IMF Country Reports 22/256

Italy: Selected Issues

INTERNATIONAL MONETARY FUND

INTERNATIONAL MONETARY FUND

IMF Country Report No. 22/256

ITALY

SELECTED ISSUES

August 2022

This Selected Issues paper on Italy was prepared by a staff team of the International Monetary Fund as background documentation for the periodic consultation with the member country. It is based on the information available at the time it was completed on July 14, 2022.

Copies of this report are available to the public from

International Monetary Fund • Publication Services
PO Box 92780 • Washington, D.C. 20090
Telephone: (202) 623-7430 • Fax: (202) 623-7201
E-mail: publications@imf.org Web: http://www.imf.org
Price: $18.00 per printed copy

International Monetary Fund
Washington, D.C.

INTERNATIONAL MONETARY FUND

ITALY

SELECTED ISSUES

July 14, 2022

Approved By
The European Department

Prepared by La-Bhus Fah Jirasavetakul, Anna Shabunina, Guillermo Tolosa, Zhongxia (Sam) Zhang (all EUR), Jean Chateau (RES), and Alan Feng (MCM).

CONTENTS

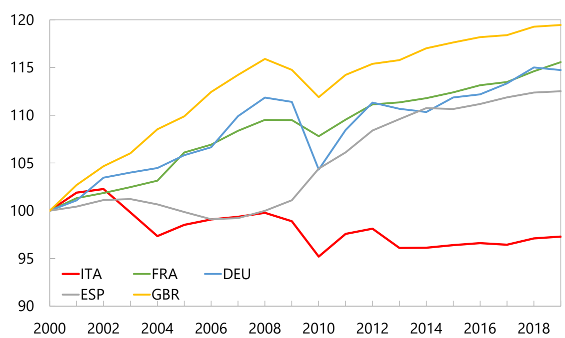
PRODUCTIVITY IN ITALY: SCOPE FOR IMPROVEMENT[1]

This paper investigates the role of structural characteristics on Italy's labor productivity at the regional and sectoral levels. Productivity-enhancing structural factors are found be highly correlated, indicating that reforms are complementary and reinforcing. As a result, a concerted, multi-faceted reform program, as envisaged in the National Recovery and Resilience Plan, would likely be most effective at raising productivity. Improving structural characteristics beyond Italy's national frontier will be crucial to lift productivity towards the level of peer EU countries.

Two Decades of Weak Productivity: Regional and Sectoral Dimensions

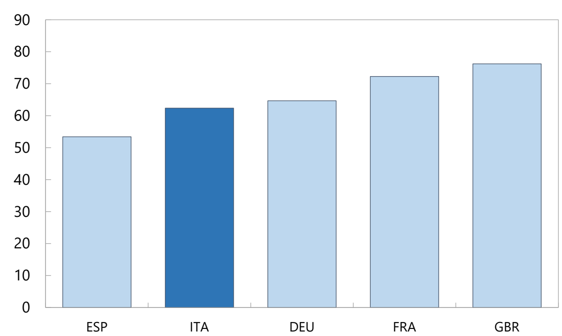
1. **Italy's productivity has been stagnant in recent decades.** Real value added per worker declined by nearly 5 percent, while total factor productivity fell by 13½ percent during 2000–19. Together with the shrinking working-age population, potential growth has been low, and the economy has slowed markedly. Real per capita income in 2019 was about 6 percent below the pre-Global Financial Crisis level. Italy's productivity has also diverged from that of other large European economies.

Labor Productivity
(Real GVA per employment, 2000=100)



Source: Eurostat.

Labor Productivity: 2019
(Real GVA in thousands of euro per employment)



Source: Eurostat.

2. **While the absence productivity growth is a common feature across Italy's regions and economic activities, internal productivity gaps have widened over time.**

- *Regional productivity* is uneven, with Northern regions being more productive than the rest of Italy. Nonetheless, the declining productivity trend is broad based, with Central, Southern and Island regions experiencing the largest productivity declines of 6 and 10 percent, respectively, over the past two decades. Despite being relatively more productive, Northern regions have also seen some weakening in productivity, although with gradual improvements in recent years.

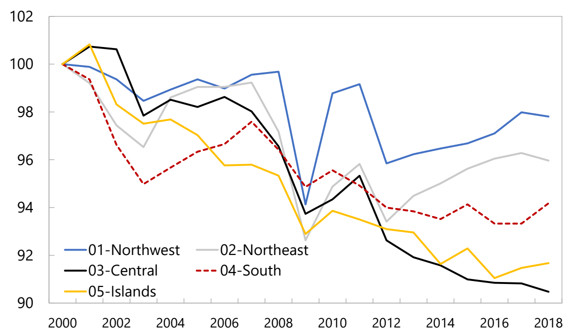
- *Sectoral productivity* differentials are also significant, with several activities displaying declining productivity. In particular, relatively labor intensive and low-skilled construction and arts-and-entertainment have suffered productivity declines of more than 20 percent during 2000–19. Most other sectors have not experienced any significant productivity growth, with the notable exceptions of information and communication technology (ICT), agriculture and, more recently,

[1] Prepared by La-Bhus Fah Jirasavetakul and Zhongxia (Sam) Zhang (both EUR).

industry. However, outperforming sectors of ICT and industry account only for about one-fifth of total value added and employment.

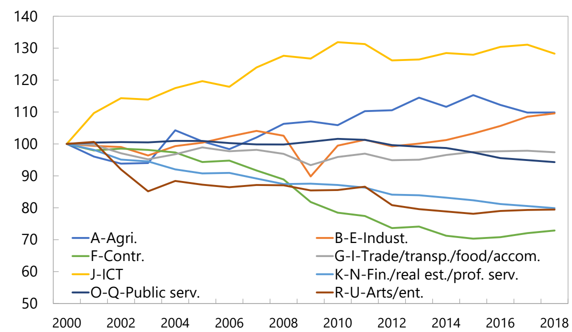
3. The poor productivity of lagging regions reflects both their weaker productivity across most activities and their greater concentration in less-productive activities. Southern and Island regions have aggregate productivity well below the national average, reflecting a faster decline than in other regions. This reflects that these regions: (i) are less productive than others across nearly all activities; and (ii) have a higher concentration in low-productivity activities (such as trade and hospitality, construction, and agriculture), which constitute their main sources of activity and employment. In addition to sectoral specialization, regions also differ greatly by firm size, which can affect their productivity.

Labor Productivity by Region
(Real GVA per employment, 2000=100)



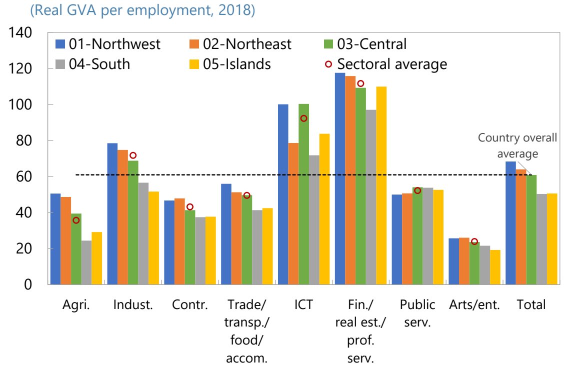
Source: IStat.

Labor Productivity by Sector
(Real GVA per employment, 2000=100)



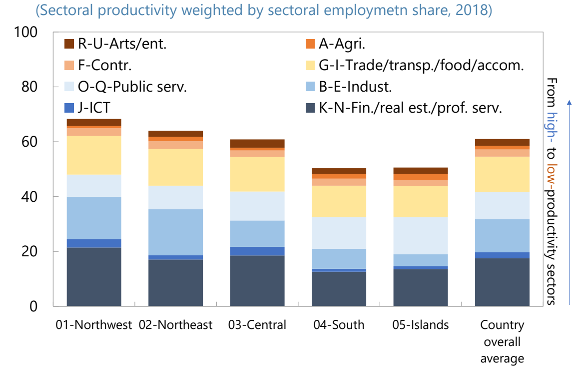
Source: Istat.

Productivity by Region and Economic Activities
(Real GVA per employment, 2018)



Source: Istat.

Contribution to Regional Productivity
(Sectoral productivity weighted by sectoral employmetn share, 2018)



Source: Istat.

Productivity Determinants and their Complementarity

4. The determinants of Italy's low productivity have been well researched in the literature, with individual studies tending to focus only on one or a few causal factors. Using a cross-country or Italy-specific perspective, previous literature has identified numerous structural variables as important contributory factors to productivity[2]—including public sector efficiency,[3]

[2] See Bugamelli and others (2018) for a comprehensive review of the literature on the determinants of Italy's productivity growth.

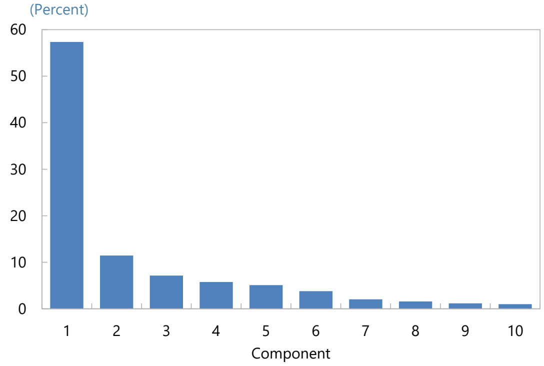
[3] Andrle and others (2018); Albanese and others (2015); Giordano and others (2020); OECD (2021).

quality of the judicial system,[4] regulatory complexity,[5] public capital stock,[6] incentives for innovation and digitization,[7] and labor market and product market regulation.[8] Undertaking reforms to improve these structural characteristics is found to raise productivity. However, each of these factors is assumed to contribute to productivity separately from the others, and even when more than one factor is considered, the possibility that effects could be complementary is overlooked.[9, 10]

5. **However, productivity-enhancing structural characteristics are found to be highly correlated, suggesting that reforms are complementary and reinforcing.** Coe and Snower (1997) recognize the potential reinforcing effects of reforms in the context of labor market policies, which are found to be more effective when coupled with reforms to improve institutional quality. In addition, Blanchard and Giavazzi (2003) find that reforms to enhance product market competition help to facilitate reforms to deregulate the labor market.

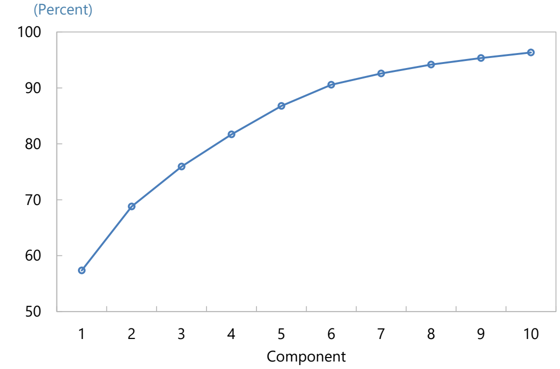
6. **For Italy, over half the informational content from a large set of structural indicators can be described by a single common factor, consistent with high complementarity.** Considering 56 structural indicators across some 21 Italian regions (Table 1) during the years 2015–19[11], and using principal component analysis (PCA, see Box 1), reveals that nearly 60 percent of the total variance in the original 56 series is accounted for by the first principal component (PC1). The vast majority of the corresponding PCA loadings conform with economic intuition (Table 2).

Variance Explained by Principal Components
(Percent)



Source: IMF staff calculations.

Cumulative Variance Explained by Principal Components
(Percent)



Source: IMF staff calculations.

---

[4] Esposito and others (2014); Guiso and others (2015); Giacomelli and Menon (2017); Bank of Italy (2020).

[5] Di Vita (2018).

[6] Marrocu and Paci (2010).

[7] Calligaris and others (2016); Bank of Italy (2020); ECB (2021).

[8] Andrle and others (2018).

[9] For instance, Andrle and others (2018) assume that the productivity gains from individual reforms are additive.

[10] Also, in models where several structural variables are included as explanatory variables, high correlation between structural variables suggests that the individual estimated coefficients will be biased.

[11] While most structural variables are slow moving, average values of structural indicators during 2015–19 are used, to avoid potential variation due to business cycles.

In addition, the explanatory power of the second principal component is considerably lower, indicating that PC1 by itself is a good summary statistic.[12] This in turn, points to the very high correlation among the original 56 structural indicators. PC1 is therefore a good potential candidate for explaining the productivity performance of Italy's regions.

Box 1. Principal Component Analysis of Structural Indicators—Methodology and Data

Principal Component Analysis (PCA) is a statistical method for extracting information from a set of individual, potentially correlated, data. It does so by identifying signals from each of the N original series and transforming them into N new uncorrelated variables ("principal components") that are linear weighted combinations ("loadings") of the original data. Hence, principal components are an ordered sequence of new uncorrelated variables, where the ordering is given by the how much of the variance in the original data is captured by each successive principal component. Hence PCA is a technique for reducing the dimensionality of data while limiting the loss of informational content.

A comprehensive dataset of 56 structural indicators at the regional level was compiled. The set includes both high-level institutional variables (e.g., indicators of the judicial system and government characteristics) in addition outcome variables (e.g., education, health, demographics, R&D, digitization, financial development, banking and corporate sector performance, and social conditions). The dataset encompasses productivity-enhancing indicators considered in the literature, as well as many more. To avoid potential variation due to business cycles (even though structural variables are typically slow moving), average values during 2015–19 are used.

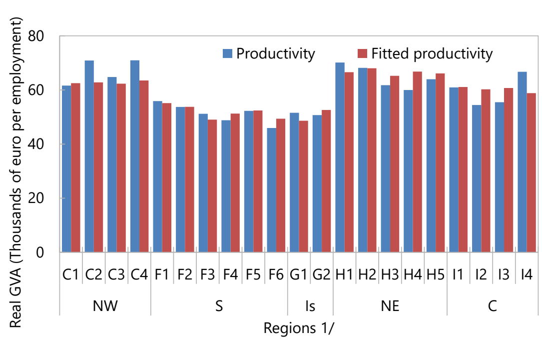
7. **Region-specific values of the first principal component of structural characteristics are found to be strongly correlated with differences in regional productivity.** Simple OLS regressions show that an improvement in a region's PC1 is associated with regional higher productivity, with a high degree of statistical significance. The model also has reasonable goodness of fit, with a larger R-squared value than found in other studies, pointing to the importance for productivity of simultaneously improving multiple structural characteristics. The productivity impacts of PC1 remains significant when using a difference-in-differences approach to mitigate potential endogeneity and reverse causality issues (Box 2).

Regressing Regional Productivity on Principal Components

Dependent variable: Log of Avg. Regional GVA per Employment, 2015-19			
	(1)	(2)	(3)
Principal component 1	0.0199***	0.0199***	0.0199***
	(0.00280)	(0.00286)	(0.00288)
Principal component 2		0.00271	0.00271
		(0.00641)	(0.00645)
Principal component 3			0.00734
			(0.00816)
Constant	4.070***	4.070***	4.070***
	(0.0155)	(0.0158)	(0.0159)
# of observations	21	21	21
R-squared	0.726	0.729	0.741

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Predictive Power



Source: IMF staff calculations.
1/ See Appendeix Table A.1 for region codes.

[12] The first and second components explain about 57 and 11 percent of the variance in the structural indicators, respectively.

Box 2. Impacts of Structural Factors on Productivity at the Regional and Sectoral Levels

The large variation in structural characteristics (measured by PC1) across Italian *regions* and different exposures to the public sector across *economic activities* can be used to assess the causal relationship between PC1 and productivity under a difference-in-differences (DID) framework. In a similar vein to Giordano and others (2020), the identifying assumption is that productivity of sectors that are more dependent on the public sector (for example, due to licensing and permits issued by public administration) would be more affected by PC1 (especially for structural factors that are related to institutional quality). The causal effects of PC1 can then be captured by the cross-region difference in productivity gaps between sectors with high and low exposure to the public sector. In this context, the degree of exposure to the public sector can be regarded as "treatment intensity" and PC1 as the "treatment" variable. The reduced-form DID regression can be written as:

$$Y_{i,s} = \beta \cdot PC1_i + \alpha \cdot PC1_i \cdot GExp_{(i),s} + \boldsymbol{\theta} \cdot \boldsymbol{X}_{i,s} + \varepsilon_{i,s}$$

where $Y_{i,s}$ is (2015–19 average) productivity (measured by real GVA per employment) in region i and sector s; $PC1_{i,t}$ is the first principal component of the 56 structural indicators (as described and computed in Box 1); $GExp_{(i),s,t}$ is (region- and) sector-specific exposure to the public sector; and $\boldsymbol{X}_{i,s,t}$ is a vector of sector- and region-specific control variables. Several variables are used to measured regional and sectoral exposure to the public sector, including the contribution of public services in each of the sectoral productions from the input-output table (OECD. 2021) and the share of public employment in a region (Eurostat, 2020).

Empirical results highlight the positive relationship between the first component of structural indicators and labor productivity. A unit improved in the first principal component of structural indicators is associated with nearly two percent increase in the regional productivity for a specific sector. Having higher exposure to the public sector could boost the impacts of better structural indicators on productivity by another 0.1–0.3 percent. The results are robust to various definitions of exposure to the public sector, and inclusions of control variables and regional and sectoral fixed effects.

Italy: Difference-in-differences Regression of Sectoral and Regional Productivity

	Dependent variable: Log of (5Y avg. of) sector- and region-specific GVA per					
	(1)	(2)	(3)	(4)	(5)	(6)
PC1	0.019***	0.014*	0.024***	0.019**	0.019**	0.019**
	(0.002)	(0.008)	(0.003)	(0.009)	(0.009)	(0.009)
PC1 # GExp1			0.001***	0.001***		
			(0.000)	(0.000)		
PC1 # GExp2					0.003***	
					(0.001)	
PC1 # GExp3						0.003***
						(0.001)
Agg. region fixed effects	No	Yes	No	Yes	Yes	Yes
Sector fixed effects	No	Yes	No	Yes	Yes	Yes
# observation	168	168	168	168	168	168
R2	0.0488	0.911	0.0565	0.918	0.917	0.917

Note: 1/ * p<0.1; ** p<0.05; and *** p<0.01.

Simulating Effects of Structural Improvements

8. **The estimated empirical model can be used to simulate the effect of improvements in structural characteristics on productivity.** Holding the regional economic structure fixed and using the estimated productivity impacts of structural characteristics from the DID model, two scenarios are considered:

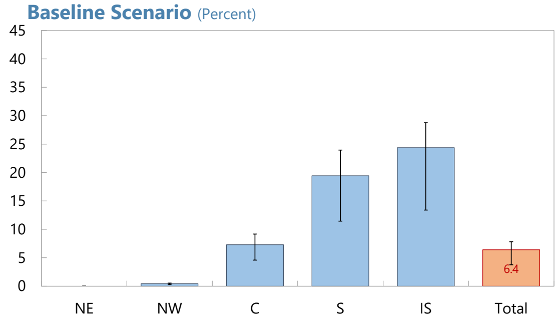
- Each region is assumed to improve its composite indicator of structural characteristics by one quintile. This would raise within-sector productivity by about 20 percent in the South and the Islands and by nearly 10 percent in the Central region, lifting Italy-wide labor productivity by about 6½ percent. This goal is equivalent to assuming that regions improve their structural factors incrementally (i.e., by one quality notch to the next better-performing regional peer) and should be relatively easy to achieve.

- A more challenging target would be for each region to lift its composite indicator of structural characteristics to the 80th percentile of the national frontier. This would raise Italy-wide labor productivity by about 10¾ percent.[13]

9. There is also significant room to expand the national frontier, which would bring larger improvements in productivity. Even in Italian regions with the highest value of the composite structural indicator, structural characteristics (such as quality of government and perception of corruption) still lag well behind other EU peers. Therefore, progressing the national frontier and toward the best performing EU countries could raise productivity by considerably more.

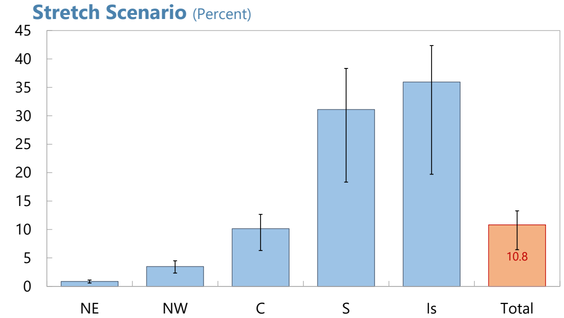
10. Nonetheless, it is important to note that these simulations are based on a reduced-form model and therefore cannot provide information on transmission channels. A "structural" model would be needed to better understand how reforms affect productivity. In this regard, Bugamelli and others (2018) consider how structural determinants affect aggregate productivity by influencing within-firm productivity, reallocation of resources across firms, and the creation and demise of firms.

Productivity Gains from Improving Structural Indicators: Baseline Scenario (Percent)



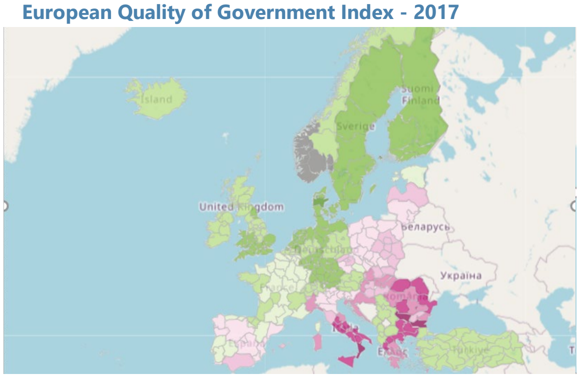
Source: IMF staff calculations.
Note: NUTS2 regions are assumed to improve their PC1 by one quintile.

Productivity Gains from Improving Structural Indicators: Stretch Scenario (Percent)



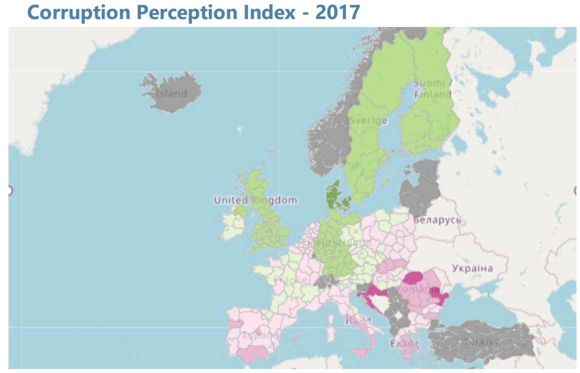
Source: IMF staff calculations.
Note: NUTS2 regions are assumed to improve their PC1 towards 80th percentile.

European Quality of Government Index - 2017



Note: Dark green=high gov. quality; dark pink=low gov. quality.
Source: University of Gothenburg's Quality of Government indicators.

Corruption Perception Index - 2017



Note: Dark green=high gov. quality; dark pink=low gov. quality.
Source: University of Gothenburg's Quality of Government indicators.

[13] Alternatively, one could consider a scenario where productivity in all regions increases to levels in regions with the highest value composite structural indicator (i.e., Emilia-Romagna and Lombardia). This would result in a somewhat larger increase in productivity.

Conclusion and Policy Implications

11. Productivity differences across regions and sectors reflect variation on an array of correlated structural characteristics, suggesting the need for a comprehensive reform push. A wide range of structural characteristics is relevant for labor productivity, and their effects are complementary, rather than additive. This suggests that a concerted, multi-faceted reform program—rather than a series of sequential reforms—would be most effective. Italy's National Recovery and Resilience Plan, which encompasses a comprehensive program of reforms and investment spending, is therefore well designed to raise labor productivity and potential growth. However, while catching up to the national frontier of best practice on structural characteristics is a crucial interim step, pushing out the national frontier is key to lifting productivity to the level of peer EU countries.

Table 1. List of Italian Regions

Code	Area	Region
C1	Northwest	Piemonte
C2	Northwest	Valle d'Aosta
C3	Northwest	Liguria
C4	Northwest	Lombardia
F1	South	Abruzzo
F2	South	Molise
F3	South	Campania
F4	South	Puglia
F5	South	Basilicata
F6	South	Calabria
G1	Islands	Sicilia
G2	Islands	Sardegna
H1	Northeast	Bolzano, Trentino Alto Adige
H2	Northeast	Trento, Trentino Alto Adige
H3	Northeast	Veneto
H4	Northeast	Friuli-Venezia Giulia
H5	Northeast	Emilia-Romagna
I1	Central	Toscana
I2	Central	Umbria
I3	Central	Marche
I4	Central	Lazio

Table 2. Variable Loadings in the First Principal Component

High-level institutional variables	Local government	Staff of local authorities per 100,000 inhabitants	-0.12
		Staff of local authorities age 60+ (percent)	-0.13
		Staff of local authorities with tertiary education	0.04
		Companies owned by local administrations per million inhabitants	0.16
		ROA of active non-financial companies owned by local authorities	0.16
		European Quality of Government index	0.15
		Regional Competitiveness Index	0.16
		European regional Social Progress Index	0.14
	Judiciary system	Duration of civil proceedings SICID	-0.14
Outcome variables	Education	Share of students with adequate Italian	0.17
		Share of students with adequate math	0.16
		Early exit rate from the education system	-0.17
		Population of 25 to 64 years with tertiary education level	0.11
		Share of Labour Force with Tertiary Education	0.04
		Share of Labour Force with Secondary Education	0.13
		Share of Labour Force with Elementary Education	-0.12
		Share of 18-24 year-old not in education, unemployed or inactive	-0.17
	Health	Percentage of obese people	-0.11
		Percentage of smokers	-0.05
		Percentage of people subjects with alcohol consumption risk	0.16
		Rate of at least two chronic conditions	-0.16
		Difficulty in accessing pharmacies	-0.17
		Difficulty accessing the emergency room	-0.16
		Number of community hospitals per 100,000 inhabitants	0.14
	Demographics	Fertility rate	0.09
		Infant mortality rate	-0.09
		Life Expectancy at Birth	0.13
		Share of Elderly Population	0.07
		Dependency Ratio	0.12
	R&D	Patent applications to the EPO	0.14
		R&D personnel (percent of population in the labor force)	0.13
		R&D Total Personnel Rate (in % of total employment)	0.12
	Digitalization	share of customers with home banking agreements	0.07
		share of online transfers	-0.09
		Households with access to the internet at home	0.16
		Households with broadband access	0.15
	Financial development	Bank loans to the private sector (percent of GDP)	0.05
		Bank branches per 100,000 inhabitants	0.16
	Banking and corporate sector	Companies with loans on COVID moratoria or guarantees	-0.16
		share of undercapitalized companies	-0.14
		NPL ratio	-0.13
		Birth rate of enterprises	-0.15
		Death rate of enterprises	-0.15
	Social conditions and crimes	Population at risk of poverty or social exclusion	-0.17
		Population at-risk-of-poverty	-0.17
		Population living in severe material deprivation	-0.15
		Food poverty rate	-0.06
		Number of Robbery Crime per 100,000 inhabitants	-0.07
		Long-term unemployment (percent of labour force)	-0.17
		Social services and benefits of municipalities (percent of GDP)	0.06
		Rate of undeclared work	-0.16
		Gini coefficient after taxes and transfers	-0.12
		Gini coefficient before taxes and transfers	-0.14
		Crude Death Rate (deaths for 1000 population)	0.05
		population)	0.16
		Inter-regional mobility rate (percent, new comers over population)	0.12

Note: mid blue = loading > 0.1 in absolute value and of correct sign; pale blue = loading < 0.1 in absolute value and of correct sign; and white = sign not as expected.

Source: IMF staff calculations.

References

Acemoglu, Daron and Simon Johnson, 2005, "Unbundling Institutions", Journal of Political Economy, Volume 113, Number 5.

Acemoglu, Daron, Simon Johnson, and James Robinson, 2005, "Institutions as a Fundamental Cause of Long-run Growth", Aghion, Philippe and Stephen Durlauf (eds.) Handbook of Economic Growth. North Pole: 2005, Chapter 6.

Albanese, Giuseppe, Guido de Blasio, and Andrea Locatelli, 2019, "Place-based Policy and Local TFP", Bank of Italy Working Paper No. 1253.

Andrle, Michal, Alvar Kangur, and Mehdi Raissi, 2018, "Italy: Quantifying the Benefits of a Comprehensive Reform Package", IMF Working Paper 18/60.

Bank of Italy, 2021, “2020 Annual Report”, Riquadro: gli effetti delle riforme sulla produttivita e sulla crescita evidenze per l'Italia.

Blanchard, Olivier and Francesco Giavazzi, 2003, "Macroeconomic Effects of Regulation and Deregulation in Goods and Labor Markets", Quarterly Journal of Economics, 118(3), 879–907.

Bugamelli, Matteo, Francesca Lotti, Monica Amici, Emanuela Ciapanna, Fabrizio Colonna, Francesco D’Amuri, Silvia Giacomelli, Andrea Linarello, Francesco Manaresi, Giuliana Palumbo, Filippo Scoccianti, and Enrico Sette, 2018, "Productivity growth in Italy: a tale of a slow-motion change", Bank of Italy Occasional Paper, No. 422, January 2018.

Calligaris, Sara, Massimo Del Gatto, Fadi Hassan, Gianmarco I.P. Ottaviano, and Fabiano Schivardi, 2016, "Italy's Productivity Conundrum. A Study on Resource Misallocation in Italy", Economic and Financial Affairs Discussion Paper 30.

Coe, David, and Dennis J. Snower, 1997, "Policy Complementarities: The Case for Fundamental Labor Market Reform", IMF Staff Paper, 44 (1), 1–35.

Di Vita, Giuseppe, 2018, "Institutional quality and the growth rates of the Italian regions: the costs of regulatory complexity", Papers in Regional Science, Volume 97 Number 4, November 2018.

Esposito, Gianluca, Sergi Lanau, and Sebastiaan Pompe, 2014, "Judicial System Reform in Italy", IMF Working Paper 14/32.

European Central Bank, 2021, "The impact of the COVID-19 pandemic on labour productivity growth", ECB Economic Bulletin, Issue 7/2021.

European Commission, 2021, "Quarterly Report on the Euro Area, Chapter 1, An overview of the economics of the Recovery and Resilience Facility", Volume 20, No 3.

Giacomelli, Silvia, and Carlo Menon, 2017, "Does weak contract enforcement affect firm size? Evidence from the neighbour's court", Journal of Economic Geography, Pages 1251–1282.

Giordano, Raffaela, Sergi Lanau, Pietro Tommasino, and Petia Topalova, 2020, "Does Public Sector Inefficiency Constrain Firm Productivity? Evidence from Italian Provinces", International Tax and Public Finance 2020 27:1019–1049.

Guiso, Luigi, Paola Sapienza, and Luigi Zingales, 2015. "Corporate Culture, Societal Culture, and Institutions" American Economic Review, 105 (5): 336–39.

Marrocu, Emanuela and Raffaele Paci, 2010, "The effects of public capital on the productivity of the Italian regions", Applied Economics, 2010–42, Pages 989–1002.

OECD, 2021, OECD Economic Surveys: Italy 2021, OECD Publishing.

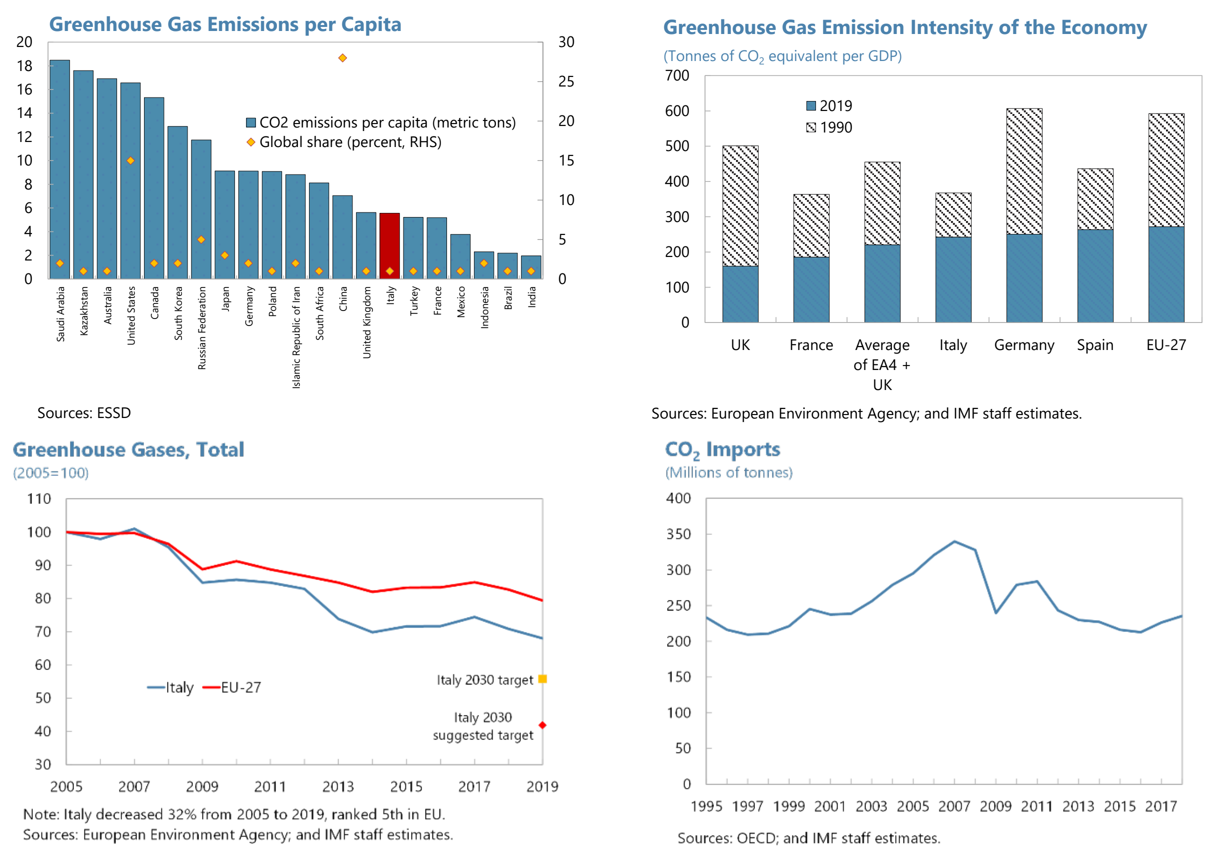
SECURING A SMOOTH GREEN TRANSITION[1]

Italy met its past climate targets thanks to a set of supportive policies but also reflecting subdued GDP growth. Going forward, it will need to step up significantly the pace of decarbonization while also facing the challenging energy security environment. The new environment will likely bring a lasting increase in fossil fuel prices, which should strengthen incentives for green investments. Green investments will be further supported by the decline in the cost of green technologies as well as the National Recovery and Resilience Plan (NRRP) investments. Nevertheless, meeting the climate goals will require important enhancements to the existing policy framework and restructuring carbon taxation.

A. Progress and Targets

1. **Italy has made notable progress with reducing carbon emissions, partly reflecting the subdued performance of the economy.** Italy's per capita emissions are in line with the average of the four largest European economies, and below those of most other G-20 countries. Despite being a relatively low emitter in 1990, total greenhouse gas (GHG) emissions have fallen since then by a further 27 percent, with most of the progress achieved during 2009–14. These reductions

Text Figure. Italy: Greenhouse Gas Emissions

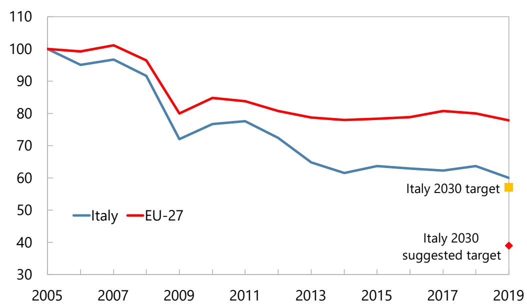


[1] Prepared by Jean Chateau (RES), Alan Feng (MCM), Anna Shabunina, Guillermo Tolosa, and Zhongxia (Sam) Zhang (all EUR).

occurred without raising the emissions-content of imports. However, progress was partially driven by Italy's slow GDP growth, while reductions in the emissions intensity of output have been smaller than for peers.

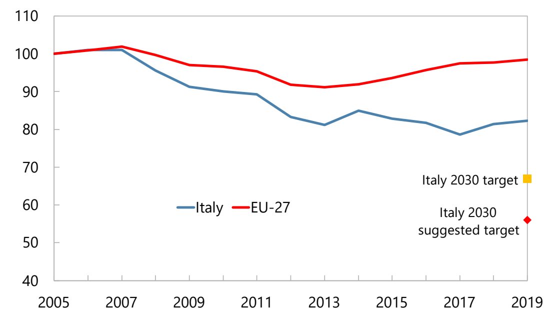
2. **Greenhouse gas reductions have been uneven across sectors.** The power and manufacturing sectors, which are subject to the European Union's Emissions Trading System (ETS), have delivered the largest reductions in emissions and are closer to meeting existing sectoral targets for 2030 (see text charts, which also include estimates of the new more ambitious "Fit for 55" targets,[2] which were proposed by the EC but have yet to be approved by the EU). However, relative to the EU-27 average, the strongest performance has been in the manufacturing and transport sectors. The outperformance is in part due to subdued activity and shifting composition of output, but also to significant progress on energy efficiency.[3] The building (i.e., housing) sector, which represents around 15 percent of emissions, has lagged in absolute and relative terms.

Greenhouse Gases, Manufacturing
(2005=100)



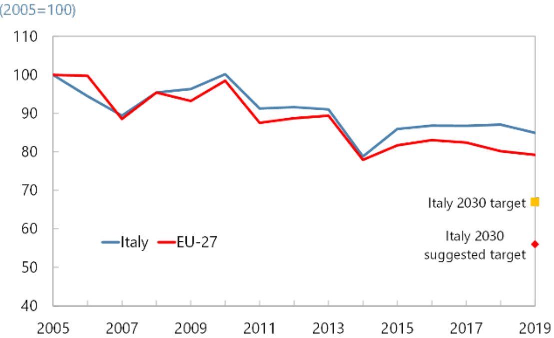
Note: Italy decreased 46% from 2005 to 2019, ranked 3rd in EU.
Sources: European Environment Agency; and IMF staff estimates.

Greenhouse Gases, Transport
(2005=100)



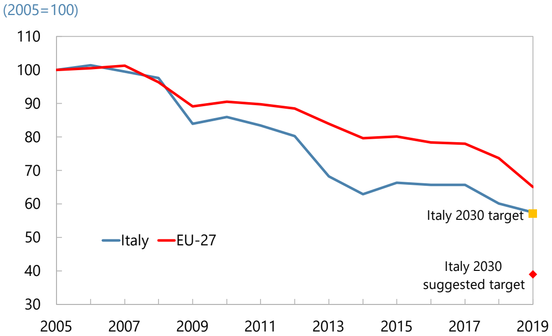
Note: Italy decreased 18% from 2005 to 2019, ranked 3rd in EU.
Sources: European Environment Agency; and IMF staff estimates.

Greenhouse Gases, Housing and Other
(2005=100)



Note: Italy decreased 15% from 2005 to 2019, ranked 16th in EU.
Sources: European Environment Agency; and IMF staff estimates.

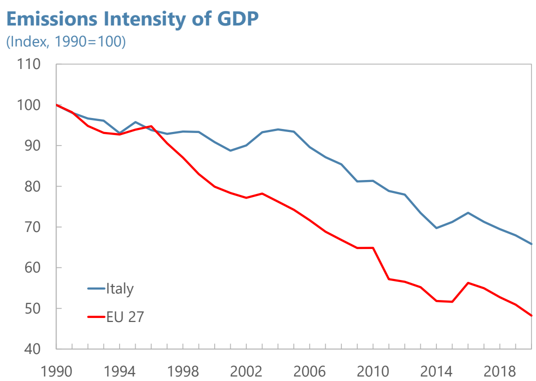
Greenhouse Gases, Power Sector
(2005=100)



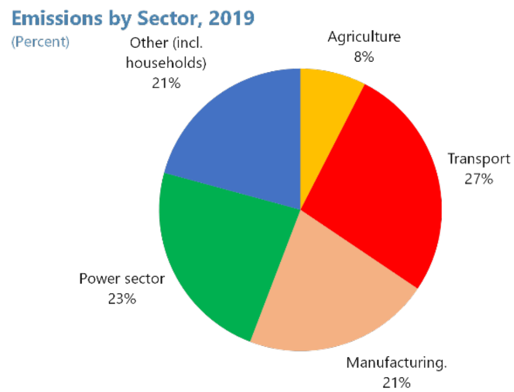
Note: Italy decreased 43% from 2005 to 2019, ranked 11th in EU.
Sources: European Environment Agency; and IMF staff estimates.

[2] The "Fit for 55" package aims to cut carbon emissions by 55 percent by 2030 (relative to 1990 levels). To reach this goal, the package would eliminate exemptions for intra-EU air transport and maritime activity, establish a separate ETS mechanism for transport and building sectors, reduce the number of annual emissions permits at a faster pace than previously and introduce a carbon border adjustment mechanism on imports from outside the EU on specific carbon-intensive products. It would introduce a new EU energy tax directive that would pave the way for improving the design of environmental taxes.

[3] See Odissey-Muree (2021), Energy Efficiency Trends and Policies (various countries).



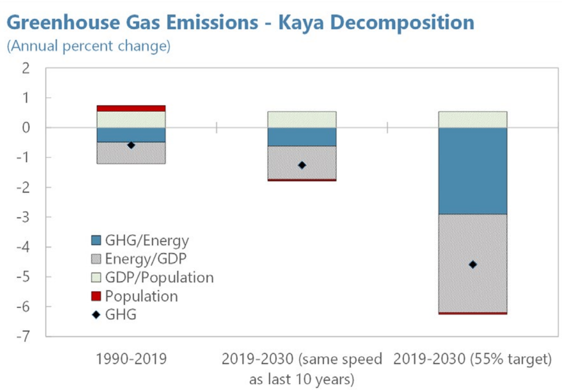
Source: IMF staff estimates.



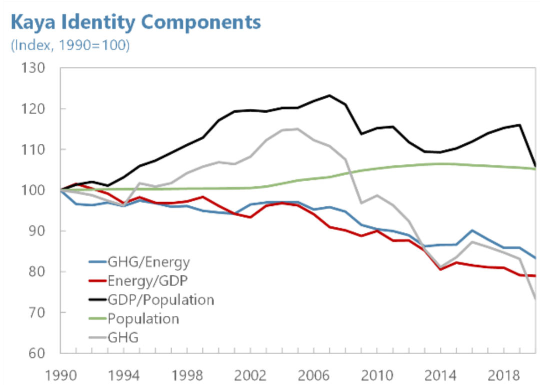
Source: EEA.

3. Most progress so far has relied on improving the energy efficiency of output, with less coming from greening energy sources. The Kaya identity decomposes the evolution of GHG emissions into changes in: (i) the emissions content of energy consumed ("energy greening"); (ii) the energy intensity of GDP ("energy efficiency"); (iii) GDP per capita; and (iv) population size.[4] Italy's progress has been supported by the very limited headwinds from growth in population and GDP per capita.

4. Greening the energy mix and/or improving the energy intensity of output needs to accelerate significantly in the next few years. To meet its "Fit for 55" emissions target, Italy would need to triple the annual decline in its emissions intensity of GDP by significantly reducing the carbon content of the energy mix and/or accelerating improvements in the energy efficiency of the GDP. By contrast, maintaining the same rate of progress as during the past decade would result in only half the needed emissions reduction by 2030.



Sources: Istat; Haver Analytics; and IMF staff estimates.



Sources: Istat; Haver Analytics; and IMF staff estimates.

5. The current policy framework and price environment will not suffice to deliver such acceleration, calling for a deepening of green policies. While the recent increase in carbon prices will be helpful in the medium term to reduce emissions, stylized model simulations (see below) show

[4] GHG = (GHG/energy)*(Energy/GDP) *(GDP/population)* population.

that in the baseline scenario, GHG emissions will still decline only gradually and eventually increase again due to insufficient efficiency improvements to compensate for economic growth (both in Italy and the EU), resulting with a significant gap with emissions targets.[5]

6. **Insufficient action on reducing emissions globally, including Italy, poses severe risks for Italy given its high exposure to climate change.** Italy is located in an area identified as particularly vulnerable to climate change. Climate observations already confirm an increase in average temperatures and an upward trend in extreme temperatures. Italy is prone to floods and drought and climate change is expected to increase vulnerability to climate-related hazards over the next decades.[6] Extreme events are occurring with increasing frequency.[7] Containing global warming will depend on global climate change mitigation efforts, and Italy should meet its corresponding commitments under international and EU climate agreements. The slow international progress with mitigation warrants stepped up adaptation efforts in Italy.

B. The Macroeconomic Effects of the Green Transition

7. **Accelerating the green transition will have macroeconomic effects, which we calibrate using a recently developed dynamic global open-economy macroeconomic model (IMF-ENV model)**.[8] The model is a recursive-dynamic computable general equilibrium model populated with optimizing agents. It is designed to assess sectoral and global macroeconomic effects of individual or multi-country changes in climate policies, including effects on GDP, employment, investment, competitiveness, trade and changes in the composition of government budgets. Given its focus on climate policy analysis, the model incorporates five fossil fuel sectors and eight power sectors, together with an array of service, industrial and agricultural sectors. The model is solved recursively in each period, with periods linked across time mainly through investment decisions, as per the Solow growth model. "New vintages" of capital are assumed to be more energy efficient than their predecessors (vintage capital model). As a result, while short-term elasticities of substitution among production inputs are low, they are larger in the longer term. In contrast, the labor market is assumed to be flexible.[9] Simultaneous equilibrium is achieved across all markets for all countries in

[5] An alternative methodological approach (CPAT) leads to similar conclusions (IMF's Fiscal Affairs Department, forthcoming).

[6] In July 2022, Italy declared a water emergency in five Northern regions following an extended period of drought and high temperature. A large part of a glacier collapsed in the same month. In August 2021, Sicily experienced the highest recoded temperature in Europe, at 48.8 degrees Celsius (119 degrees Fahrenheit). In October 2021, more than 300 mm (11.8 inches) of rain fell in near Catania in a few hours, almost half the normal average annual rainfall.

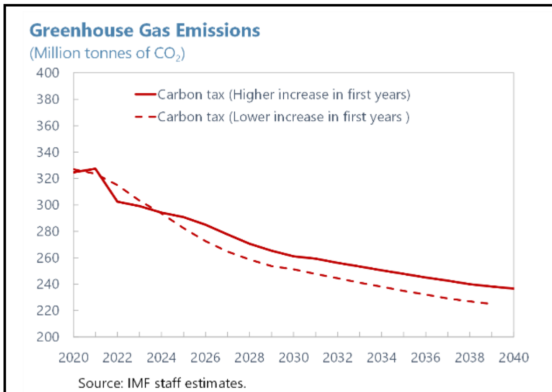
[7] According to the European Severe Weather Database, Italy experienced 1,499 extreme weather events in 2020, compared to 380 in 2010.

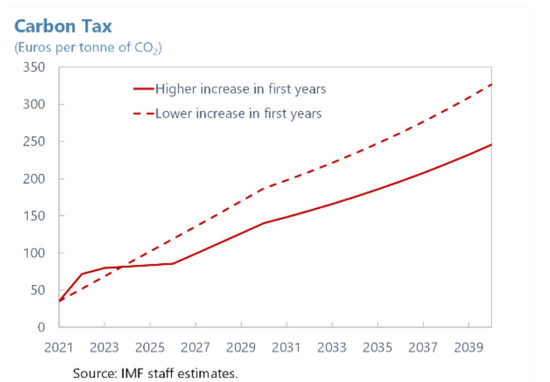
[8] Chateau, Jean, Florence Jaumotte, and Gregor Schwerhoff (2022). Economic and Environmental Benefits from International Cooperation on Climate Policies." IMF Departmental Paper No 2022/007, International Monetary Fund, Washington DC. (Box1)

[9] The model does not consider possible labor market frictions that could limit cross-sector mobility of labor and induce larger short-run GDP losses.

each period. GHG emissions depend on economic activity, which in turn depends on past investment decisions.[10]

8. Model simulations show that a gradually rising carbon tax would be needed for Italy to achieve its climate goals, and that starting sooner from current levels reduces the needed terminal tax rate. The model highlights the effectiveness of a comprehensive carbon tax that is increased gradually. The path for the carbon tax is endogenously determined to ensure that Italy meets its emission reduction targets (a reduction of GHG emissions relative to 2005 of just under 45 percent by 2030). The starting point for a scenario where the carbon tax is increased in the first few years builds on the recent significant increase in the carbon price and assumes it is not reversed. The required carbon tax is 2030 to achieve these targets is €140 per ton of CO_2, representing an increase of around €60 from the current ETS carbon price, but which covers only a subset of emissions (and hence is considerably lower in effective terms). In contrast, an alternative scenario where the carbon tax initially increases more slowly assumes partial reversal of the recent ETS price increase, and requires a larger increase in the tax by 2030 to around €200 per ton of CO_2. This delayed adjustment scenario also results in larger cumulative GDP losses, reflecting the need to adopt a more aggressive policy response later on to achieve the same cumulative emissions reduction. The result that delayed climate action leads to larger GDP losses is corroborated in an analytical model with green and dirty capital (Annex I). Corresponding carbon tax revenues are estimated to triple by 2030 (from 0.6 percent of GDP in 2021 to a still relatively modest 1.7 percent of GDP in 2030).





9. While raising the carbon tax lowers output relative to the business-as-usual baseline,[11] this effect is reduced if tax revenues are recycled to decrease distortive taxes, such as the tax on labor income. A carbon tax raises aggregate production costs and hence reduces output.[12]

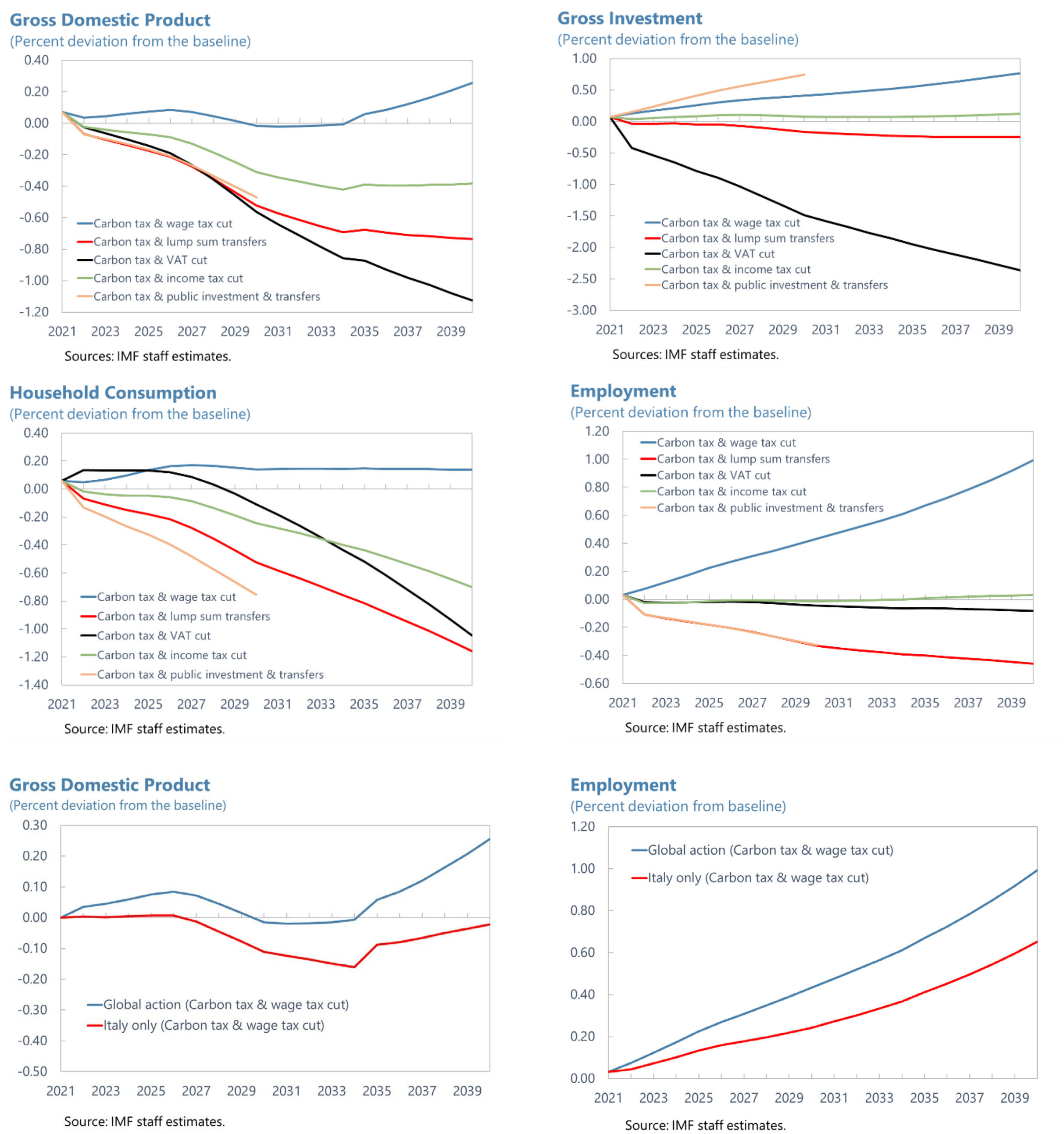
[10] The model is calibrated using a database of national economies and bilateral trade flows. The central input of the model is the data of the *Global Trade Analysis Project version 10* database (Aguiar and others 2019). This includes country-specific input-output tables for 141 countries and 65 commodities as well as real macroeconomic flows. It also relies on data from IMF *macro-economic trends* and IEA *energy trends*.

[11] A baseline scenario incorporates the existing ETS carbon price that is maintained throughout the projection period.

[12] This ignores that in the absence of mitigating measures, climate change would result in permanently lower future output. Thus there is an intertemporal tradeoff between the upfront policy-induced output losses and the benefits of avoiding future climate change-induced output losses.

Revenue from carbon pricing is assumed to be recycled through different channels. Three alternative recycling strategies that keep government revenue to GDP and the private sector tax burden unchanged are considered: (i) a reduction in the tax wedge on labor income; (ii) a lower VAT rate; and (iii) a cut in income taxes. In addition, (iv) equal lump sum transfers to households and (v) a 50/50 split of carbon tax revenue between higher public investment and transfers to households are

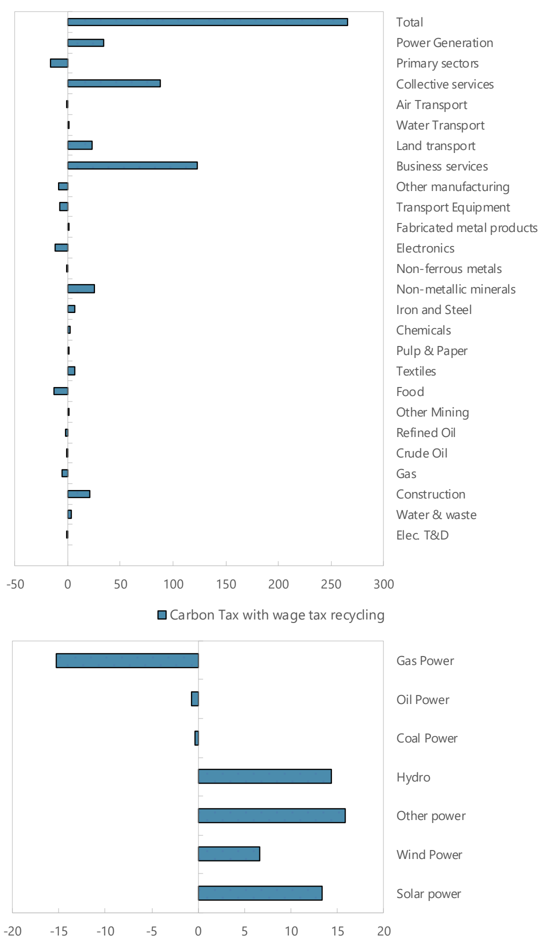
Text Figure. Italy: Scenarios with Higher Carbon Tax Increase in First Years—Macroeconomic Effects of the Different Carbon Tax Revenue Recycling Policies



considered. The model finds that using carbon tax revenue to lower the tax on wages generates the smallest cumulative negative impact on GDP by 2030. Moreover, the level of output surpasses the no-carbon-tax counterfactual beyond 2030 as the reduction in a highly-distortive tax (financed by an efficient carbon tax) raises employment, investment and consumption. In a scenario where Italy moves unilaterally to achieve its climate mitigation targets versus a collective global action scenario, Italy's GDP will be slightly lower because relative international competitiveness would be lower. The employment impact would be positive, but less so than under the collective global action scenario.

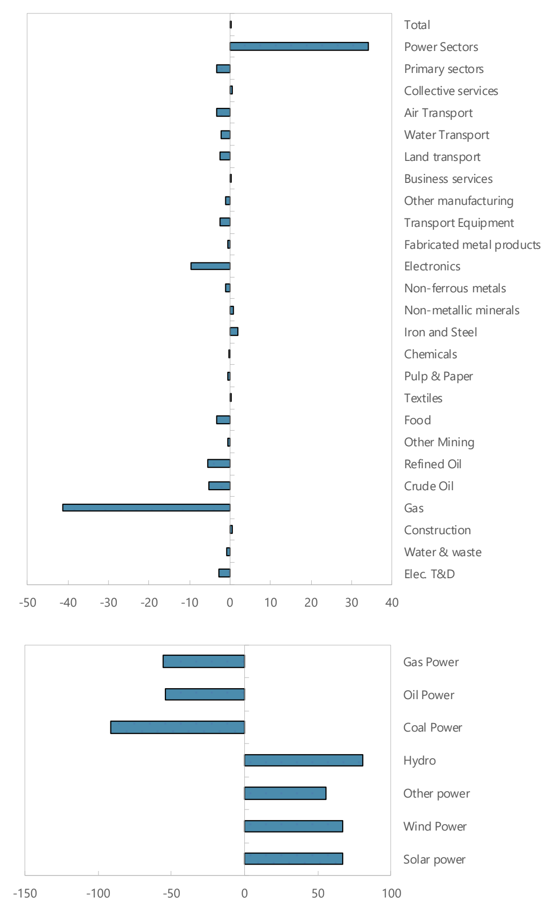
10. The overall mild GDP impact hides large sectoral heterogeneity and reallocation. The reduction in the tax rate on labor income financed by the carbon tax stimulates labor supply and demand, leading to a small net increase in employment. Nonetheless, this triggers sizable sectoral reallocation toward more labor-intensive sectors. Compared to the baseline, value added in fossil fuel extraction and energy transformation sectors (including refined oil and fossil-fuel power generations) declines by more than 15 percent. The electricity sector benefits from the policies, as it adds renewable energy and improvements to the electricity grid. Somewhat surprisingly, energy-

Global Action Scenario: Changes in Employment in 2030 (Difference with the baseline, thousands of people)



Source: IMF staff estimates.

Global Action Scenario: Changes in Value Added in 2030 (Difference with the baseline, percent)

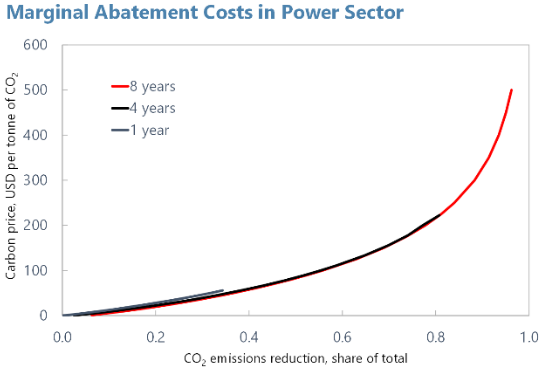


Source: IMF staff estimates.

intensive trade-exposed (EITE) industries (i.e., chemicals, iron and steel and non-metallic minerals, pulp and paper) are not the most adversely affected by the carbon tax, and their output could even increase relative to the baseline. This result reflects that Italy gains competitiveness in these sectors relative to its main trading partners (France, Germany and the rest of the EU. For services, the picture is less clear. Publicly provided services (including education and health) expand relative to the baseline as they are not very energy intensive and benefit more from the lower cost of labor, but transportation services, which rely on fossil fuels, are more negatively impacted despite the increase of electrification.

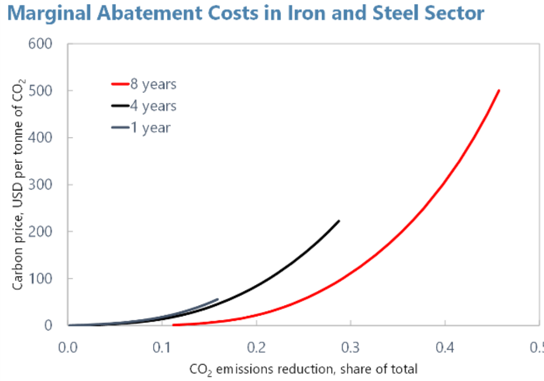
11. Earlier increases in carbon taxes are associated with lower costs of carbon abatement in all sectors. A feature of the model's optimizing framework is that in equilibrium, marginal costs of abating carbon (MACs) are equated across all sectors in every time period. As expected, MAC curves are upward sloping, and increasing at an increasing rate. Abatement cost curves reflect the cost of investing in new generation, less emissions-intensive capital and the ease of substitution between factors of production. Differences in MAC curves across sectors are large, with a much flatter curve for the power sector than for the iron and steel sector. This indicates that for any given level of the carbon tax, more emissions reduction can be obtained from the relatively-easy-to-abate power sector (e.g., by substituting wind and solar for fossil fuels) than from the harder-to-abate iron and steel sector (since coal is a necessary feedstock input for iron production). Nonetheless, each sectors' longer-run MAC curves are flatter than their shorter-term curves, owing to the greater degree of substitutability between factors of production over time and that older, more-polluting capital will have been replaced by newer-vintage greener capital. Importantly, flatter longer-run MAC curves demonstrate that moving early with raising carbon taxes allows a larger reduction in emissions at a lower economic cost. Alternatively, postponing the start date while still attempting to achieve a similar cut in emissions will force adjustment along a shorter-run, steeper MAC curve that could require large cuts in output of heavily polluting sectors because they had not previously undertaken clean investment and substitutability between factors of production is much more limited.

Marginal Abatement Costs in Power Sector



Source: IMF staff estimates.

Marginal Abatement Costs in Iron and Steel Sector

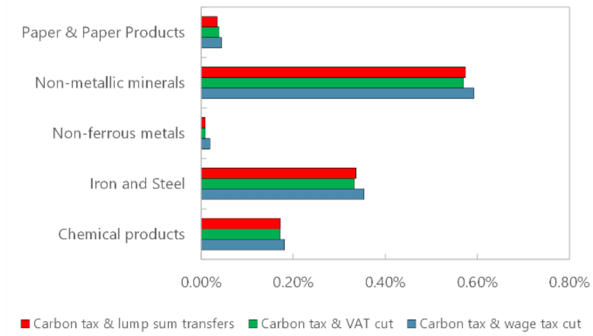


Source: IMF staff estimates.

12. Italy's competitiveness is expected to be less affected by climate mitigation policies than other large EU countries. The effect of climate policy on gross output in the EITE sectors will depend on relative price changes across countries and the current state of emissions intensity of production. Italy is found to benefit relative to other EU countries in a scenario where all EU countries are implementing their climate targets either because: (i) others have more stringent targets (e.g. Germany); and/or (ii) their economy is already less carbon-intensive than Italy's (e.g. France), such that they have higher mitigation costs than Italy.

Export Market Shares, 2030

(Percent deviation from the baseline)



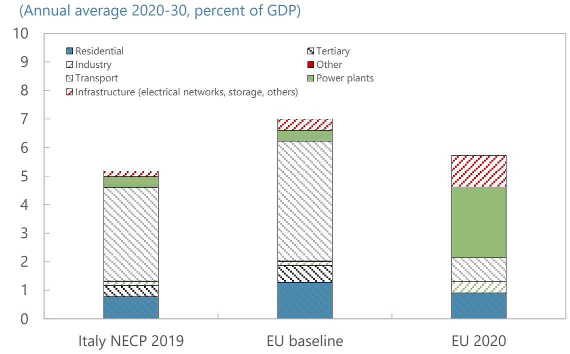
Source: IMF staff estimates.

C. Tilting Investments toward Green Technologies

13. Achieving a significant revamping of current infrastructure and capital across sectors of the economy is a priority. While compressing demand for energy will need to contribute to climate goals, accelerating progress also hinges on large-scale phase-out of that part of the existing capital stock that relies on dirty or brown technologies and its replacement with green capital. Much of this green investment would not necessarily be additional spending, but would replace investment in less-green technologies. Italy's 2019 National Climate Plan estimated that 5 percent of GDP in annual investment would be needed (estimates of how much of this investment is in addition to regular replacement of capital in a baseline scenario range between 0.8–1.6 percent). To achieve the more ambitious EU "Fit for 55" goals, the EU-wide revision of investment needs would suggest that Italy's needs would increase to around 6 percent of GDP.

Investment Needs

(Annual average 2020-30, percent of GDP)



Sources: IEA; EU; NECS.

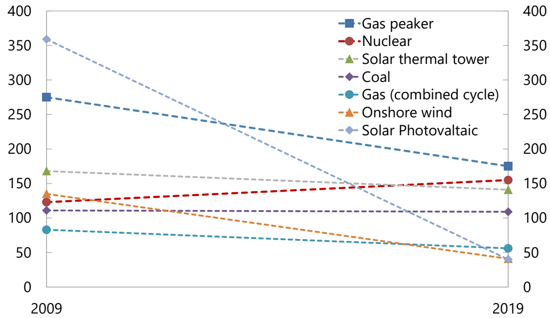
14. While investment needs are manageable, somewhat higher investment could be needed to offset the stranding of part of the capital stock. Accelerated phase out of brown capital (i.e., asset stranding), will be needed if the transition is delayed (see Annex I). Assuming that the share of the capital stock at risk of stranding is between 30–60 percent[13] and inversely proportional to a sector's energy intensity, we estimate assets equivalent to 11 percent of GDP in the manufacturing sector and 5 percent in the power sector[14] could be subject to stranding. For the manufacturing sector, this points to the need for some additional 1.5 percent of GDP in annual investment over the decade in addition to the needs identified in the 2019 National Climate Plan.

[13] These parameters are drawn from literature, the upper limit takes into account other types of capital, including intellectual property.

[14] Representing an average of 42 and 40 percent of the capital stock, respectively.

Levelized Cost of Energy, 2009 and 2019

(Euros per MWh)



Sources: Our World in Data

Capital Stock at Risk of Stranding

(In percent of GDP)

	Capital stock	Stranding potentia
Industry	**27.2%**	**11.6%**
of which		
Transport equipment	3.4%	1.7%
Metals	3.7%	2.1%
Food	3.3%	1.3%
Nonmetallic minerals and plastic	2.6%	1.7%
Power	11.1%	4.4%

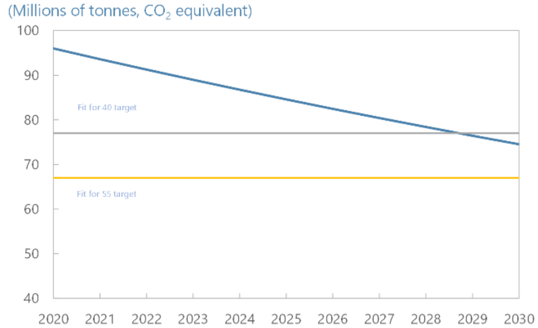
Sources: Istat and IMF staff calculations.

15. **Green investment in renewable electricity has so far been small, and without a significant acceleration, would fall short of these objectives.** Stepping up efforts to boost renewable energy is key to achieving green transition targets because it enables electrification of downstream activities, including in the housing and transport sectors. Deployment of renewable energy has been low despite sharply falling costs over the past decade (only very mildly offset by recent pickup linked to higher commodity prices and interest rates). The share of renewables in total energy production stands at 20 percent, close to the EU average. Significant expansion occurred between 2010–13, supported by significant subsidies offered during this period. Since then, deployment of new capacity has been slow, notwithstanding some increase in recent months. This is in contrast to many other EU countries, which saw increasingly rapid growth in renewable energy investment in recent years.

16. **Private investment in clean transport should accelerate further to meet the sector's emissions target, notwithstanding the recent strong increase.** In 2021, the share of electric cars sold (including hybrids) reached 40 percent, up from 6 percent in 2019. This reduced the average carbon emissions from new cars by 40 percent since 2020. However, even with the optimistic assumption that each new car purchased has half the emissions of the old one it replaced and that the car fleet (at 38 million) is constant, the emissions objectives for 2030 will not be met.

Car Passenger Emissions

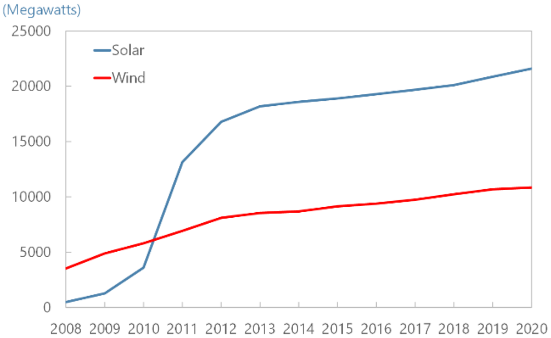
(Millions of tonnes, CO_2 equivalent)



Sources: UNRAE; and IMF staff estimates.

Installed Electricity Capacity

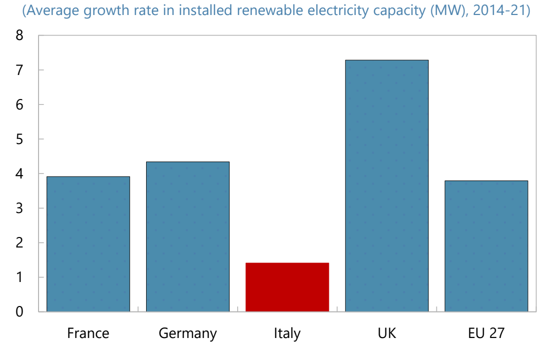
(Megawatts)



Source: IRENA

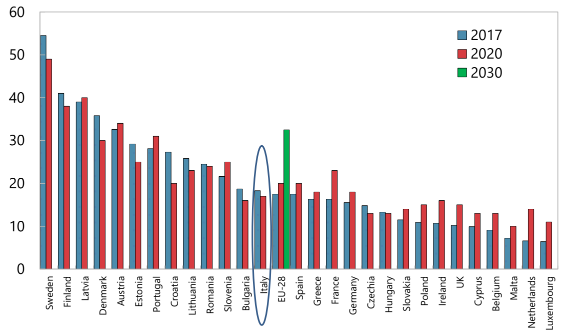
Renewable Energy Investment

(Average growth rate in installed renewable electricity capacity (MW), 2014-21)



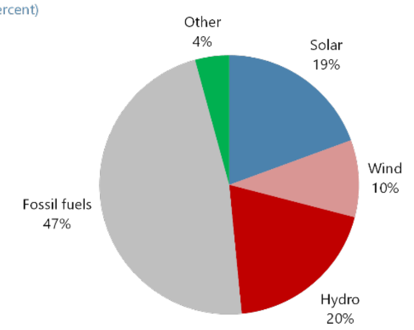
Source: IRENA.

Share of Renewables in Final Energy Consumption
(Percent of total energy consumption)



Source: Eurostat.

Installed Electricity Capacity
(Percent)



Source: IRENA.

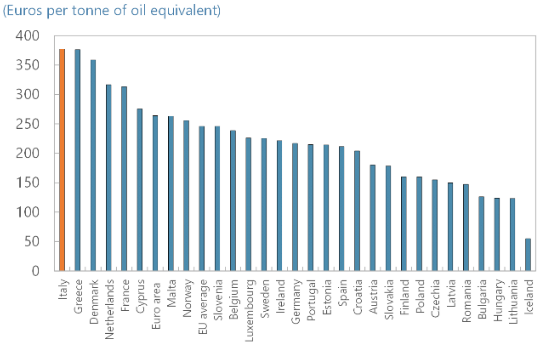
D. Green Policy Framework

17. Ensuring larger green investment and faster progress on emissions requires strengthening the policy tools. Italy benefits from a comprehensive green policy framework that is in part a reflection of EU-wide policies. In this section we focus on specific areas where Italy's policies have room for maneuver, or deviate somewhat from the EU's, to offer clues on relative strengths and areas with opportunities for further refinements. This package of policies tools, while not straightforward to include in a stylized model, could moderate the needed carbon tax path going forward.

Tax Policy

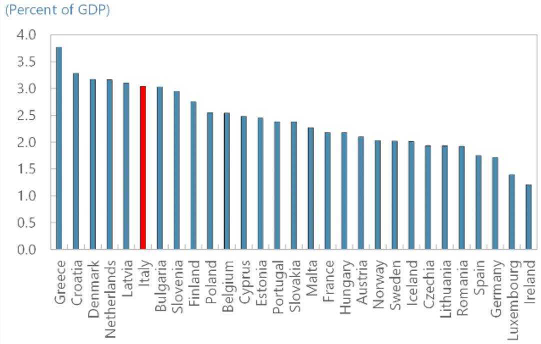
18. Italy's average level of energy taxes is high compared to peers, but tax rates vary considerably across sectors. Italy's implicit tax on energy consumed[15] is the highest among all OECD countries. When measured in terms of GDP, it remains among the highest at 3 percent of GDP (or 7 percent of fiscal revenue). High energy taxes have led to the effective tax on carbon also being among the highest in the world. Despite Italy not having an explicit carbon tax in addition to ETS, the effective tax on carbon is the second highest for all OECD countries. Owing to high gasoline excise taxes, carbon emissions from road transport are on average taxed the heaviest, at an average of €250 per t/CO_2, which is much higher than for carbon emitted by other sectors. Italian fuel taxes are also among the highest internationally.

Implicit Tax Rate on Energy, 2020
(Euros per tonne of oil equivalent)



Source: Eurostat.

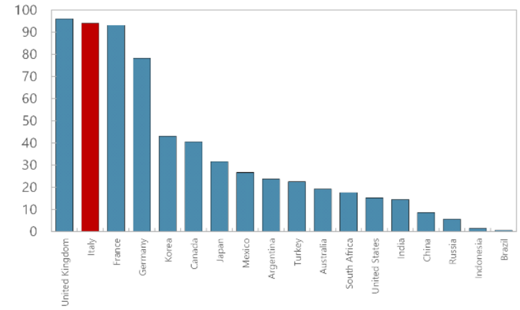
Environmental Taxes
(Percent of GDP)



Source: Eurostat.

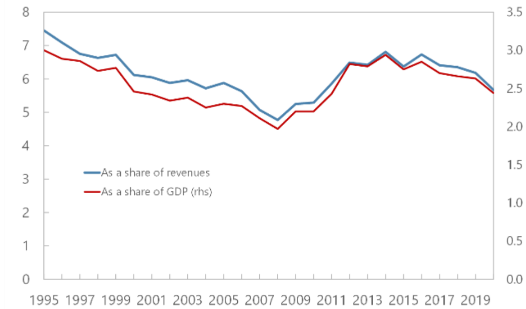
[15] Defined as the ratio between energy tax revenue and final energy consumption

Average Effective Carbon Rate, 2021
(Euros per tonnes of CO_2)



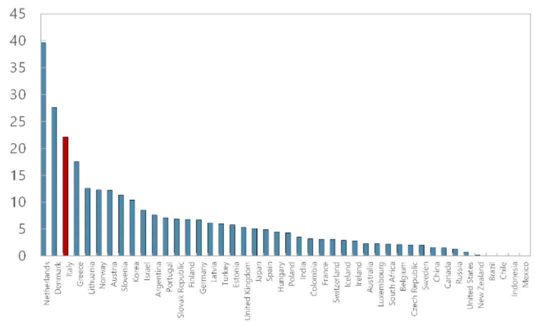
Source: OECD.

Energy Taxes
(Percent)



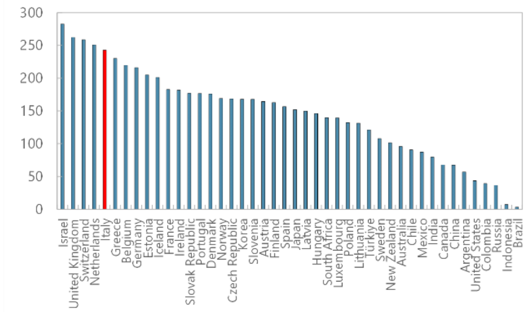
Source: Eurostat.

Non-Road Average Fuel Excise Tax
(Euros per tonnes of CO_2)



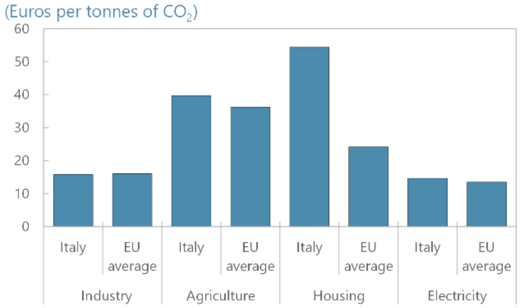
Source: OECD.

Road Transport Excise Tax, 2018
(Euros per tonnes of CO_2)



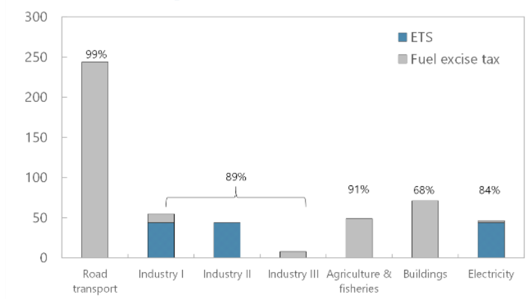
Source: OECD.

Effective Carbon Tax Rate*
(Euros per tonnes of CO_2)



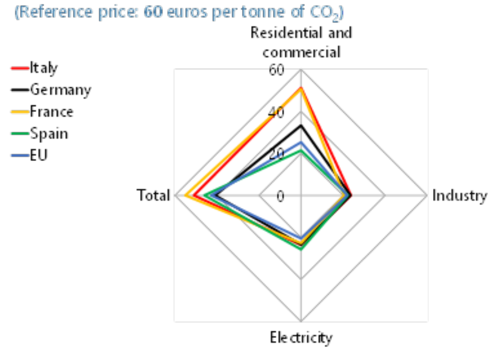
* As estimated from information on share of emissions by price bracket.
Sources: OECD; and IMF staff estimates.

Effective Carbon Tax Rates, 2021
(Euros per tonnes of CO_2)



Percentage above bars reflect percentage of sector covered by effective carbon taxes.
Bars represent selected cases where emmission is above 5000 KtCO2.
Source: OECD.

Carbon Pricing Score 1/
(Reference price: 60 euros per tonne of CO_2)



1/ Represents the share of emissions above the reference price.
Sources: OECD; and IMF staff estimates.

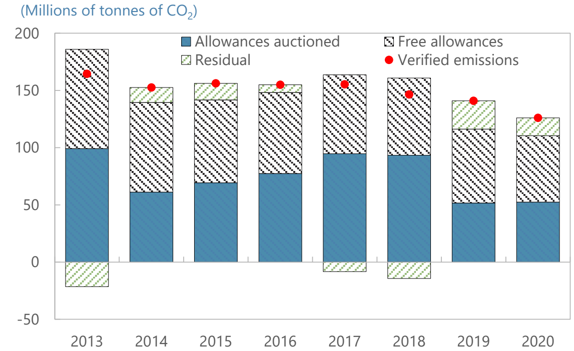
19. **However, energy taxation for much of the economy remains insufficient to achieve climate targets.** Data for 2021 (which does not fully reflect the sharp increase in ETS permit prices in the latter part of that year) indicates that fuels for other activities have been taxed an average of €20 per t/CO_2. The low taxation is in line with other EU countries, and is influenced by the EU's Energy Taxation Directive (2003/96/EC). However, the average level masks significant heterogeneity across fuels and sectors. An alternative indicator from OECD called the "carbon pricing score" sheds light on the coverage and distribution of taxes by indicating the share of emissions that is taxed above a minimum threshold.

The indicator shows that more than 50 percent of Italy's emissions were taxed below the threshold of €60 per t/CO_2 (although still above the EU average), pointing to significant gaps in the coverage of carbon taxation.

20. Explicit taxation of emissions covered by the ETS sectors (power and industry) has been especially low. Incentives for abatement in these sectors have relied almost exclusively on the ETS scheme. However, with carbon prices having been persistently low until recently and a significant amount of free permits being issued, most emissions in these sectors were taxed below €60 per t/CO_2. Corresponding ETS revenue was also low at less than 0.2 percent of GDP per year. While Italy's average carbon tax and carbon pricing score are similar to the rest of Europe's, countries with their own explicit carbon tax to supplement the ETS fared better in terms of coverage of emissions exceeding the minimum tax threshold. Electricity consumption is heavily taxed (representing the second largest source of energy tax revenue after gasoline taxes). The revenues from ETS auctions since mid-last year are expected to at least double, but will not return energy tax revenue as a share of GDP to historical highs. Also, ETS permit prices are vulnerable to price volatility, including sudden price dips. In the buildings sector, Italy's taxes were moderately above EU average, but still low and incomplete, with one third of emissions exempt from carbon taxes.

Emissions and Allowances

(Millions of tonnes of CO_2)



Source: Eurostat.

21. Within sectors, taxes are also uneven and disconnected from carbon content. In line with many other EU countries, existing energy taxes are poorly aligned with the carbon content of the type of energy. Carbon from gas is generally taxed less than carbon from oil. Oil and coal used by businesses are very lightly taxed despite their high carbon content. This compounds inefficiencies across sectors: the road transport sector is incurring potentially high abatement costs to reduce carbon emissions while other sectors facing low carbon taxes are not incentivized to abate even though their abatement costs could be low.

Tax Incentives and Subsidies for Investment

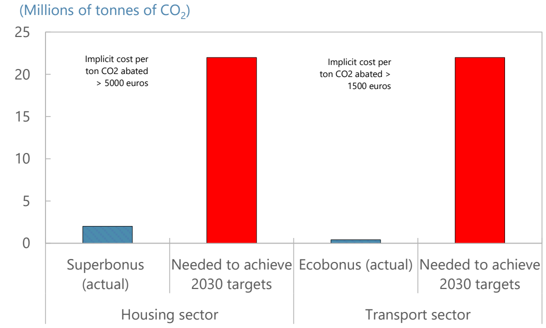
22. Italy has tended to rely on subsidies to support green investment. Subsidies for renewable electricity production have comprised the vast majority of carbon-reducing subsidies (at around €12 billion annually). These are financed by a general system charge on electricity bills and mostly benefit photovoltaic energy under the "Conto Energia" program implemented in various phases until mid-2013, but involving 20-year payments to recipients. In 2019, a new decree allowed for subsidies in new photovoltaic projects, but at an expected cost of €1 billion a year.

23. A significant expansion of tax incentives to induce private sector green investment has recently taken place, including in the context of NRRP. For the last two years, total green subsidies—including pre-existing schemes—amounted to 2.2 percent of GDP. The NRRP (which

includes a total of more than 2 percent of GDP for green tax incentives in coming years) has helped to scale up substantially programs that are also co-financed by national fiscal resources. Technological transformation in industry is incentivized through the Transition 4.0 plan, which can be used to support a switch from natural gas to solar thermal energy, heat pumps and renewable electricity for process heat generation by industry. Tax credits range between 6 percent and 50 percent according to the type of investment, the invested amount, and the investment period.

24. Green subsidies for home refurbishment, anti-seismic improvements and car purchases were also scaled up during the pandemic. The Superbonus program represents a scale-up of previously existing regimes that provide a tax credit equal to 110 percent of the costs incurred to increase the level of energy efficiency of existing buildings (see Annex VII in the 2022 Italy Staff Report) Spending under the Superbonus is estimated at more than €10 billion in 2021, out of a total budget envelope of €33 billion, and the full envelope has now been committed. Despite its cost, Superbonus 7has only covered 57,000 building units (the total stock in Italy is 12.4 million, of which more than 60 percent is over 45 years old). The Car Ecobonus provides incentives up to €5,000 for the purchase of low emission cars, and has an annual cost of €650 million. These schemes are estimated to have delivered 2 million and 0.4 million tons of CO_2 savings, well short of savings needed to achieve 2030 targets and at the high cost of €5,000 and €1,500 per ton of CO_2, respectively. This points to the significant need to improve the effectiveness of the use of fiscal resources.[16]

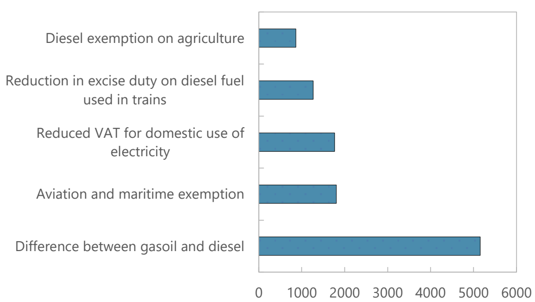
Greenhouse Gas Emissions Reduction
(Millions of tonnes of CO_2)



Sources: IMF staff estimates.

25. There are also subsidies that are damaging to the environment and support fossil fuel-based products. In particular, 40 fossil-fuel subsidies for a total of €13 billion existed in 2020. Most notably, the lower tax on diesel versus gasoline does not reflect relative carbon emissions and the more damaging health risks from diesel. However, more favorable tax treatment of diesel is a prevalent feature across much of Europe.

Environmentally Damaging Subsidies, 2018
(Thousands of euros)



Source: ECCO.

Incentive Schemes 1/
(In billions of euros)

	2021	**2022**
Transition 4.0	12	12
Superbonus	14	15
Ecobonus	1	1
Renewables 2/	12	12
Other 3/	2	2
Total	**41**	**42**
In percent of GDP	**2.3**	**2.2**

1/ Estimates.
2/ of which 1 billion for new projects.
3/ Include Conto Termico, Fondo Nazionale Efficiencia energetica, Cohesion Funds.

[16] Alpino, Citino, Zeni (2022) undertake a social benefit-cost evaluation of green investment projects included in the NRRP and conclude that a positive net present value is achieved only by using a relatively low discount rate and when more weight is given to damages incurred in developing than in advanced economies.

Public Investment

26. Public investment in the green transition is increasing, although from low levels. The NRRP will enable a step-up in public investment, but will only represent an annual average of 0.3 of GDP.[17] However, the IEA estimates that 30 percent of total investment resources should be in public investment, which for Italy would amount to 2 percent of GDP. The authorities intend to focus on public transport, with the development of high-speed train and public transport lines and vehicle charging stations. Some investments in innovative renewable energy sources in the circular economy and improvement in waste and water management are also planned. While resources for other objectives are small, there is awareness of the need to invest further, including in infrastructure (electricity grid and batteries, transmission capacity) in order to accommodate the future growth in renewable energy while avoiding system instability.

Pricing and Insurance

27. Unlike several other EU countries, in recent years Italy has not implemented measures to reduce the price volatility facing green investments. In the power sector, the current marginal cost pricing scheme at the EU level provides, in principle, incentives to renewables by linking electricity prices to generally much higher costs in fossil fuel-based generation. However, uncertainty regarding future fossil fuel and carbon permit prices as well as tax policy can be an important deterrent to committing capital into alternative technologies. While previous costly subsidies provided price certainty for the deployment of renewable electricity until 2013, policy interventions reducing the margins of price uncertainty since then have been limited. Earlier this year, the government introduced a Contract for Difference program that locked in a price for renewable energy. Growth in long-term private contracts in the form of Power Purchase Agreements are key, but have fallen behind expectations, with the authorities working on developing a trading platform which should help foster the development of such market.

Energy Efficiency Obligation

28. Italy was among the pioneers of important elements in the regulatory landscape. Most notably, from 2005, Italy has implemented an energy efficiency obligation scheme ("white certificates"), in which firms are expected to deliver a certain amount of energy savings (over and above market trends) or buy certificates to forego such obligation. Certificates are actively traded, inducing those with least cost to engage in efficiencies to deliver them. The scheme, which has triggered strengthened internal systems and an external industry of energy management service, has been evaluated as very effective in delivering energy savings[18], especially in the manufacturing sector.

Administrative Bottlenecks

29. Administrative bottlenecks have been an important obstacle to faster deployment of renewable energy. A large number of private renewable energy projects (amounting to potential

[17] This excludes subsidies to private investment supported by the NRRP.
[18] See, among others, "Good Practice of Energy Efficiency", European Commission

capacity of 60 MW, which would double the existing renewables capacity) is awaiting approval, with delays reaching 6 years on average. Due to the sharp decline in the cost of new installed capacity over the past decade, most of these new projects require no or minimal fiscal support to be profitable, unlike the existing renewable energy installations, which continue to depend on large fiscal subsidies (which could reach a cumulative 13 percent of GDP over 20 years). The government has recently reduced administrative barriers by simplifying permit-granting procedures in designated areas, but further progress in streamlining regulations and implementation is needed.

E. Conclusions and Policy Issues

30. Italy has featured some ambitious policies that—alongside low GDP growth—contributed to faster reduction in carbon emissions in some sectors relative to peers. Italy's high fuel taxes helped contain transport sector emissions to a greater extent than other EU countries. However, the low price elasticity of gasoline consumption, coupled with remaining subsidies (including for diesel, maritime and aviation sectors) has limited progress towards targets in Italy. Italy's pioneering green policies in the manufacturing sector are likely to have contributed, alongside the sector's subdued activity and its changing composition, to overperforming EU peers. Policy focus on renewable energy saw Italy take a lead on renewable developments early in the previous decade (at a significant fiscal cost) but progress has stalled despite falling installation costs of new renewables amid a variety of administrative obstacles.

31. Going forward, policy action is needed to increase investment in green technologies and capital in order to ensure sufficient progress toward emissions goals. Model simulations find that significant gaps exist for Italy to meet its climate goals under baseline policies. Greater near-term reliance on coal-based power production to mitigate energy security concerns calls for stronger action in the coming years. Italy's policy framework is to a considerable degree the reflection of that of the EU, which has not so far delivered a sufficient pace of emission abatement. While it is now in the process of being upgraded within the context of Fit for 55, Italy could promptly adopt some measures with limited risks to its competitiveness. Current carbon prices could be locked in through a carbon price floor to secure incentives for renewables and provide greater certainty for green investment. Although recent legislative interventions should already speed up the renewable capacity deployment, further streamlining of regulatory procedures is needed to unlock the potential for higher investment, which would also mitigate near-term energy security concerns.

32. Considerable room exists to improve the green fiscal policy framework. Effective carbon taxation should be increased and revamped to reduce asymmetries across sectors and types of primary energy sources.[19] Given the very high energy taxes on some products, a comprehensive carbon tax may not entail a sizable increase for some products and sectors. Current elevated fossil fuel prices should accelerate the green transition. However, fossil fuel prices do not necessarily reflect their relative carbon intensity, and delaying introducing a comprehensive carbon tax could require more abrupt and larger increases in the future, bringing also a higher macroeconomic cost.

[19] Estimates for elasticity of energy demand lend support to the effectiveness of carbon taxes to diminish emissions (see Faiella and Lavechia, 2021).

With the recent scaling up of environmentally-friendly subsidies not leading to sizable emissions reductions, these should be rationalized. Increased fiscal resources associated with higher effective carbon taxation and more cost-effective subsidies could create space to boost green public investment and reduce distortive taxation, fostering faster and greener growth.

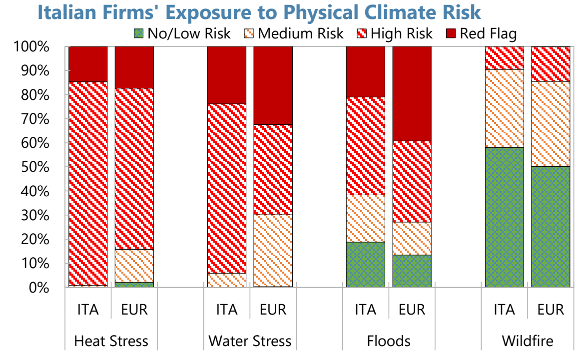
Box 1. Climate Finance by the Private Sector in Italy

Financing spending for climate mitigation and adaptation will require mainly private sector capital. In Italy, banks will likely have a central role in climate finance given their dominant place in the financial system. Strengthening banks' resilience to physical and transition climate risk while providing adequate funding to facilitate the economy's low-carbon transition will be critical to ensuring macrofinancial stability.

Italian Firms' and Banks' Exposure to Physical Climate Risk

Italian firms have significant exposure to physical climate risk, including water stress, heat stress, floods as well as multiple climate hazards. Based on a large firm-level dataset for European companies, Italian firms are especially exposed to heat stress and water stress as well as flood risk.[1] In this sample of firms, nearly all Italian firms have high or very high exposure to heat stress, while over 90 percent of them are also highly exposed to water stress. Italian banks are therefore exposed to physical climate risk through their lending to firms located in those areas of high risk. According to the ECB/ESRB, the Italian banking system has over €300 billion of exposures to firms in areas with high or increasing climate physical risk, which is one of the highest among EU countries.[2] Other recent and forthcoming studies are considering increasing the sample size as well as sample representativeness by using firm or facility-level data from the universe of firms in the credit register AnaCredit.[3] Using this approach, a recent study conducted at the Bank of Italy estimates that Italian banks have about €170 billion of exposure to physical climate risk.

Italian Firms' Exposure to Physical Climate Risk

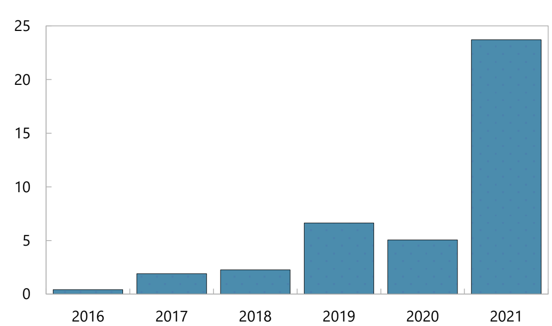


Sources: Moody's, IMF staff estimates.
Notes: Sample includes 37,103 European firms/facilities; among them, 970 are Italian firms/facilities.

Financing Climate Mitigation and Managing Transition Risk

Efficient private-sector capital allocation for the low-carbon transition requires appropriate pricing of the costs and risks associated with carbon emissions. However, if carbon is priced too low, the social benefits of reducing carbon emissions will not be fully reflected into private sector financial contracts. In that case, banks would be subject to transition risk as their loans to fossil-fuel-dependent borrowers could significantly lose value during the economic transition. Recent studies conducted by the Bank of Italy show that about 40–50 percent of corporate loans to Italian firms are exposed to climate transition risk, with small and micro firm borrowers particularly vulnerable.[4]

Green Bond Issuances
(Billion euros)



Sources: Haver Analytics, IMF Staff Calculation.

On financing climate mitigation, Italy has made progress in recent years, and like many other countries, there is also significant room for sustainable finance to develop further. Italy has seen growth in its green bond issuance in recent years, including its first green sovereign bond in 2021, and some Italian firms are

Box 1. Climate Finance by the Private Sector in Italy (Concluded)

among the pioneers in issuing sustainability-linked bonds (SLBs). However, these markets are mostly limited to large issuers and the scale of issuance is still very small compared to green financing needs.[5] Several Italian banks are starting to incorporate climate considerations into their lending decisions, but misaligned financial incentives and high uncertainties are among the major obstacles and, in certain cases, could give rise to boom-bust cycles in segments of green finance.[6] Further enhancing climate-related data disclosure and standardization is needed to continue to strengthen the foundation for adequate and sound climate finance.

---

[1] This dataset contains information on the firm-level exposure to sources of physical climate risk for the largest 1,000 firms in each country.

[2] ECB/ESRB, "Climate-related risk and financial stability", 2021. The Bank of Italy conducted another study using publicly available data and finds that Italian banks had about €170 billion in exposure as of 2020.[3] A drawback of this approach is that the information on firm-level climate risk is less accurate.

[3] A drawback of this approach is that the information on firm-level climate risk is less accurate.

[4] See Bank of Italy, "Financial Stability Review", 2020/2, 2022/1 and "Central banks, climate risks and sustainable finance", March 2021. An important challenge to assess climate-related risks is the lack of comprehensive and high-quality customer data, especially for households and smaller-sized firms.

[5] While international standardization of green bonds (such as the International Capital Market Association (ICMA) principles) is useful, it is still a challenging task in practice to assess the actual climate mitigation effects from investments that are labeled "green".

[6] Like many historical episodes such as the IT bubble in the US in the late 1990s and the crypto mania in 2020–21, high uncertainties in certain climate-related technologies and policies could also introduce biases in private investment decisions, thereby leading to boom-bust investment cycles.

Annex I. Carbon Taxes and Asset Stranding[1]

Reducing carbon emissions requires shifting away from fossil fuel-based technologies and toward green technologies. To achieve this transition, the stock of fossil-fuel related capital needs to decline at the same time as the stock of capital compatible with renewable energy rises.

This annex presents a simple stylized Solow growth model with carbon pricing to examine how the pace of the green transition determines the behavior of the two types of capital and economy-wide output. A numerical simulation illustrates the dependence of the dynamic adjustment paths on how quickly the carbon tax is increased.

An economy produces a single good Y, using two types of capital, fossil-fuel related (or dirty) capital, denoted by K, and clean capital, denoted by R, using a Cobb-Douglas type production function:

$$Y_t = \frac{1}{\theta} K_t^{\alpha} + \theta R_t^{\beta} \tag{1}$$

Both types of capital have diminishing returns, such that $0<\alpha, \beta <1$. A constant parameter, θ, raises the productivity of green capital and lowers it for dirty capital. In addition, the two types of capital are additively separable in production, such that output can be produced with dirty or clean, or both types of capital.

However, using dirty capital to produce output generates carbon emissions, e, according to $e_t = \frac{1}{\theta} K_t^{\alpha}$, such that carbon emissions are proportional to the output produced with dirty capital.

Assuming a closed economy, so that saving equals investment, and that total saving is a fixed share, s, of GDP, we have the constraint: $s_{k,t} + s_{r,t} = s$, where s_k, $s_r \geq 0$ is the share of saving devoted to investment in K and R. Capital of each type grows with the amount of investment minus physical depreciation of the existing stock:

$$K_{t+1} = K_t + s_{k,t} Y_t - \delta_k K_t \tag{2}$$

$$R_{t+1} = R_t + s_{r,t} Y_t - \delta_r R_t \tag{3}$$

where δ_k and δ_r denote physical depreciation of dirty and clean capital. In equilibrium, saving is allocated such that the marginal return from investing an additional unit in dirty and clean capital are equated:

$$\frac{1}{\theta} \alpha K_{t+1}^{\alpha-1} - \delta_k = \theta \beta R_{t+1}^{\beta-1} - \delta_r \tag{4}$$

[1] Prepared by Zhongxia Zhang (EUR). The author is grateful to Rachel van Elkan, Philip Barrett, Hou Wang, and Si Guo for their helpful discussions.

In the steady state without policy action, both types of capital are used to produce output, and output, capital stocks and the share of output produced using dirty capital and clean capital are constant. Thus, a constant amount of carbon will be emitted each period, which is inconsistent with carbon reduction commitments.

To deliver on carbon reduction commitments, a tax on dirty capital and a subsidy to clean capital is considered.[2] This modifies equations 2–4 according to:

$$K_{t+1} = K_t + s_{k,t} Y_t - \delta_k K_t - \tau K_t \quad (5)$$

$$R_{t+1} = R_t + s_{r,t} Y_t - \delta_r R_t + \mu R_t \quad (6)$$

$$\frac{1}{\theta} \alpha K_{t+1}^{\alpha-1} - \delta_k - \tau = \theta \beta R_{t+1}^{\beta-1} - \delta_r + \mu \quad (7)$$

where τ (μ) is the tax (subsidy) rate on dirty (clean) capital. For dirty capital, this reflects policy-induced deprecation, while for clean capital, the subsidy increase encourages investment. Total depreciation for each type of capital is the sum of physical depreciation and policy-induced changes in capital, which is positive for clean capital. Thus for dirty capital, policy-induced depreciation augments physical depreciation, leading to some capital being retired before its physical life has been exhausted because it is no longer economically profitable—i.e., asset stranding. For clean capital, policy-induced appreciation can partially or fully offset physical depreciation.

The three scenarios are considered: (i) business-as-usual (BaU) without climate policies, such that the economy remains in its original steady state; (ii) an immediate-and-gradual (IaG) policy scenario where the tax and subsidy are increased gradually in a linear manner at the outset; and (iii) a delayed-but-aggressive (DbA) policy scenario where BaU continues for seven more periods, followed by full deployment of taxes and subsidies. The tax and subsidy rates under the IaG and DbA policy scenarios are calibrated to achieve the same cumulative reduction in carbon emissions. Numerical simulations are conducted to compare these three scenarios.

Under the IaG scenario (red dashed lines in the panel charts), the gradual increase in the tax on dirty capital and increase in the subsidy on clean capital leads to a decline in the share of saving allocated to dirty capital, with an offsetting increase in the share devoted to clean capital. As a result, the stock of dirty capital declines gradually and clean capital rises smoothly. Total output along this transition path is on average similar to the BaU steady state but marginally lower. Output is increasingly produced with less dirty and more clean capital. Carbon emissions decline gradually. In the medium term, depreciation of dirty capital is lower than in the BaU steady state because of the smaller stock of dirty capital.

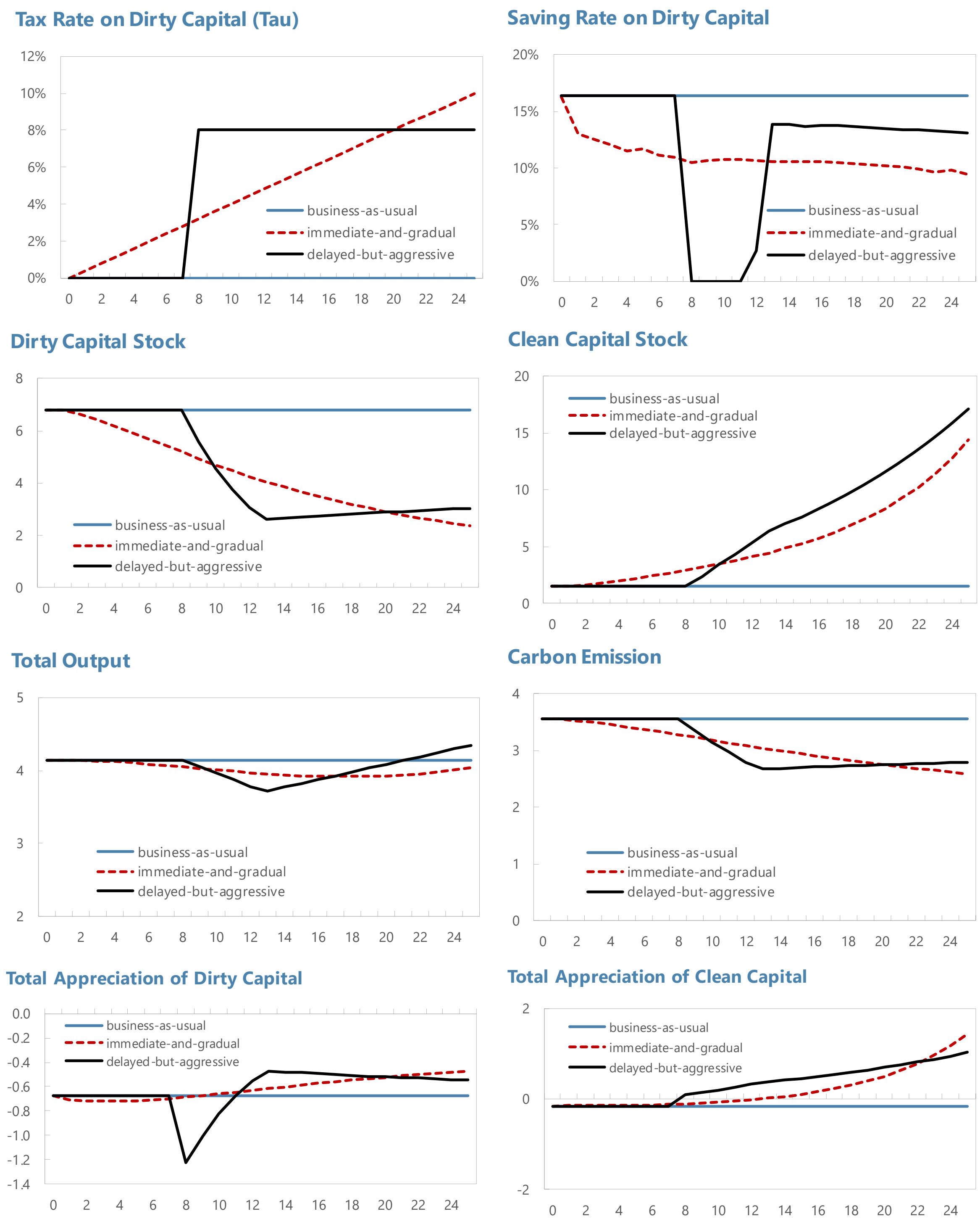
Under the DbA scenario (black solid lines in the panel charts), tax and subsidy rates are raised sharply after seven periods and then kept unchanged at their higher levels. In response to the sharp

[2] An alternative would be to tax emissions directly, which is effectively a tax on the output produced by dirty capital. However, this would not allow for subsidies to green investment.

policy shift, all saving is quickly re-allocated to clean capital investment. Compared with the IaG scenario, the dirty capital stock declines more sharply and clean capital grows more quickly. However, total output along the transition path is temporarily much lower after the policies are introduced because the larger upfront policy-induced depreciation of dirty capital reduces the amount of dirty capital used in production. While clean capital grows rapidly during these early periods, it is constrained by the aggregate saving rate, leading to a temporary decline in the total capital stock and output. Rapid accumulation of clean capital eventually lifts output above the IaG path. Once the policies are in place, emissions decline more quickly under the DbA scenario due to the sharper decline in the stock of dirty capital.

The model simulations suggest that delaying action to address carbon emissions requires adopting a more aggressive policy response to achieve the same cumulative emissions reduction. Moreover, these more aggressive policies lead to a temporary sharp drop in output and greater stranding of dirty assets before their physical life has expired.

Text Figure. Simulation Results for the Three Carbon Tax Scenarios



Note: total appreciation is the sum of technological depreciation (-delta*K) and policy-induced deprecation (-tau*K).

Note: total appreciation is the sum of technological depreciation (-delta*R) and policy-induced appreciation (+mu*K).

Note: the simulations are based on the following set of parameter values:

$\alpha = 0.3, \beta = 0.4, s = 0.2, \delta_k = 0.1, \delta_r = 0.1, \theta = 0.5, \mu = 2\tau.$

Annex II. EU "Fit for 55" Key Legislative Proposals

Existing EU Laws and Planned Changes	Main Proposals
EU Emission Trading System (EU ETS)	Lower overall emission cap and increase annual rate of reduction. Phasing out of emission allowances for aviation. Phased inclusion (2023–25) of the shipping sector under the EU ETS for intra-EU traffic (plus half of international voyages). Introduction from 2026 of a separate new emission trading system for fuel distribution for road transport and building.
Regulation on Land Use, Land Use Change and Forestry (LULUCF)	Revision will increase the aim for carbon sequestration from the current 225 million to 310 million tons of CO_2 equivalent.
Effort Sharing Regulation (ESR)	A 40 percent (previously 29 percent) reduction in emissions covered by the ESR. Unchanged application of metrics (e.g. GDP per capita) to allow for "fair" burden sharing across Member States. The ESR will continue to cover the road transport and buildings sectors, alongside their inclusion in a new emissions trading system.
Renewable Energy Directive (RED)	Increase the binding EU-level target for renewables to 40 percent. Increased support to renewables, including use of renewable fuels such as hydrogen in sectors that are hard to decarbonize. New indicative target in renewable energy use in industry and binding target of renewables in heating and cooling of a 1.1 percentage point annual increase, respectively. New benchmark to reach at least 49 percent renewable share in the energy used in buildings. Measures to boost electrification, including by accelerated permitting for renewable energy projects.
Energy Efficiency Directive (EED)	New EU 2030 binding target for final and primary energy consumption (36–39 percent) underpinned by increased annual energy savings obligation of 1.5 percent for all Member States percent each year from 2024 to 2030, up from currently 0.8 percent, with 1.7 percent annual energy savings in the public sector facilitated by requirement of at least 3 percent of the total floor area renovation of all public buildings annually.
Alternative Fuels Infrastructure Directive (AFID)	Introduction of binding requirements for charging infrastructure (electric and hydrogen) deployment.
Regulation setting CO_2 emission standards for cars and vans	A 55 percent reduction (previously 37.5 percent) in emission intensity relative to 2021 required by 2030 for cars (50 percent for vans, previously 31 percent). All sales required to be zero-emission by 2035.
Energy taxation directive	Introduce a new structure of minimum tax rates based on energy content and environmental performance of fuels and electricity, rather than on volumes. Most polluting fuels to be taxed the highest. Member States must ensure this ranking is replicated domestically. Minimum rates adjusted annually, based on CPI inflation figures excluding energy and unprocessed food as published by Eurostat. Possibility to exempt for a maximum period of 10 years vulnerable and energy poor households from taxation on heating fuels and electricity. Broaden the tax base by including more products and by removing some exemptions and reductions. Reduced rates will be different for specific purposes, such as those for primary sector industries (e.g., farming). Fuel in the aviation industry and heavy oil in the maritime industry will no longer be fully exempt from energy taxation for intra-EU voyages. Over a period of ten years, the minimum tax rates for these fuels will gradually increase while sustainable fuels for these sectors will benefit from a minimum rate of zero to foster their uptake.

New Legislative Proposals	Main Proposals
Social Climate Fund	New fund to protect vulnerable households against potential price increases for heating and transport fuels, especially in regions where clean options are not readily available.
A Carbon Border Adjustment Mechanism (CBAM)	The mechanism will aim to equalize the carbon costs of imports and domestically produced goods in selected sectors (at present date, cement, fertilizer, iron and steel, aluminum and electricity) to minimize the risk of carbon leakage.
ReFuelEU Aviation—on sustainable aviation fuels	Obligation on fuel-suppliers to blend increasing levels of sustainable aviation fuels in jet fuel taken on-board at EU airports.
FuelEU Maritime—on greening maritime space	Introduction of a fuel standard limiting the emission content of energy used by ships calling at EU ports.

References

Alpino, Matteo, Luca Citino and Federica Zeni (2022), "Costs and Benefits of the "Green" Transition Envisaged in the Italian NRRP—An Evaluation Using the Social Cost of Carbon", Bank of Italy Occasional Paper, forthcoming.

Ambrosetti and Enel Foundation (2018) Electrify 2030.

ENEA (2020), Annual Report on Fiscal Incentives.

ENEA (2020), Annual Report on Energy Efficiency.

European Commission (2017), "Good Practices of Energy Efficiency".

European Commission (2020), Assessment of the Final National Energy and Climate Plan of Italy, Commission Staff Working Document.

European Investment Bank (2021), EIB Investment Report 2020/2021, "Building a Smart and Green Europe in the COVID-19 Era"

International Energy Agency (2021), Net Zero by 2050, A Roadmap for the Global Energy Sector.

Faiella and Lavechia (2021) "Households' Energy Demand and the Effects of Carbon Pricing in Italy", Banca D'Italia Occasional Papers 614.

IMF (2020), "Sectoral Policies for Climate Change Mitigation in the EU".

IMF (2020) "Mitigating Climate Change Growth and Distribution-friendly Strategies", Chapter 3 of World Economic Outlook

IMF (2021) "Not Yet on Track to Net Zero" IMF Staff Climate Note 2021/005

IRENA (2021) Investment Needs for the Global Energy Transformation

Ministry of Development (2019), Integrated National Energy and Climate Plan.

Ministry of Ecological Transition (2021), Catalog of Environmentally Friendly and Environmentally Damaging Subsidies"

Odyssee-Mure (2021) "Italy: Energy Efficiency Trends and Policies"

OECD (2021) "Opportunities and Challenges of Environmental Fiscal Reform in Italy"

OECD (2021), "An action Plan for Environmental Reform in Italy"

Zatti, Andrea (2020) "For an Ecological Fiscal Reform", an Ecco Think Tank Report.