 18-21 BMT depending on how the revenue is used.

The use of the carbon tax revenue affects the policy's broad economic impacts as well as the composition of GDP across consumption, investment and net exports. For most of the scenarios, the carbon tax tends to lower GDP slightly by reducing investment. The effect on consumption varies across policies and can be positive if households receive the revenue as a lump sum transfer.

Using the revenue for a capital tax cut, however, is significantly different than the other revenue recycling policies. In that case, investment rises, employment and wages rise, and overall GDP is significantly above its baseline through year 25. Thus, adopting a carbon tax and using the revenue to reduce capital taxes would achieve two goals: reducing CO_2 emissions significantly and expanding employment and the economy.

We examine three ways to reduce the deficit: a carbon tax, an increase in tax rates on labor income, and an increase in tax rates on capital income. We find that a carbon tax or labor tax increase both have small negative effects on GDP, consumption and investment. A carbon tax thus offers a way to help reduce the deficit and improve the quality of the environment with minimal disturbance to overall economic activity. In contrast, using a capital tax increase to reduce the deficit would cause a significant and persistent drop in investment and much larger reductions in GDP, and it would provide no significant environmental benefits.

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Table 1: Summary of Baseline and Policy Scenarios

Scenario	Short Code	Carbon Tax	Deficit	Labor Tax Rate	Capital Tax Rate	Lump Sum Rebate
Baseline	Base	no	exogenous	exogenous	exogenous	no
1	S1_CT/LS	yes	baseline	baseline	baseline	yes
2	S2_CT/DR	same as Scenario 1	below baseline	baseline	baseline	no
3	S3_LT/DR	no	same as Scenario 2	above baseline	baseline	no
4	S4_KT/DR	no	same as Scenario 2	baseline	above baseline	no
5	S5_CT/LTR	same as Scenario 1	baseline	below baseline	baseline	no
6	S6_CT/KTR	same as Scenario 1	baseline	baseline	below baseline	no

Figure 1: Selected Results for Scenario 1, a Carbon Tax with Lump Sum Recycling

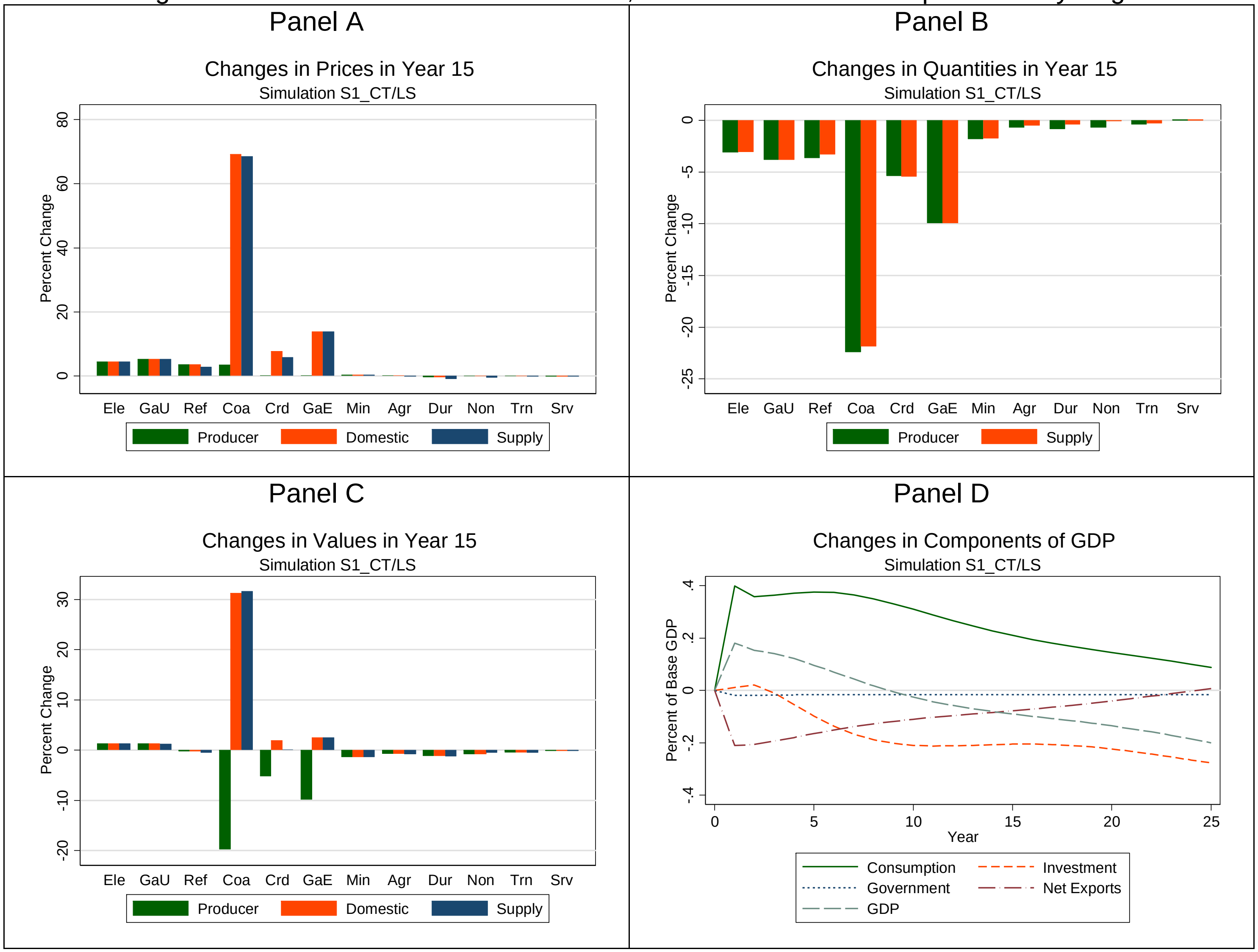


Figure 2: Selected Results for Carbon Tax Scenarios

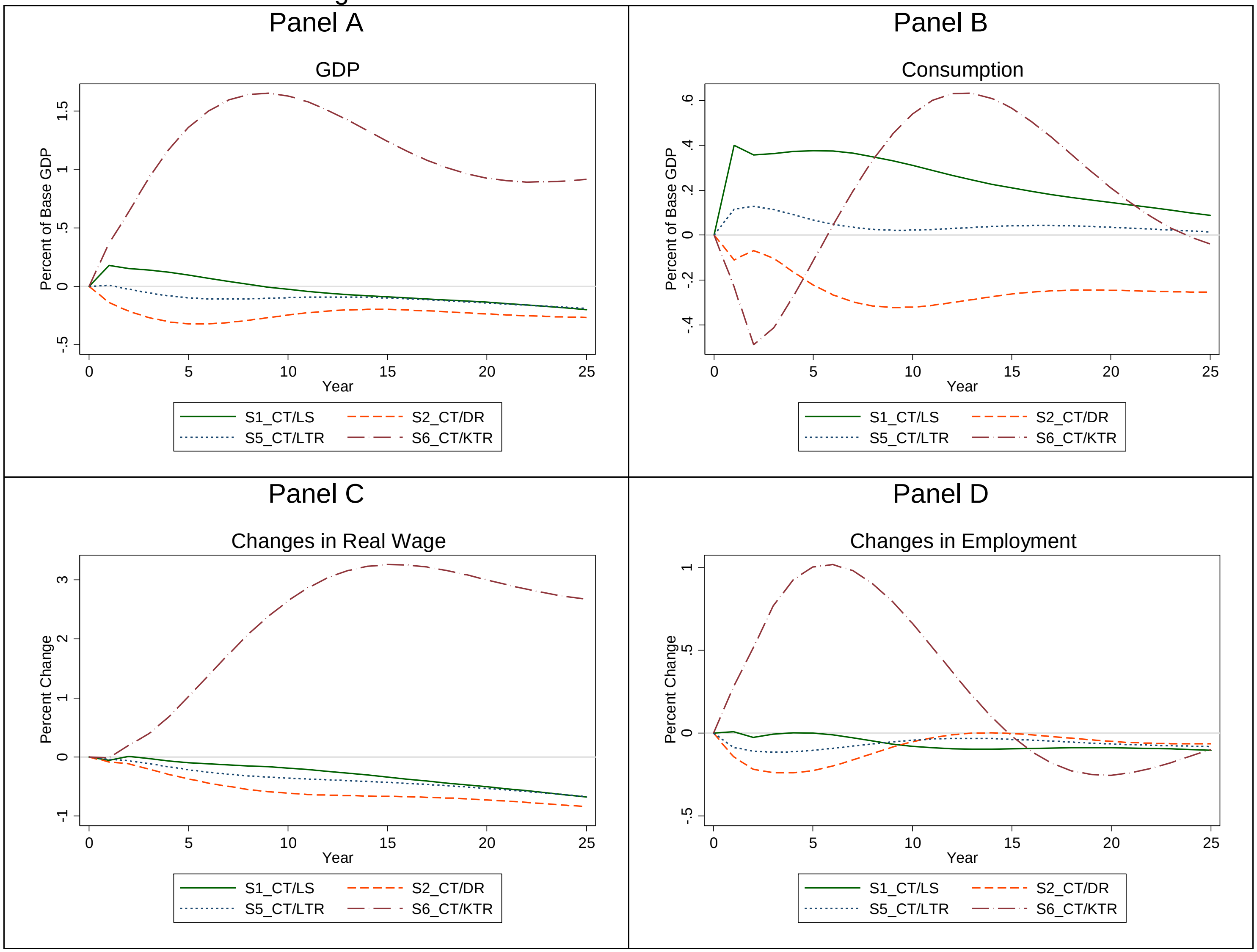
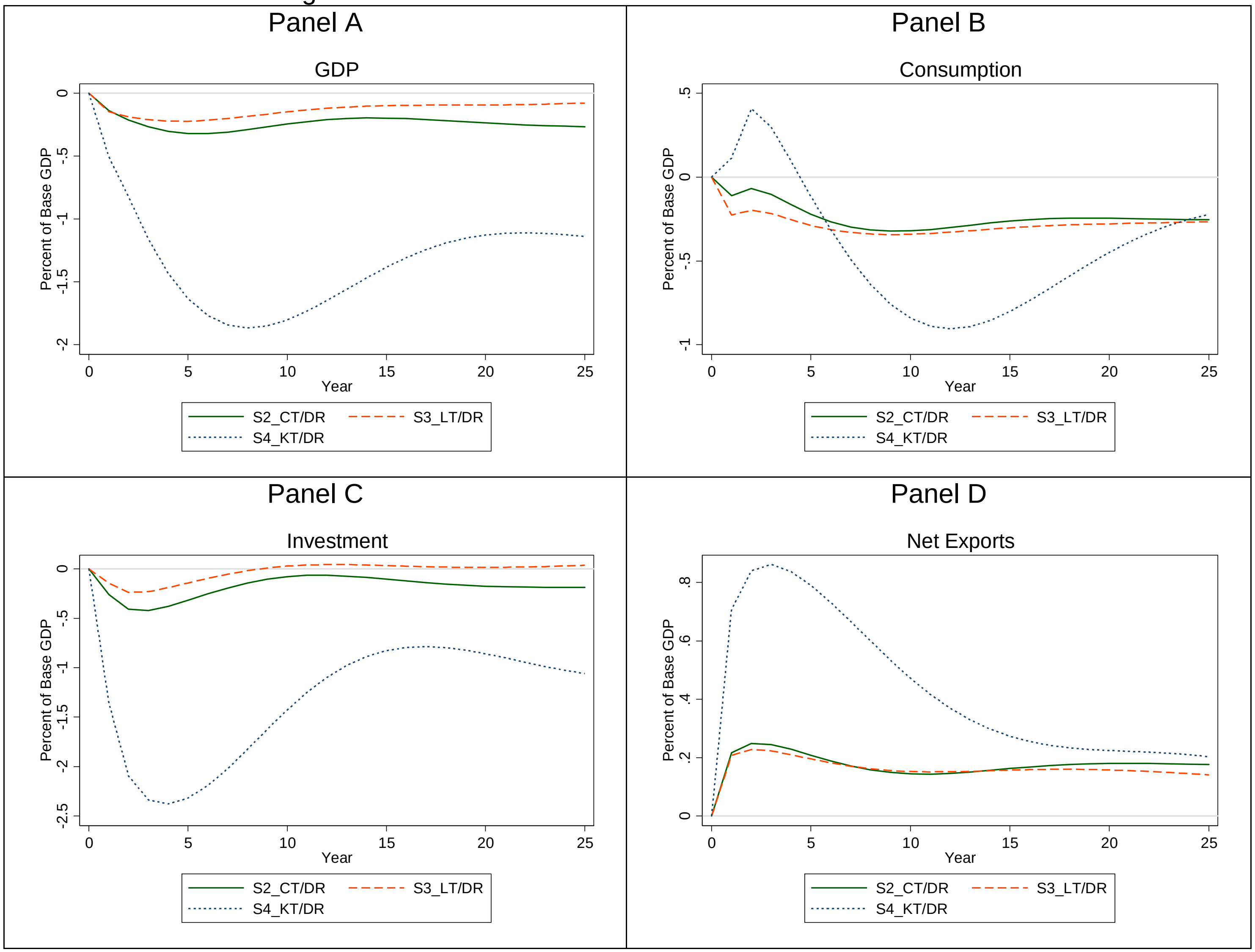


Figure 3: Selected Results for Deficit Reduction Scenarios



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