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Assessing the Efficiency and Fairness of the Fit for 55 Package toward Net Zero Emissions under Different Revenue Recycling Schemes for Italy

Carlo Orecchia
Valerio Ferdinando Cala
Fabiana de Cristofaro
Hasan Dudu

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Abstract

One of Italy's key objectives is to reform and modernize the tax system to increase tax efficiency and improve environmental sustainability and regional economic outcomes, in line with the European Union strategy. Within the framework of the European Green Deal, Italy is committed to contributing to the goal of becoming the first climate neutral region by 2050 (the "Fit for 55" package). As an intermediate step toward the 2050 target, the European Union must reduce greenhouse gas emissions by at least 55 percent by 2030 compared to 1990 levels. Carbon pricing is at the core of the proposal, but its full implementation is also expected to have regressive effects, harming poorer households, and adverse economic impacts, reducing firms' competitiveness. This paper evaluates the effects of the carbon pricing proposal of the "Fit for 55" package on welfare, sectoral production, and income distribution. To tackle the adverse social and economic effects, it compares different revenue recycling schemes shifting the tax burden from major direct and indirect taxes to carbon emissions. It finds that well-targeted revenue recycling policies might significantly reduce the negative effects. The analysis adopts the Italian Regional and Environmental Computable General Equilibrium of the Department of Finance model, which is a new (recursive) dynamic computable general equilibrium model developed by the Italian Ministry of the Economy with technical assistance from the World Bank. It has a detailed energy specification that allows for capital/labor/energy substitution in production, intra-fuel energy substitution across all demand agents, a multi-output and multi-input production structure, an extended energy system with 11 different types of technologies, multiple households to address distributional impacts, and detailed information on the Italian tax system.

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by

Carlo Orecchia[a], Valerio Ferdinando Cala[a], Fabiana de Cristofaro[a], Hasan Dudu[b]

[a] Department of Finance; Italian Ministry of Economy and Finance, Italy.

[b] International Monetary Fund. Hasan Dudu was with the World Bank during the preparation of the working paper.

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1 Introduction

Green transition is becoming more pressing than ever, both in the context of climate change and in the energy crisis scenario caused by the Russian invasion of Ukraine. To face the climate change challenge, the European Green Deal (see EU 2020), adopted in 2020, sets the path to make the EU's climate, energy, transport, and taxation policies fit for efficiently facing the environmental degradation threat. As part of the European Green Deal, with the European Climate Law, EU Member States agreed on the ambitious target of achieving climate neutrality by 2050, under the so-called "Fit for 55" package. In accordance with this set of measures, as an intermediate step, Member States are pledged to reduce emissions by at least 55% by 2030, compared to 1990 levels. The significant commitment thereof comes as an opportunity for developing new policy evaluation tools, especially in the new energy crisis scenario that seems to undermine the achievement of the ambitious "Fit for 55" goals. The increase in energy prices and the worsening of international relations with the Russian Federation are already influencing economic activity, employment, and household living conditions so that new policy strategies are needed. Developing and testing new economic models featuring detailed energy structure can play an important role in designing quick policy responses and assessing options for the energy crisis.

This paper has two main research objectives, which are novel contributions to the existing literature. From a methodological perspective, we present the Italian Regional and Environmental Computable General Equilibrium of the Department of Finance (IRENCGE-DF, henceforth), which seeks to answer to the new current policy needs. As we shall see, IRENCGE-DF's structure makes it very topical and extremely useful for analyzing different policy scenarios coming either from the EU legislation or from the international political scenario. The IRENCGE-DF is a single-country CGE model with regional and environmental modules, tailored to the specific Social Accounting Matrix (SAM) built for Italy. It is a multi-sector, multi-household CGE model, based on a set of equations which aim to capture the structure of the economy and behavioral response of agents such as firms, households, government, and the rest of the world. This provides a very rich framework to simulate the policy changes and trace the impact on the key economic variables, including income and expenditure flows. The model incorporates an environmental module which features a detailed energy specification that allows for capital/labor/energy substitution in production, intra-fuel energy substitution across all the demand agents, a multi-output multi-input production structure, an energy system extended with 11 different types of technologies including renewable and clean energy, and an extended environmental policy that can allow simulation of the effects of carbon tax and carbon emission on different sectors.

From a policy perspective, the comprehensive environmental and tax structure of the IRENCGE-DF model makes it well suited for analyzing a wide range of policy scenarios. In particular, the “Fit for 55” package is analyzed in the model by limiting the level of emissions and letting the model calculate the endogenous price consistent with this cap. Thanks to the extensive focus on tax modeling, the IRENCGE-DF model is able to properly fit scenarios with new structures of tax rates based on the energy content and environmental performance of the fuels and electricity and also to simulate broader taxable bases by including more products in the scope and by removing some of the current exemptions and reductions. Several simulation scenarios will be discussed in the following sections.

The remainder of the paper is organized as follows. In Section 2, we present the data and methodology, reviewing the main aspects of the IRENCGE-DF model. In the Section 3, we present the results of our policy simulations. The final section concludes with some policy implications.

2 Data and Methodology

2.1 SAM Construction

The model is calibrated on the 2017 SAM. We update the benchmark data to 2020 by using macroeconomic variations resulting from the latest public economic and financial documents (i.e. Italian annual budget law, etc.).

The information contained in the SAM is obtained by combining national account data, such as the national account matrix for 2014, supply-use tables for 2017, and Eurostat data. In addition, we integrate missing information with data from tax returns available at the Department of Finance.

National accounts data provide detailed information on the final and intermediate consumption at activity and commodity levels, though they do not contain detailed information on taxation. Hence, we use the tax return data to distribute taxes and subsidies per commodity. In Table 1, we provide a description of the sets and structure used in the analysis. For the purpose of this study, the SAM distinguishes between 77 activities, 68 commodities, 10 household groups and 10 tax categories.

Table 1: Sets used in model definition

Set	Description
$\boldsymbol{is}$	Full set of SAM Accounts
$\boldsymbol{aa}(\boldsymbol{is})$	Set of Armington agents—includes all production activities and final demand
$\boldsymbol{a}(\boldsymbol{aa})$	Set of production activities
$\boldsymbol{oa}(\boldsymbol{aa})$	Other Armington agents—mostly final demand accounts
$\boldsymbol{fd}(\boldsymbol{oa})$	Final demand accounts (excludes the trade and transport margin accounts)
$\boldsymbol{h}(\boldsymbol{oa})$	Household accounts
$\boldsymbol{f}(\boldsymbol{oa})$	Other final demand accounts
$\boldsymbol{i}(\boldsymbol{is})$	Commodities
$\boldsymbol{e}(\boldsymbol{i})$	Energy commodities
$\boldsymbol{in}(\boldsymbol{i})$	Non-energy commodities
$\boldsymbol{k}$	Consumed commodities
$\boldsymbol{nrg}(\boldsymbol{k})$	The energy bundle in consumed commodities
$\boldsymbol{inst}(\boldsymbol{is})$	Institutions (for transfers)
$\boldsymbol{fp}(\boldsymbol{is})$	Factors of production
$\boldsymbol{l}(\boldsymbol{fp})$	Labor categories
$\boldsymbol{ul}(\boldsymbol{l})$	Unskilled labor types
$\boldsymbol{sl}(\boldsymbol{k})$	Skilled labor types
$\boldsymbol{lnd}(\boldsymbol{fp})$	Land types
$\boldsymbol{cap}(\boldsymbol{fp})$	Capital types
$\boldsymbol{v}$	Vintages (Old and New)

Table 2: sectoral coverage

Agriculture	**Sewerage-Waste**
Forestry	Construction
Fishing	Trade-of-motor-vehicles
Mining	Wholesale-trade
Coal	Retail-trade
Oil	Land-transport
Gas	Water-transport
Food-products	Air-transport
Textiles	Warehousing-and-stransportation
Wood	Postal
Paper	Accommodation-food-serv
Printing	Publishing
Coke-and-pp	Motion-picture-TV
Chemicals	Telecommunications
Pharmaceutical	Computer-prog-Information-serv
Rubber-and-plastic	Financial-serv
Non-metallic-mineral-products	Insurance
Basic-metals	Aux-to-financial-svcs-insurance
Metal-products	Real-estate

Computer-electronic	Legal-accounting-consultancy
Electrical-equipment	Architectural-engineering
Machinery-Equipment-nec	Scientific-research-development
Motor-vehicles-trailers	Advertising
Other-transport-equipment	Other-professional-Veterinary
Furniture-Other-manufacturing	Rental-leasing
Repair-installation	Employment-activities
Transmission and Distrib.	Travel-agency-Tourism
CoalBL	Other-serv
GasBL	Public-administration
WindBL	Education
HydroBL	Health
OilBL	Residential-care
OtherBL	Creative-arts-cultural
GasP	Sports
HydroP	Membership-organisations
OilP	Repair-of-computers-and-personal-goods
SolarP	Other-personal-serv
Gdt	Households
Water	

Taxes

Information on major taxes in Italy is obtained by reconciling tax return data with information from Istat (the Italian National Institute of Statistics) national accounts. Among commodity taxes in the model, the following are explicitly considered:

- Value Added Tax (VAT), whose aggregate amount is published by the Istat, is allocated by commodity according to the VAT Microsimulation Model developed by the Department of Finance (DF). The VAT DF Microsimulation Model estimates VAT by commodity distinguishing between final consumption of households, intermediate goods and capital goods.
- Excises, published by Istat with the details of the goods they are imposed on, have been allocated by commodity accordingly and associated to both intermediate and final consumption using the use table from Istat.
- Tariffs on Imports are computed by applying estimated import tariffs to imports.
- Other Net Tax on Products (other indirect taxes less subsidies on products) are calculated as a residual by subtracting VAT, excises and tariffs on imports by commodity from the net indirect taxes on products published by Istat in the Supply table for 2017.

Taxes by activity explicitly considered are the following:

- Corporate income tax IRES ("Imposta sul reddito delle società") and the regional production tax IRAP ("Imposta regionale sulle attività produttive") are added together and disaggregated by activity using tax return data available at DF (the Department of Finance). The implicit tax rates are calculated using the operating surplus as a tax base and will increase the cost of capital used by each firm.
- Social Security contributions paid by the employer (SSCs Employer) are retrieved from the use table, defined as the difference between employee income of regular workers and gross wages by sector of economic activity; subsequently, this value is classified according to the type of skill category: low skilled, skilled, and high skilled.
- Other taxes on production are published by Istat by sector. As IRAP is considered with IRES as a separate entry in the SAM, its amount is subtracted to obtain the other taxes on production as the residual value.

Finally, households' direct taxes are included in the model and treated as a single entry that combines income taxes (imposta sui redditi delle persone fisiche (IRPEF)) and IRPEF surcharges, substitutive taxes (forfeit mixed, rents, capital income taxes etc.) and other special regimes and social security contribution paid by the employee.

2.2 The IRENCGE-DF Model

Model Overview

The Italian Regional and Environmental Computable General Equilibrium of Department of Finance (IRENCGE-DF) Model is a (recursive) dynamic single country computable general equilibrium (CGE) model that is developed by the Italian Ministry of the Economy with technical assistance from the World Bank. It is based on the MANAGE-WB model of the World Bank (World Bank, 2023), which is in turn based on the MANAGE model that is documented in van der Mensbrugghe (2021).

IRENCGE-DF is designed to focus on energy, emissions and climate change. In addition to the standard features of a single country CGE model, the IRENCGE-DF model includes a detailed energy specification that allows for capital/labor/energy substitution in production, intra-fuel energy substitution across all demand agents, and a multi-output multi-input production structure. Furthermore, the model introduces household heterogeneity to better analyze the impacts of environmental and energy policies on welfare and inequality and disaggregates the representative household into ten household groups. The sources of income and consumption structure reflect the information coming from statistical households' surveys. Labor growth is exogenous. Capital accumulation derives from savings/investment decisions. The model has a vintage structure for capital that allows for putty/semi-putty assumptions with sluggish mobility of installed capital.

The model allows for a wide range of productivity assumptions that include autonomous improvements in energy efficiency that can differ across agents and energy carriers. The model can be calibrated to different SAMs that follow a standard set of conventions in representing the economic structure. The model is implemented in the General Algebraic Modeling System (GAMS) software and an aggregation facility is used as a front-end to the model to allow for full aggregation flexibility.

Model Description

The IRENCGE-DF model is a recursive dynamic computable general equilibrium (CGE) model. Each year, a scenario is solved as a static equilibrium, with dynamic equations linking exogenous factors (such as population growth and capital accumulation) across years with, in addition, update equations for productivity factors. Each static equilibrium relies on a relatively standard set of equation specifications.

Production is modeled using a series of nested constant-elasticity-of-substitution (CES) functions designed to capture the substitutions and complements across the different inputs, notably capital and labor, but also with a focus on energy as energy policies are one of the key objectives of the IRENCGE-DF model. Energy is assumed to be a near-complement with capital in the short-run, but a substitute in the long-run. Thus, rising energy prices tend to lead to rising production costs in the short-run when substitution is low, but a long-run response would lead to energy-saving technologies that dampen the cost-push factor. This feature of the model is embodied in a vintage capital structure that captures the semi-putty/putty relations across inputs with more elastic long-run behavior as compared to the short-run.

The model allows for both multi-input and multi-output production. The former, for example, would allow for electricity supply to be produced by multiple activities—thermal, hydro, solar and other renewable forms of electricity production. The latter allows for a single activity to produce more than one product—for example, oil seed crushing produces both vegetable oils and oil cakes (for feed).

Labor and capital income are largely allocated to households with pass-through accounts to enterprises. Government revenue is derived from both direct and indirect taxes.

Households are disaggregated into ten income groups and their demand is modeled using the constant-differences-in-elasticity (CDE) demand function that is the standard utility function used in the Global Trade Analysis Project (GTAP) model. The model allows for a different specification of demanded commodities (indexed by k) from supplied commodities (indexed by i). A transition matrix approach is used to convert consumer goods to supplied goods that also relies on a nested CES approach. The transition matrix is largely diagonal in the current version with consumed commodities directly mapped to supplied commodities. Energy demand is bundled into a single commodity and disaggregated by energy type using a CES structure that allows for inter-fuel substitution. Other final demand is handled similarly, though the aggregate expenditure function is a CES function rather than the CDE.

Goods are evaluated at basic prices with tax wedges. The model incorporates trade and transport margins that add an additional wedge between basic prices and end-user prices. The trade and transport margins are differentiated across transport nodes-farm/factory gate to domestic markets and the border (for exports), and from port to end-user (for imports).

Import demand is modeled using the ubiquitous Armington assumption, i.e., goods with the same nomenclature are differentiated by region of origin. This allows for imperfect substitution between domestically produced goods and imported goods. The level of the CES elasticity determines the degree of substitutability across regions of origin. Domestic production is analogously differentiated by region of destination using the constant-elasticity-of-transformation (CET) function. The ability of producers to switch between domestic and foreign markets is determined by the level of the CET elasticity. The model allows for perfect transformation in which case the law-of-one price must hold.

Market equilibrium for domestically produced goods sold domestically is assumed through market clearing prices. By default, the small country assumption is assumed for export and import prices and thus they are exogenous, i.e., export levels do not influence the price received by exporters and import demand does not influence (CIF) import prices. The model does allow for implementation of an export demand schedule and an import supply schedule in which case the terms-of-trade would be endogenously determined.

The current version of the model assumes market clearing wages on the labor markets with the possibility of an upward sloping labor supply schedule and sluggish mobility of labor across sectors. Introduction of more labor market segmentation (for example rural versus urban) and some form of wage rigidity could be readily implemented.

In dynamic simulations, new capital, i.e. that generated by recent investments, is allocated across sectors so as to equalize the rate of return across sectors. Old capital remains installed in its original sector unless the sector is in decline. A sector in decline is one in which potential supply, as measured by the capital/output ratio, exceeds ex post demand. This can occur from a variety of shocks that lower demand for a specific commodity. If a sector is in decline, it releases its installed capital using an upward sloping supply schedule and its ex post return on capital is less than the economy-wide average. Old capital in expanding sectors earns the same rate of return as new capital.

The dynamics of IRENCGE-DF is composed of three elements. Population and labor stock growth are exogenous and the latter is often equated to the growth of the working age population. The aggregate capital stock grows according to the overall level of saving (enterprises, households, public and foreign), but will also be influenced by the investment price index and the rate of depreciation. The third component relies on productivity or TFP (Total Factor Productivity) growth assumptions.

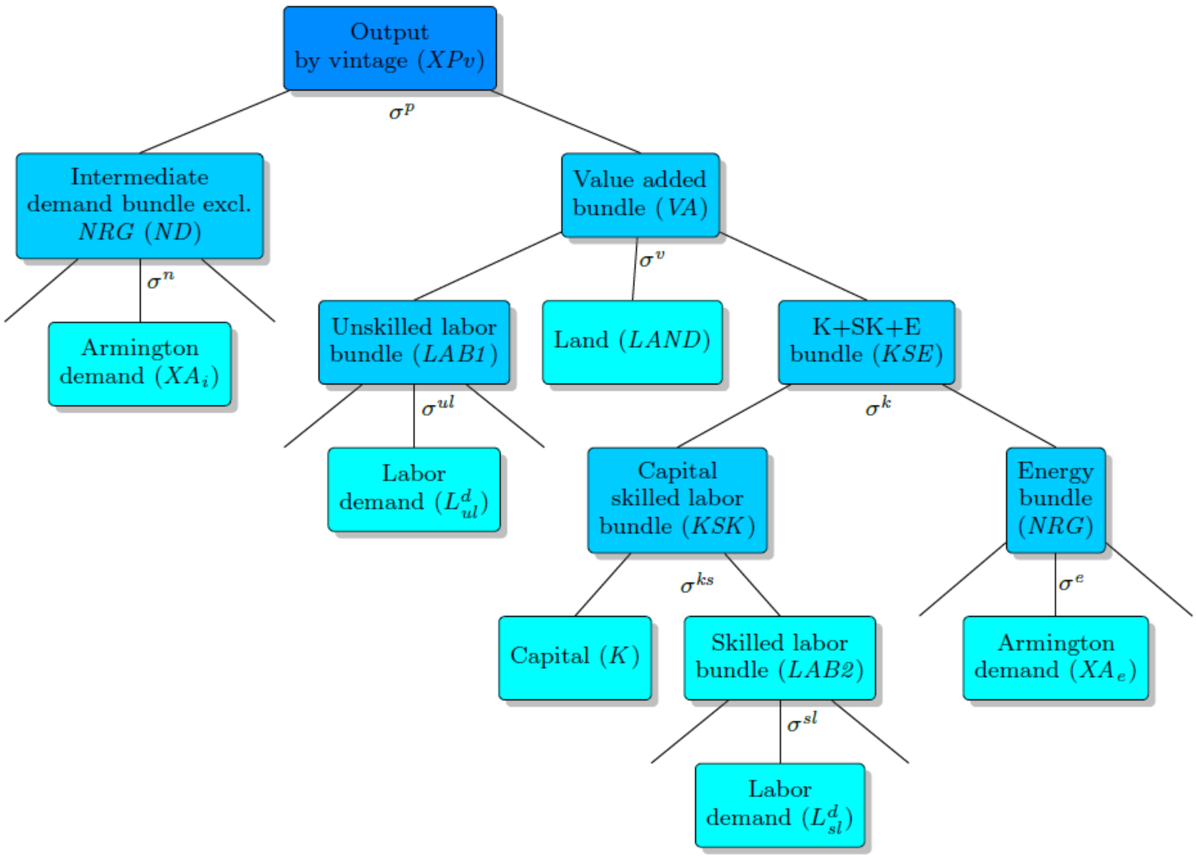


Figure 1. DF-RENVCGE, production function

3. Policy Simulations and Results

Carbon taxes as examples of Pigouvian taxes are powerful instruments to correct market failures and negative externalities adding in the price of products the environmental cost of carbon-intensive activities. In addition, revenues from carbon pricing can be used to lower existing distortionary taxes with the aim of promoting both greater efficiency and equity in the tax system. To evaluate the economic appeal of alternative reforms, we start from a reference scenario (Baseline) that represents future demographic, energy and emissions evolution under current policy legislation. Then a set of policy scenarios are evaluated which implement the climate mitigation measures to achieve the fitfor55 emissions reductions. The policy measures are represented through the introduction of carbon prices and are compared with respect to the baseline scenario to estimate the policy impacts. Scenarios cover the 2021-2030 timeframe.

Scenarios	**Description**
Baseline	Continuation of current policies: 40% reduction in GHGs compared to 1990
Fit55	Increased climate ambition to achieve 55% emissions reduction target
Fit55 – Wage tax	Fit for 55 with additional carbon revenues recycling to reduce Labour taxes (i.e. Social Security Contributions paid by the employer, SSCer) – revenue-neutral reform
Fit55 – CIT	Fit for 55 with additional carbon revenues recycling to reduce corporate income taxes (IRAP and IRES) – revenue-neutral reform
Fit55 – VAT	Fit for 55 with additional carbon revenues recycling to reduce VAT – revenue-neutral reform
Fit55 – Excises	Fit for 55 with additional carbon revenues recycling to reduce Excises – revenue-neutral reform
Fit55 – Income tax	Fit for 55 with additional carbon revenues recycling to reduce households' income taxes - revenue-neutral reform

The baseline scenario replicates trends of the Gross Domestic Product (GDP) from the International Monetary Fund's (IMF, 2021). To capture the expected energy and emission trends, some assumptions on energy-related variables are assumed: costs of renewable electricity generation decline over time, non-price related changes in preferences in favor of renewables, increases in electricity shares for the final and intermediate consumers, improvements in energy efficiency. In addition to these assumptions, in the baseline scenarios we also introduce carbon prices to replicate the current climate targets ambition (see Figure 2). Under these assumptions, GHGs emissions are declining considerably in the baseline scenario to achieve a reduction of at least 40% (from 1990 levels). The fitfor55 policy scenarios raise the 2030 greenhouse gas emission reduction target, including emissions and removals, to at least 55% compared to 1990. The different level of climate ambition in the scenarios can be observed in Figure 3. All “fitfor55” scenarios achieve the same level of GHGs emissions consisting in a reduction of -33% with respect to the baseline scenario.

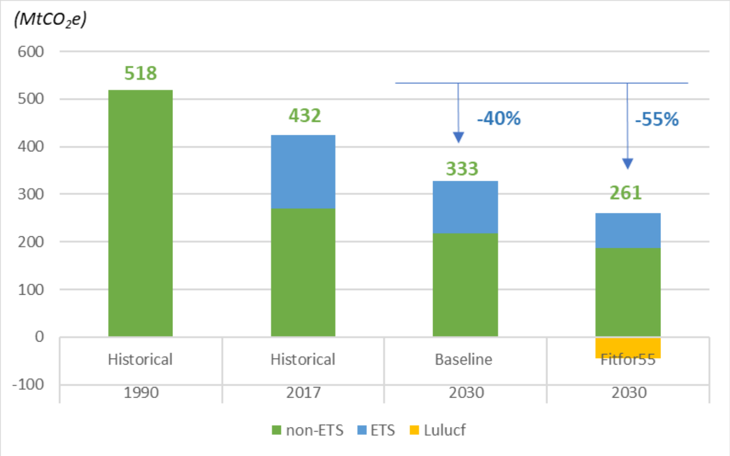
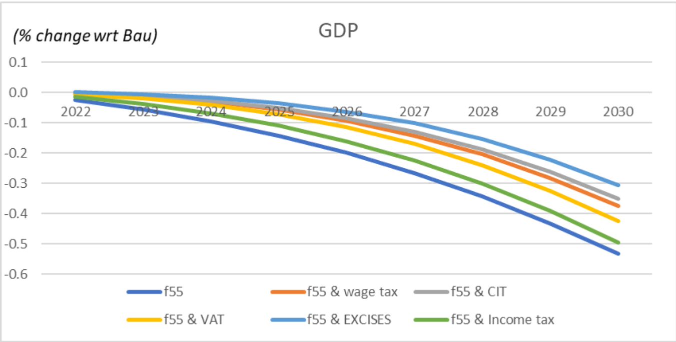


Figure 2: Climate ambition in baseline and fitfor55 scenarios

To tackle the adverse distributional impacts that carbon pricing can have, different recycling schemes are evaluated. In the “Fitfor55” scenario, carbon revenues are not recycled and are used to reduce the government deficit. The other scenarios are instead examples of revenue-neutral tax reform where additional carbon revenues accruing in the fitfor55 scenario are earmarked for the specific purpose of reducing the level of other existing taxes keeping the total government revenues unaffected. In the “Fit55 – Wage tax” scenario, carbon revenues are used to decrease the tax wedge on labor through a reduction of the level of the Social Security Contributions paid by the employer. The third scenario (“Fit55 – CIT”) assumes that carbon revenues are used to reduce corporate taxes (IRES and IRAP) on operating surplus. In the fourth and fifth scenarios, revenues raised are used to reduce the incidence of VAT and excise taxes respectively. Finally, the “Fit55 – Income tax” scenario analyzes a shift of the tax burden from households’ income to carbon emissions.

Looking at the results in Figure 3, while the evolution of emissions in the period is the same across all policy scenarios (see Figure 3 left), abatement costs differ. Carbon price reaches 97 €/tCO2e in the “Fit55”, stays approximately at this level in all scenarios with the only exception being the “Fit55 – Excises” where the carbon price goes up to 105 €/tCO2e.



	Carbon Price in 2030, EUR/tCO2
Baseline	69
f55	97
f55 & wage tax	98
f55 & CIT	98
f55 & VAT	98
f55 & EXCISES	105
f55 & Income tax	98

Figure 3: Emissions pathways and carbon prices in different scenarios

In neoclassical general equilibrium models, taxes are distortionary, and the welfare loss caused by the tax can vary depending on the elasticity of supply and demand with respect to prices. In general, the literature suggests that taxes levied on immovable property or consumption are less distortionary and thus, less harmful to economic growth than those levied on corporate or labor income (Mankiw and others, 2009; Bayar et al. 2021; Slemrod, 1990). Thus, using carbon revenues to reduce pre-existing taxes can improve overall efficiency and reduce welfare losses. In doing so, carbon prices might be higher compared to the scenario without recycling scheme as the reduction in pre-existing capital and labor taxes decrease production costs, increase output and determine higher abatement costs. The carbon price is imposed on all GHGs emissions including the so-called non-CO_2 emissions (i.e. CH_4, N_2O and Fgass) thus improving the overall efficiency of the climate policy (Orecchia and Parrado, 2014). It is worth observing that the reduction of emissions to achieve fitfor55 target leads to a small GDP loss of around -0.5% in 2030 (Table 3). Recycling schemes, where revenues are used to reduce highly distortionary taxes (as excise taxes and factor taxes levied on capital or wages) with an efficient carbon tax on all sectors/commodities, alleviate the negative impacts on employment, investment and consumption. Two scenarios turn out to be the most cost-effective and are the ones where carbon revenues are used to reduce excises and corporate income taxes, with GDP going from -0.5% to -0.3%. The next most favorable recycling mechanism is when revenues are used to reduce labor taxes which stimulates consumption and labor demand.

The result that excises, mostly energy taxes, are found to be highly distortive might depend on a number of reasons. The first reason is "model-based" as the energy bundle is combined with the capital-skilled labor bundle and thus its taxation is as distortionary as that on other primary factors, such as labor and capital. The second relies on the characteristics of excises compared to a uniform carbon price. In fact, the burden of excise taxes varies a lot across different sectors and even across fuels for different uses in each sector (IMF 2022) due to the presence of exemptions and tax expenditures. Moreover, excises are not directly linked to the carbon content of the product. These two aspects deepen the inefficiency across sectors as some incur very high abatement costs to reduce carbon emissions while others do not abate even when their abatement costs are significantly low. On the contrary, with a uniform carbon price endogenously determined by the model, all profit-maximizing firms will reduce emissions up to the point where marginal abatement costs are equal to the carbon tax rate ensuring that the required level of emissions reduction is achieved at least cost. Finally, as shown in Bohringer et al. 2008 and 2016, overlapping regulation can determine efficiency losses as the use of multiple policy instruments to curb greenhouse gas emissions as it is in the presence of a comprehensive emission pricing and energy taxes can cause what is defined as "excess cost". Thus, the cut of energy taxes could reduce this additional cost due to the overlapping regulation.

Table 3: Macroeconomic results in 2030 (% change wrt Baseline)

Scenarios	consumption	gov. Expend.	investment	public investment	export	import	gdp	Gini index *(Average 2022-2030)*
f55	-0.9	-0.5	0.4	-0.5	-1.0	-1.3	-0.5	0.009
f55 & wage tax	-0.6	-0.4	0.1	-0.4	-0.9	-1.2	-0.4	0.004
f55 & CIT	-0.5	-0.3	0.0	-0.3	-0.9	-1.1	-0.3	0.001
f55 & VAT	-0.5	-0.4	-0.6	-0.4	-1.0	-1.3	-0.4	-0.006
f55 & EXCISES	-0.3	-0.3	-0.5	-0.3	-0.8	-1.0	-0.3	-0.004
f55 & Income tax	-0.7	-0.5	-0.1	-0.5	-1.0	-1.3	-0.5	-0.006

In terms of income distribution, we can look at the Gini index (average 2022-2030). From Table 3, we can observe that there are regressive effects on income distribution in the "f55" scenario to comply to the stringent climate policy constraints. The negative impacts on income distribution are reduced in all recycling schemes. The Gini index slightly declines in some scenarios with the largest reductions in the "f55 & Income tax" and "f55 & VAT" recycling schemes where carbon revenues are used to reduce the personal income tax and VAT tax.

In Figure 4, welfare impacts are differentiated across household deciles. We observe that welfare effects differ significantly across households, with poorer households bearing a disproportional impact of climate regulation mostly because poorer households spend on average a larger share of their income on polluting activities.

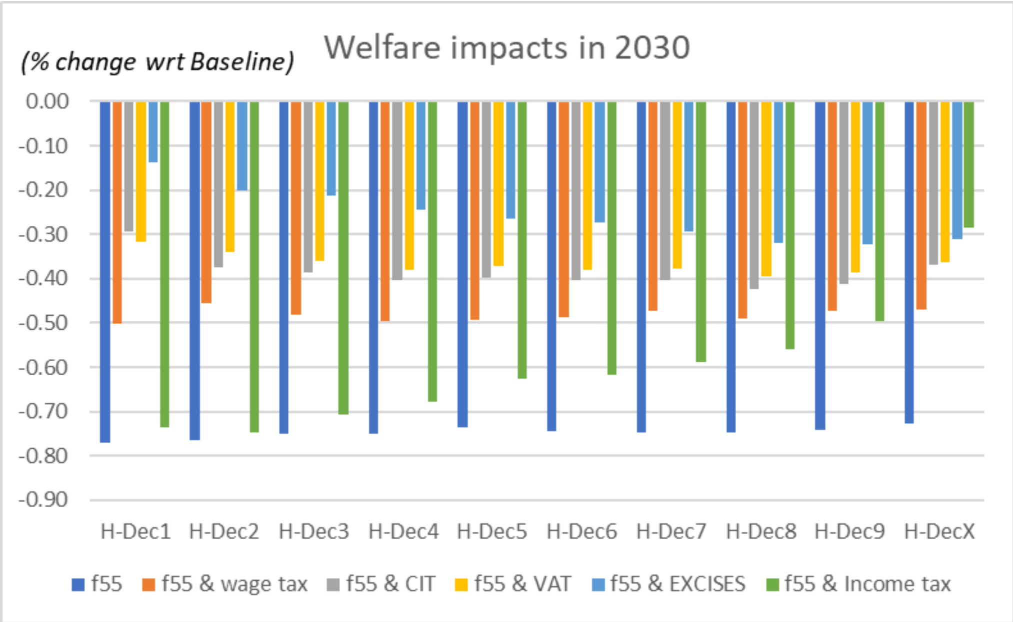


Figure 4 – Welfare impacts in 2030

Turning to the impacts on economic sectors (Figure 5), fossil fuel and energy intensive industries observe the largest reductions in terms of output. The magnitude of the reductions is generally larger in the fitfor55 scenario. In the area of renewable energy, sectors like solar, wind-power and hydroelectric, register positive productions changes ranging between 5% and 9%. It is worth noticing that some other, less carbon intensive sectors are also gaining slightly from the climate policy: among these, textiles, production of machinery equipment and electrical equipment are showing the larger increase.

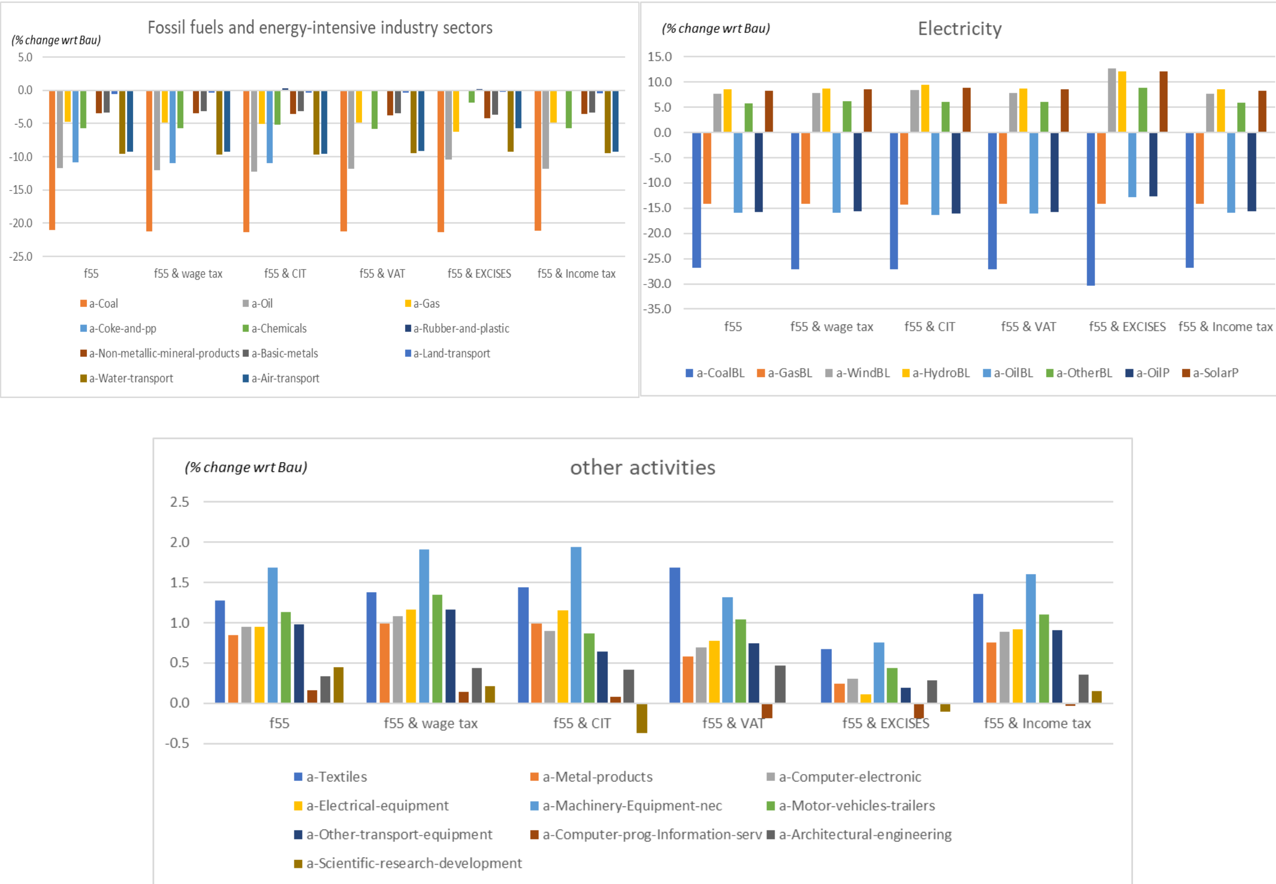


Figure 5 - Sectoral output (% change wrt Baseline)

4. Concluding Remarks

In this paper, we analyzed the effects on the Italian economy of an increasing reduction over time of GHG emissions to meet the target required by the Fit for 55 EU proposal by 2030. We adopt the IRENCGE-DF model, a new (recursive) dynamic computable general equilibrium (CGE) model developed by the Italian Ministry of the Economy and the World Bank. The model endogenously calculates a carbon price to comply with the desired level of emissions abatement simulating the behavior of agents based on optimizing microeconomic theory. Carbon price negatively impacts the performance of the Italian economy, reducing GDP by 0.5% in 2030 compared to our reference scenario. Regressive effects on income distribution are also observed in this scenario considering the change in the Gini index. To tackle the adverse social and economic effects, we compared different revenue recycling schemes shifting the tax burden from major direct and indirect taxes to carbon emissions. It turns out that recycling carbon revenues can significantly reduce the negative impacts on GDP and welfare. In particular, the most cost-effective recycling schemes are with excises and corporate income taxes, with GDP decreasing by -0.5% to -0.3%. Although differences are small in size, the use of carbon revenues to reduce VAT and Personal Income Tax are found to be the most desirable recycling options in terms of equity and income distribution.

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