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A New Carbon Tax in Portugal: A Missed Opportunity to Achieve the Triple Dividend?

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Abstract: In 2014, the Portuguese government appointed a Commission for Environmental Tax Reform that formulated a carbon-tax proposal designed to achieve three dividends: to help Portugal meet the European Union's target for emissions reductions by 2030, to boost long-term employment and GDP above their pre-carbon tax levels, and to strengthen public finances by lowering public indebtedness. A key feature of this proposal was a judicious set of mixed strategies to recycle all carbon-tax revenues back into the economy. In this note, we show how the carbon tax that the Portuguese Parliament eventually approved deviated from such guidelines, and ultimately failed to achieve the triple dividend. We argue that authorities need to quickly amend the existing legislation to avoid this misguided attempt turning into a missed opportunity to improve environmental, macroeconomic, and fiscal outcomes.

Keywords: Carbon Tax; Triple Dividend; Economic Growth; Fiscal Consolidation; Dynamic General Equilibrium; Portugal.

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1. Introduction

Portugal has pledged to cut its carbon-dioxide emissions by 2030 by 40% in relation to 1990 levels (European Commission, 2014c). Reaching this target, on time, will require a public policy that lowers the carbon intensity of the Portuguese economy, well beyond what will be achieved with the ongoing trends both in the price of fossil fuels and in domestic energy-efficiency gains.

There is a growing consensus among economists that putting a price on GHG pollution is the most effective means of reducing our carbon footprint (see, for example, Stern, 2007; IMF, 2014; Parry et al., 2014; Mankiw, 2013; and OECD, 2011). Indeed, carbon taxes are preferred to top-down regulations for three reasons: by "internalizing the externality" in a less-invasive way, they encompass all possible margins of adjustment in the fight against global warming (Mankiw, 2013), they spur innovation in energy efficiency beyond the regulated targets, by diverting demand to cleaner renewable alternatives (Stern, 2007; World Bank, 2014), and, importantly, they provide revenues that can be recycled back into the economy and into the environment (Jorgenson, 2014).

This 'tax and dividend' approach, whereby pollution is taxed away and the proceeds are allocated to lowering taxes aimed at spurring economic growth, thereby improving public finances, is at the heart of what is known in the literature as the second and the third dividends (see, for example, Goulder, 1995; Nordhaus, 2010; Metcalf, 2010; and Pereira and Pereira, 2014a). The first dividend is of an environmental nature, and is naturally connected with the reduction in carbon-dioxide emissions. The second dividend is related to macroeconomic performance, specifically if the levels of employment and of GDP are higher with the carbon tax. The third and final dividend is connected with the budgetary position, and materializes with a lower ratio of public debt to GDP.

Since the beginning of this century, Portugal has witnessed disappointing economic growth, to the extent that it has consistently fallen behind in terms of real convergence to its EU peers. Similarly, plagued by a structurally-weak budgetary position, in the wake of the global financial crisis of 2008, Portugal lost access to international bond markets in mid-2011, and only recently exited a strict EU-ECB-IMF adjustment program. In such a context of historically-high levels of public indebtedness, where fiscal space is now meagre and the economic recovery is still nascent, even more care is needed in terms of the specific design of a carbon tax, because it is crucial that Portugal achieve the three dividends. It is definitely not enough for Portugal just to reach the 40% target reduction for carbon-dioxide emissions by 2030, if doing so entails even weaker macroeconomic and fiscal outcomes in the future.

In September of 2014, a Commission for Environmental Tax Reform (*Comissão para a Reforma da Fiscalidade Verde*, CRFV, hereafter), appointed by the Portuguese government earlier in the year, submitted a report containing a proposal for a package that was designed to guide Portugal to a triple dividend in the long run (see CRFV, 2014). Then, in the final quarter of the same year, Parliament approved a new carbon tax, enacted on January 1st 2015, which ignored many of the key characteristics proposed by this Commission.

The objective of this note is to present simulation results on how far is what was approved by the Portuguese Parliament from what was proposed by the CRFV Commission. We show that a carbon tax in Portugal is needed, and it can be virtuous in the long run, but only if it is done right. Furthermore, we present evidence that what was approved by Parliament and became law in 2015 fails to achieve the three dividends.

The simulation results on the environmental, macroeconomic, and budgetary effects of a new carbon tax were obtained with a dynamic general-equilibrium model of the Portuguese economy. This model incorporates fully-dynamic optimization behavior, and features an endogenous-growth mechanism, as well as a detailed modeling of the public-sector account, both in terms of spending and in terms of taxes and contributions. It is worth highlighting that all major tax bases are fully endogenous, a feature that is crucial to seriously evaluate any tax reform package.

Previous versions of this model were used to evaluate the impact of alternative tax policies (see Pereira and Rodrigues, 2002, 2004), public pension reform (see Pereira and Rodrigues, 2007), and, more recently, other energy and climate policies (see Pereira and Pereira, 2013, 2014a, 2014b). Even more crucial from this note's perspective, this model served as the basis for the Commission's recommendations, and all results presented here are, although naturally in a different context, included in its official report (see CRFV, 2014).

The remainder of this note is structured as follows. Section 2 describes the dynamic general-equilibrium model used. Section 3 summarizes and discusses the significance of the simulation results. Section 4 concludes with policy recommendations.

2. Methods and Data

To determine the long-term environmental, economic, and budgetary effects of a carbon tax in Portugal, we use a dynamic general-equilibrium model that features an energy sector, endogenous growth, and a detailed public sector. Pereira and Pereira (2012, revised in 2014) provide a full account of the model's equations, parameters, data, calibration, and numerical implementation. What follows is a very general description.

In a decentralized economy framed in real terms, all agents are price takers with perfect foresight. The production sector, the household sector and the public sector are fully endogenous, while the foreign sector is not. All sectors interconnect through competitive-market-equilibrium conditions, as well as the evolution of the stock variables and the relevant shadow prices.

The economy's trajectory is given by the optimal evolution of eight stock and five shadow price variables – private capital, wind energy capital, public capital, human capital, and public debt, together with their respective shadow prices, along with foreign debt, private financial wealth, and human wealth. In the long run, growth is endogenous and is driven by the optimal accumulation of private capital, public capital and human capital, the last two of which are publicly provided.

2.1. The Production Sector and the Energy Module

Aggregate output has a CES technology that links value added to primary-energy demand that is also CES and uses as inputs: crude oil and non-transportation energy sources such as coal, natural gas and wind energy. Value added is Cobb-Douglas with constant returns to scale in the reproducible inputs – effective labor, private capital, and public capital. The firm chooses investment and labor-demand schedules that maximize the present value of its net cash flows, subject to the equation of motion for private capital accumulation that is subject to depreciation. Gross investment is dynamic and induced by strictly-convex adjustment costs associated to learning and installation that are internal to the firm. Public infrastructure and knowledge are publicly-financed positive externalities, and, without public investment, decreasing returns set in. The firms' cash flow is net of all relevant corporate-income and payroll taxes, as well as any investment-tax credits, and at the end of each operating period this cash flow is transferred back to the households.

Firms purchase primary energy, subject to CO_2 taxes or auctioned-off permits. This surcharge is passed on to consumers in accordance with the energy content of the good. Primary-energy demand reflects the direct use of energy at the source, without conversion or transformation, accounting for CO_2 emissions from fossil-fuel combustion activities. This demand is produced with a CES technology, where crude oil and non-transportation fuels are imperfect substitutes. Petroleum products dominate in transportation-energy demand, while coal, natural gas and wind energy rule in electric power and industry. With a greater potential for substitution, the latter fuels are assumed to be Cobb-Douglas. Wind turbines depreciate, and wind-energy investment that is internal to the firm is also subject to adjustment costs. Coal, natural gas and oil are imported.

Optimal primary-energy demand is such that it maximizes the present value of the firms' net cash flows. The demand for coal and natural gas results from a nested-dual problem of minimizing energy costs, given production and the optimal energy demand in electric power and industry.

Upon combustion, fossil fuels release carbon into the atmosphere. In accordance with the Intergovernmental Panel on Climate Change (2006) reference approach, the demand for fossil fuels is converted linearly into carbon emissions. Together, the amount of fuel consumed, along with its carbon factor, its oxidation rate, and the ratio of the molecular weight of CO_2 to carbon are all used to compute how much CO_2 is emitted. The relative abundancy of carbon in each hydrocarbon can be used to determine how much carbon the different fossil fuels emit per unit of energy. For each ton of oil equivalent consumed, Pereira and Pereira (2014c) find that crude oil yields 3.04 tCO_2, bituminous coal yields 3.78 tCO_2, and natural gas yields 2.34 tCO_2.

2.2. The Households

In an overlapping-generations setting with a finite but non-deterministic planning horizon, households choose consumption and leisure streams to maximize intertemporal subjectively discounted lifetime-expected utility, subject to a consolidated budget constraint. Preferences are CES and additively separable in consumption and leisure. Households become relatively more impatient with a lower probability of survival.

Consumption is subject to value-added and excise taxes, and a budget constraint ensures that the households' expenditure stream, discounted at the after-tax market real interest rate, remains below total wealth. This wealth is age-specific and is made up of human wealth, net financial worth, and the present value of all firms.

Human wealth reflects the present discounted value of future labor income, net of personal-income taxes and workers' Social Security contributions. Households decide how much labor to supply, where their wages are affected by the stocks of knowledge and human capital that are augmented through public investment.

A household's income includes public transfers, international transfers, net interest payments received on public debt, and net profits distributed by corporations. Spending includes consumption, taxes and paying off debts to foreigners. Income, net of spending, adds to net financial wealth.

2.3. The Public Sector

Public debt has a dynamic equation where the excess of public spending over all tax revenues and contributions has to be financed with further borrowing. Tax revenues include value-added and excise taxes, personal-income taxes, corporate-income taxes, and Social Security contributions paid by firms and workers. All taxes are levied on endogenously-determined tax bases. Residual taxes are lump sum, and grow exogenously.

Interest payments service public debt, and households benefit from public transfers such as pensions, unemployment subsidies, and other social spending that grow exogenously. In addition, there is public consumption and public investment both in human capital and in infrastructures.

Public investments are subject to depreciation and strictly-convex adjustment costs, and constitute an engine of endogenous growth. Along with public consumption, the public sector chooses them to maximize social welfare, defined as the net present value of the future stream of utility. These optimal choices are constrained by the dynamic equations for public debt, human capital and infrastructures.

2.4. The Intertemporal Market Equilibrium

The intertemporal path for the economy is determined by behavioral equations, by the dynamic equations for all stock and shadow price variables, and by market-equilibrium conditions.

Labor-market clearing incorporates an exogenous structural unemployment rate. The product market equalizes demand and supply for output. As an open economy, part of domestic demand is satisfied with foreign production. Financial-market equilibrium reflects the fact that private capital formation and public indebtedness are financed by household savings and foreign financing.

The balance of payments is highly stylized. Domestic production and imports are absorbed by domestic expenditure and exports. Net imports include fossil fuels, and are financed through foreign transfers and foreign borrowing. As a small open economy, Portugal obtains financing at a rate determined in international financial markets.

2.5. Dataset, Parameter Specification, and Calibration

The model is implemented numerically using detailed macroeconomic data and parameters sets for the period 2000-2013. This reflects the most recent available information and covers several business cycles, reflecting the long-term nature of the model. Stock variables are set at 2013 levels. Whenever possible, parameters are set from data sources or the literature, or are obtained by calibration, i.e., extrapolating, as the steady-state trajectory, the trends for 2000-2013.

3. Results and Discussion

This section is a commented walk through a sequence of simulation results, aimed at presenting evidence of three facts: a carbon tax in Portugal is needed, it is possible to design a reform package that achieves the triple dividend in the long run, and, finally, what was approved by Parliament and became law in 2015 fails to achieve the three dividends.

3.1. The Reference Case: Why a Carbon Tax is Necessary

What would likely happen in Portugal in terms of carbon emissions without a carbon tax? The Reference Case is the answer to this question. Without a surcharge on the goods and services produced, in accordance with their carbon content, fossil-fuel emissions will probably still fall over time, on account of two ongoing trends.

First, there is a consensus that international fossil-fuel prices are on an uptrend. Using the central fossil-fuel price scenario forecasts in CRFV (2014), by 2030, crude oil is expected to be 11% more expensive than in 2013, coal by 20%, and natural gas by 26%. These central-scenario forecasts are the midpoint of the forecasts implicit in European Commission (2014c) and in the Intercontinental Exchange futures markets, appended using the growth of the European Commission's prices over time.

The second ongoing trend that drives GHG emissions lower is an annual domestic energy efficiency gain of 2%. A series of EU directives have set goals for energy efficiency. Most notably, EC Directive 2009/28/EC set a legally-binding target of increasing energy efficiency by 20% by 2020, relative to 1990 levels (European Commission, 2013, 2014a, 2014b). Recent EU legislation and discussions suggest even more ambitious targets, aiming, for example, at a 40% reduction in primary-energy use by 2030, relative to 1990 (European Commission, 2014a, 2014b). In both cases, the average annual gain in energy efficiency over the next two decades will have to be around 2%.

Table 1 shows that, together, these two ongoing trends are expected to reduce emissions by as much as 21.7%, by 2030, in relation to their 1990 levels. This proves that a carbon tax is needed, given that in the Reference Case only a little more than half of the 40% reduction target will be reached. Even by 2050, CO_2 emissions will only have fallen by around one third.

<Insert Table 1 here>

As the pre-carbon-tax scenario, the Reference Case is also instrumental to identify the existence and to measure the strength of the second and third dividends. In particular, if by recycling carbon-tax revenues back into the economy in the form of lower distortionary tax margins, the levels of employment and GDP rise above those attained in the Reference Case, then we have a strong realization of the second dividend. Similarly, if, with recycling, the ratio of public debt to GDP is lower than in the pre-carbon-tax scenario, then we have a strong realization of the third dividend, which pertains to public finances.

3.2. The Commission's Proposal: Achieving the Three Dividends

The Commission for Environmental Tax Reform (CRFV, 2014) proposed a carbon tax that is designed to achieve a strong realization of the three dividends, at least in the long run. As further detailed in Pereira and Pereira (2015), to simultaneously ensure a reduction in GHG emissions, along with improved macroeconomic performance, and a stronger budgetary position, we have to consider mixed recycling strategies, where the carbon-tax revenues are used not only to alleviate various distortionary tax margins that are key to economic growth, but are also used to actively promote consistent gains in terms of further energy efficiency.

A significant part of the Portuguese economy, responsible for 37% of all CO_2 emissions, is already covered by the European Union's Emissions Trading System (EU-ETS). As such, only those sectors not participating in the EU-ETS are to be subject to a carbon tax. The CRFV Commission opted to index the carbon tax to the EU-ETS, meaning that it will start at 6 EUR/tCO_2, but is expected to rise to 10 EUR/tCO_2 by 2020, leveling off at 35 EUR/tCO_2 from 2030 onwards (see European Commission, 2014c).

Table 2 shows that, by 2030, the Commission's proposal would lower CO_2 emissions by 38.54% in relation to 1990 levels, within striking distance of the GHG-emissions target. Naturally, the effects of the carbon tax would continue thereafter, and, by 2050, the reductions would reach 48.31% of the 1990 emission levels.

<Insert Table 2 here>

Having experimented with several alternative recycling strategies, the CRFV adopted one where, of all carbon-tax revenues raised, 50% are spent on investment tax credits (ITC), 25% are used to alleviate Social Security contributions (SSC) paid by employers, and 25% go to finance lower personal-income taxes (PIT). It is worth highlighting that these tax changes are to be directly connected with promoting activities that result in a consistent additional 1% annual domestic gain in terms of energy efficiency (for the specifics surrounding these tax changes, see CRFV, 2014).

Table 3 presents the impact of the Commission's proposal (see the row in bold). Note how a strong realization of the triple dividend is achieved by 2050, with long-term CO_2 emissions falling by 48.31% in relation to their 1990 levels, with the levels of employment and of GDP 0.26% and 0.68% higher than in the pre-carbon-tax scenario, and, finally, with the ratio of public debt to GDP 1.47 pp lower. Also, we conclude that it takes time for all three dividends to materialize. Indeed, by 2030, while the first dividend has already been achieved, the detrimental effects of the carbon tax on employment and GDP are just close to being neutralized, although not yet reversed, and the third dividend is substantially less pronounced than twenty years later.

<Insert Table 3 here>

It is interesting to see how the Commission's proposal combines the best characteristics of two more elementary mixed strategies. In particular, the case (see the first row) where more carbon-tax revenues (50%) are allocated to reducing personal-income taxes (PIT) results in a comparatively larger increase in the levels of employment and GDP than the case that lowers payroll taxes (SSC). This is because labor demand is more elastic than labor supply, probably because, to some extent, firms can substitute capital for labor, and wages are most households' primary source of income. On the other hand, the case where the ratio of public debt to GDP falls the most is where payroll taxes are lowered (see the second row). We can conclude that the 50%, 25% and 25% allocation of carbon-tax revenues to each of the three tax margins was chosen by the Commission given the significance of the investment tax credit, and the attempt to find an acceptable point on a trade-off between a lower PIT that expands employment, but fails to yield much of a third dividend, and a lower SSC that is comparatively better at fiscal consolidation than at job creation. This mixed-strategy allocation is fully in line with recent tax-policy recommendations (see, for example, OECD, 2014; and Eurogroup, 2014).

3.3. What Parliament Ultimately Approved: Failure to Deliver

In the last quarter of 2014, with the Commission's final report in hand, the Portuguese Parliament approved a new carbon tax that was enacted on January 1st 2015. To the dismay of many, most of the key characteristics of the environmental tax reform package that the Commission had proposed were now absent.

Although the new carbon tax was still indexed to the EU-ETS, the commitment to direct the tax changes towards promoting consistent gains in energy efficiency had disappeared, as had the commitment to recycle all revenues back into the economy by alleviating key distortionary tax margins. In fact, with parliamentary elections scheduled for the same year, 2015, it was decided that carbon-tax revenues would only be recycled once, and in the form of lower personal-income taxes.

To ascertain how far is what was approved from what was proposed, we examine a series of cases (see Table 4) that allow us to trace how the long-term simulation results change when we move, step by step, away from what the Commission designed, to what will soon become reality.

<Insert Table 4 here>

As discussed above, the CRFV Commission's plan achieves a strong realization of the triple dividend, i.e., in relation to the Reference Case (the pre-carbon-tax scenario), GHG emissions are reduced, levels of employment and GDP are increased, and the ratio of public debt to GDP is lowered. In contrast, if what was approved is not amended, only CO_2 emissions will be reduced, and, even then, by not as much as needed to reach the 40% target reduction by 2030, in relation to 1990 levels. In addition, the carbon tax, as approved, will induce detrimental economic and budgetary effects. In that case, in failing to fully achieve the first dividend, the sacrifices made in terms of disappointing macroeconomic performance and a weaker fiscal position will have been in vain.

In the long term, by 2050, when PIT and SSC recycling are replaced with just PIT recycling, relative to the effects under the CRFV plan, the level of GDP falls and the ratio of public debt to GDP increases. Greenhouse-gas emissions fall because of less economic activity, and the level of employment rises because more recycling now goes to alleviate PIT. Given that labor demand is more elastic than labor supply, a personal-income-tax-induced expansion in the labor supply schedule will generate more jobs.

When, in addition to the exclusive focus on PIT recycling, there are no further energy efficiency gains, carbon-dioxide emissions reductions fall significantly, the level of GDP falls even more, and public finances deteriorate, again. Interestingly, the level of employment is unaffected.

Finally, when the recycling of carbon-tax revenues is limited to alleviating PIT, and only in 2015, i.e. when, in practice, the recycling of revenues beyond that year does not take place, the levels of employment and of GDP suffer, public indebtedness mounts, and carbon-dioxide emissions are only marginally lower due to weaker macroeconomic activity.

By comparing the results of the carbon-tax reform that was approved by Parliament with those of the package proposed by the CRFV Commission appointed by the Portuguese government, we conclude that, in the long term, the carbon-dioxide emissions reductions are 2.65 pp lower than they could be, the levels of employment and of GDP are 0.83 and 2.23 pp lower, respectively, and the ratio of public debt to GDP is 5.43 pp higher.

This means that, while the first dividend of the carbon tax is somewhat weaker than it would otherwise be, with what was ultimately approved, the second and the third dividends disappear, as both the levels of employment and GDP are now below those of the Reference Case, and the ratio of public debt to GDP is several percentage points higher.

To summarize, the new carbon tax in Portugal, in the form it was approved by the Portuguese Parliament, fails to deliver on the triple dividend. Specifically, there is less of the first dividend, and there is no basis whatsoever for the second and third dividends to materialize. Furthermore, it is clear that the two main reasons for these less-favorable results across the board, compared to what was proposed, are the lack of revenue recycling and, therefore, also the lack of energy-efficiency objectives. The mere change from the mixed strategy proposed by the Commission to an exclusive focus on the personal-income tax, while reducing the realization of the three dividends, would not lead to such a dramatic reversal.

4. Conclusions and Policy Implications

We have presented evidence that a carbon tax is needed if, by 2030, Portugal is to reach the 40% target it committed itself to, in terms of reducing CO_2 emissions in relation to their 1990 levels. Furthermore, a carbon tax can be virtuous, in the sense that a strong realization of the triple dividend can be achieved. This means that, in the long term, simultaneously, GHG emissions can be reduced, macroeconomic performance can be improved, and public finances can be strengthened.

But this positive outcome will only materialize if carbon-tax revenues are recycled, i.e. if they are used to promote sustained gains in terms of energy efficiency, and, at the same time, to alleviate various key distortionary tax margins.

A new carbon tax in Portugal with none of the key characteristics needed to ensure a triple dividend was enacted at the beginning of 2015. One can only speculate as to why a proposal formulated by the Commission for Environmental Tax Reform, appointed by the Portuguese government, was completely sidestepped. The economic and budgetary consequences of this fact, however, are clear: the new carbon tax will likely have detrimental effects on both economic and budgetary performance as the counterpart of its possible environmental success. The new carbon tax will ultimately fail to deliver on the second and the third dividend.

The problem may, however, turn out to be even more complex. In fact, because of a number of serious practical shortcomings in its implementation, the positive environmental impact of the new carbon tax could prove to be even smaller than what we simulated, at least in the short run. In its current configuration, rather than being an autonomous levy, the new carbon tax in Portugal is a component of the tax on petroleum products (ISP). The new carbon tax is as hidden and as invisible as a value-added tax. Furthermore, as part of the ISP, it is subject to all types of exemptions that are counterproductive from an environmental perspective. This means that, because the public is largely unaware of its current magnitude, and seems to be completely oblivious to the sharp increase that is built-in for the near future, it is reasonable to conclude that their behavior is unlikely to change very much, making it rather difficult for GHG emissions to fall very significantly over the coming years. Therefore, even a meaningful realization of the first dividend, an environmental dividend, is not a foregone conclusion.

The policy recommendations are clear. To increase the probability of reaching the 2030 target for emissions reductions, and to ensure the realization of a triple dividend associated with the introduction of a carbon tax, Portugal needs to act on three fronts, and urgently amend the law it approved in late 2014. First, it must pass legislation that not only separates the indexed carbon tax from the tax on petroleum products, but also makes it totally comprehensive and visible to the public at large. Second, it must enshrine, as a principle, that all carbon-tax revenues are to recycled back into the economy in the form of lower tax burdens, and back into the environment in the form of financing activities aimed at obtaining further energy-efficiency gains on a consistent basis. Third and finally, the new law must stress that, in order to achieve a more robust triple dividend in terms of better long-term environmental, macroeconomic and budgetary outcomes, there is a need for a mixed revenue-recycling strategy that lowers personal-income taxes, lowers employers' payroll contributions, and increases investment tax credits, and all these have to be closely linked to further promoting energy efficiency.

The longer it takes the Portuguese Parliament to amend the current law, the greater the cost, given that the international price per ton of CO_2 is projected to be on an uptrend, and both economic performance and budgetary consolidation continue to show great debilities, in general. It is therefore crucial that the several problems we highlighted in this note be acknowledged and corrected, sooner rather than later. What are relatively painless mechanisms for achieving the environmental targets, if adopted now, will soon become rather painful, if one waits for too long. Besides, now is the time to seize the opportunity both to secure the recent progress in terms of fiscal consolidation, and to jumpstart economic growth.

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Table 1
Projected reductions of CO_2 emissions from fossil-fuel combustion:
Why a carbon tax is necessary

	(Percent changes relative to 1990 levels)	
	2030	**2050**
Reference Case	**21.70**	**33.29**
Of which:		
Fossil-fuel price (central scenario)	8.03	17.98
Annual energy-efficiency gain of 2%	13.67	15.31
Target set by European Commission (2014c)	**40.00**	**-**

Table 2
Projected reductions of CO_2 emissions from fossil-fuel combustion:
How the Environmental Tax Reform Commission [CRFV] planned to reach the target

(Percent changes relative to 1990 levels)

	2030	**2050**
CRFV's central scenario	**38.54**	**48.31**
Of which:		
Reference Case	21.70	33.29
Indexed carbon tax, as proposed by CRFV (2014)	16.84	15.02
Target set by European Commission (2014c)	**40.00**	**-**

Table 3
Effects of the indexed carbon tax under alternative revenue-recycling mechanisms, with an additional annual energy efficiency gain of 1%

(Percent changes relative to the Reference Case)

			First dividend:		***Second dividend:***				***Third dividend:***	
			Carbon Dioxide Emissions [1]		Employment		GDP		Public Debt / GDP [2]	
ITC Share	**SSC Share**	**PIT Share**	**2030**	**2050**	**2030**	**2050**	**2030**	**2050**	**2030**	**2050**
0.50	0.00	0.50	-38.50	-48.25	0.04	0.33	0.02	0.76	-0.48	-0.27
0.50	0.50	0.00	-38.57	-48.37	-0.08	0.18	-0.07	0.59	-0.98	-2.67
0.50	**0.25**	**0.25**	**-38.54**	**-48.31**	**-0.02**	**0.26**	**-0.02**	**0.68**	**-0.73**	**-1.47**

[1] Percent changes relative to 1990 levels.
[2] Changes in percentage points.

Table 4
Effects of the indexed carbon tax, with no revenue recycling and no further energy-efficiency gains: Moving from the Commission's plan to what was approved by Parliament

(Percent changes relative to the Reference Case)

Case	***First dividend:*** Carbon Dioxide Emissions [1]		***Second dividend:*** Employment		GDP		***Third dividend:*** Public Debt /GDP [2]	
	2030	**2050**	**2030**	**2050**	**2030**	**2050**	**2030**	**2050**
CRFV's plan (ITC, SSC & PIT recycling)	**-38.54**	**-48.31**	**-0.02**	**0.26**	**-0.02**	**0.68**	**-0.73**	**-1.47**
... But limiting revenue recycling to PIT	-38.52	-48.77	0.47	0.46	0.00	0.00	-0.41	-0.26
... But limiting revenue recycling to PIT, without any further energy-efficiency gains	-34.32	-44.85	0.54	0.46	-0.25	-0.44	0.55	2.10
... But limiting revenue recycling to 2015	-34.83	-45.66	-0.31	-0.57	-0.92	-1.55	1.74	3.96
The Law, as approved by Parliament	**-34.83**	**-45.66**	**-0.31**	**-0.57**	**-0.92**	**-1.55**	**1.74**	**3.96**

[1] Percent changes relative to 1990 levels.
[2] Changes in percentage points.