INTERNATIONAL MONETARY FUND

Labor Market Implications for Green Investments and Carbon Pricing in Spain

SPAIN

Ana Lariau and Yu Shi

SIP/2023/001

***IMF Selected Issues Papers* are prepared by IMF staff as background documentation for periodic consultations with member countries.** It is based on the information available at the time it was completed on December 16, 2022. This paper is also published separately as IMF Country Report No 23/034.

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Labor Market Implications for Green Investments and Carbon Pricing in Spain
Prepared by Ana Lariau and Yu Shi

Authorized for distribution by Dora Iakova
January 2023

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Approved By
European Department

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CONTENTS

LABOR MARKET IMPLICATIONS OF GREEN INVESTMENTS AND CARBON PRICING IN SPAIN[1]

We provide a tractable framework for assessing the labor market impact of policies that support the green transition of the Spanish economy, taking into account input-output linkages. We present illustrative examples that quantify changes in sectoral employment, occupations and skills stemming from two different green policies: (i) the announced green investments in the recovery plan; and (ii) an increase in carbon pricing and an expansion of the EU Emission Trading System (ETS). Our analysis shows that the labor market impact of these two policies is net positive, although the results depend on the design of the green policies, particularly on the use of the proceeds from the increase in carbon pricing. Strengthening active labor market policies, with a focus on training, and complementing them with education policies such as the expansion of vocational training, would facilitate the transition of workers from shrinking to expanding sectors.

A. Green Policies in Spain[2]

1. **Spain has set ambitious climate mitigation objectives.** Spain's Law on Climate Change and the Energy Transition, enacted in 2021, establishes the goal of climate neutrality by 2050 at the latest, when the Spanish electricity system must be 100 percent renewable. Furthermore, the Law includes an intermediate target to reduce emissions by 23 percent relative to 1990 levels by 2030, as well as targets for 2030 for renewables to account for 42 percent of the country's energy mix, to generate 74 percent of its electricity (on a primary energy basis), and to reduce primary energy consumption by at least 39.5 percent by 2030.[3]

2. **Achieving these objectives will require significant policy efforts in the coming years.** The country's mitigation policies over the coming decade are guided by the National Integrated Energy and Climate Plan 2021–2030 (NECP). The Plan outlines sectoral actions necessary to meet the 2030 objectives. It envisages increasing renewable power installations and boosting the use of renewable gases in the power sector, modal shifts and electrification in the transport sector, refurbishments and increasing the use of renewable heating in the residential and commercial sectors, promoting energy efficiency and fuel switching in the industry sector, and energy efficiency improvements in the agricultural sector. The 2030 plan is complemented by a Just Transition Strategy to anticipate and manage the social implications of the ecological transition, and a Long-Term Strategy 2050 to ensure continuity in mitigations efforts beyond 2030.

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[1] Prepared by Ana Lariau and Yu Shi (both EUR).

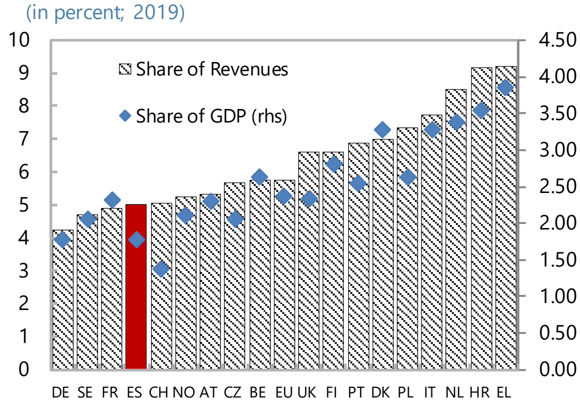
[2] This section is based on Spain: 2021 Selected Issues.

[3] In addition to the specified targets, Spain's climate law establishes specific policies, such as that no later than 2040 new passenger cars and light commercial vehicles will be vehicles with emissions of 0gCO2/km, and the establishment of low emission zones in urban centers with a population of at least 50 thousand by 2023. The law also strengthens the climate policy framework, with the creation of an Expert Committee tasked with submitting an annual report to Congress with policy evaluation and recommendations, among other elements.

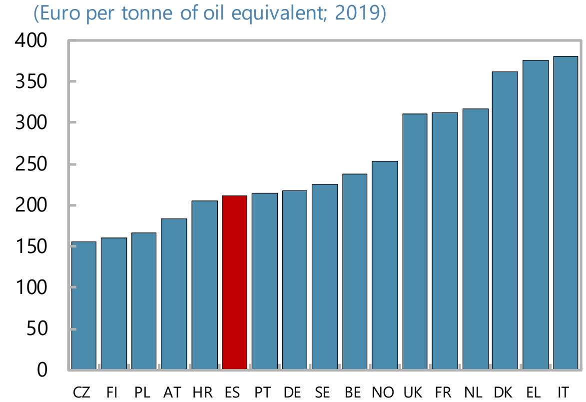
3. Our analysis focuses on two main policies to reduce emissions and boost the green economy: carbon pricing and green investments. For a detailed discussion on a broader set of policies to support the green transition see Spain: 2021 Selected Issues.

- *Carbon pricing*. Most emissions in each major emitting sector are subject to some form of carbon pricing, including via the EU ETS in the power and industry sectors, and via fuel duties in the road transport sector. An explicit domestic carbon tax on fluorinated greenhouse gases has been in place since 2014, covering 3 percent of Spain's total emissions. Nonetheless, effective carbon rates are low relative to estimates of carbon emission damage, and typically lower than in peer economies (in those sectors not covered by a common EU framework). There is also significant variation in levels across sectors. Several international, as well as expert committees set up by the Spanish government itself have recommended an increase in energy-environmental taxation. Spain's 2030 NECP acknowledges the potential role of carbon pricing as a policy tool for climate mitigation, and authorities are in the process of conducting an in-depth review of the environmental taxation.

Environmental Taxes
(in percent; 2019)



Implicit Tax Rate on Energy
(Euro per tonne of oil equivalent; 2019)



Sources: Eurostat, and IMF staff calculations.
Note: Environmental taxes include on energy (including explicit CO2 taxes and EU ETS), transport, and pollution/resources. Implicit tax rate on energy is the ratio of energy taxes to final energy consumption.

- *Green investments*. Spain's Recovery, Transformation and Resilience Plan (RTRP) seeks to leverage EU funds to support the economic recovery from the Covid-19 crisis while promoting a structural shift to a more inclusive, digital and greener economy. About 40 percent of the announced investments (€77.2 billion, 5.9 percent of 2022 GDP) for the period 2021–23 are allocated to green projects, with initial investments prioritizing clean energy, sustainable mobility and building efficiency renovations.

B. The Labor Market Impact of Green Investments and Carbon Pricing

Green Investments: Modeling and Multipliers

4. Green investments are modelled as a labor productivity shock since it would increase the level of physical capital and improve sectoral labor productivity. The initial impact on sector-specific labor productivity is computed using information on the green investments announced in the RTRP and on the stock of fixed assets by industry from Eurostat. The analysis is based on the NACE Rev.2 sectoral disaggregation at the 1-digit level, covering 18 sectors.

Main Green Investments Under the Recovery Plan

Project	Sector	EUR million 2021–23	% of 2018 Capital Stock
Sustainable, safe and connect mobility	Transport	13203	6.39
Building renovation and urban renewal	Construction	6820	1.93
Deployment and integration of renewable energy	Eletricity, gas, power	3165	
Roadmap for renewable hydrogen	Eletricity, gas, power	1555	6.62
Energy infrastructures, smart networks, storage	Eletricity, gas, power	1365	
Conservation and restoration of ecosystems and biodiversity	Agriculture	1642	2.89
Preservation of the coastline and water resources	Water and waste management	2091	3.64

Sources: OECD and IMF staff calculations.

5. We use input-output linkages across sectors to estimate the impact of green investments on output and employment. The direct and indirect multipliers for each sector are computed using the 2018 (latest available) input-output table for Spain. In principle, higher labor productivity for a given sector implies lower relative prices, and lower production costs for downstream sectors. Thus, well-connected upstream sectors, such as mining, transportation, and support services, are expected to see large indirect impact on aggregate output. We used NACE 2-digit sectors for analyzing the propagation of green investments along the input-output network.[4] See Annex I for details on the calculation of the output and employment multipliers.

Carbon Pricing

6. We quantify the impact of changes in carbon pricing on employment using estimates from the literature. The estimated impact of carbon pricing on sectoral output is taken directly from Aguilar, González and Hurtado (2022)**.** These authors already incorporate the propagation of carbon pricing through input-output linkages. They compute changes of sectoral GVA in four carbon-pricing scenarios: (i) an increase in the price of CO2 emissions from €25 to €100 per ton; (ii) an expansion of the coverage of the ETS system, to fully cover all emissions from all firms, of all sectors; (iii) a combination of (i) and (ii); and (iv) a combination of (i) and (ii) with the revenue from those measures used to finance a reduction in labor taxes. For our baseline analysis, we map changes in sectoral GVA to changes in employment using the results from scenario (iv). We also produce an alternative scenario based on (iii); detailed results are reported in Annex II. The difference between the two scenarios highlights the importance of using carbon revenues effectively to reduce distortionary taxes and support growth.

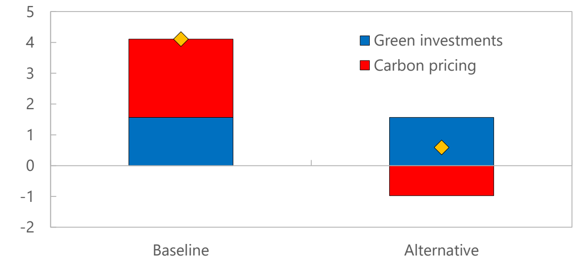
[4] In order to map the investment shock at the 1-digit sector to the 2-digit level input-output table, we assume the same investment shock (in percent change of sectoral capital stock) to each subsector with in the same 1-digit sector.

The Employment Impact of Green Policies

7. While the employment impact of green investments is unequivocally positive, the one of carbon pricing is ambiguous and largely depends on how the collected revenue is used. In our baseline simulation using scenario (iv) from [Aguilar, González and Hurtado (2022)](), carbon pricing has a positive effect on sectoral employment, since the revenue collected from carbon pricing is used to reduce labor taxes. As a result, both green investments and carbon pricing go in the same direction and together the two initiatives would increase overall employment by about 4 percent. Nevertheless, the effect of carbon pricing could be smaller or even negative under different assumptions. In the alternative scenario with the increase in carbon pricing and the expansion in ETS but without the redistribution of the proceeds via lower labor taxes, the employment effect goes down to only 0.6 percent (see Annex II for more details). This is because the employment gains from the green investments are partially offset by the employment losses from higher carbon pricing.

Employment Growth Due to Green Policies

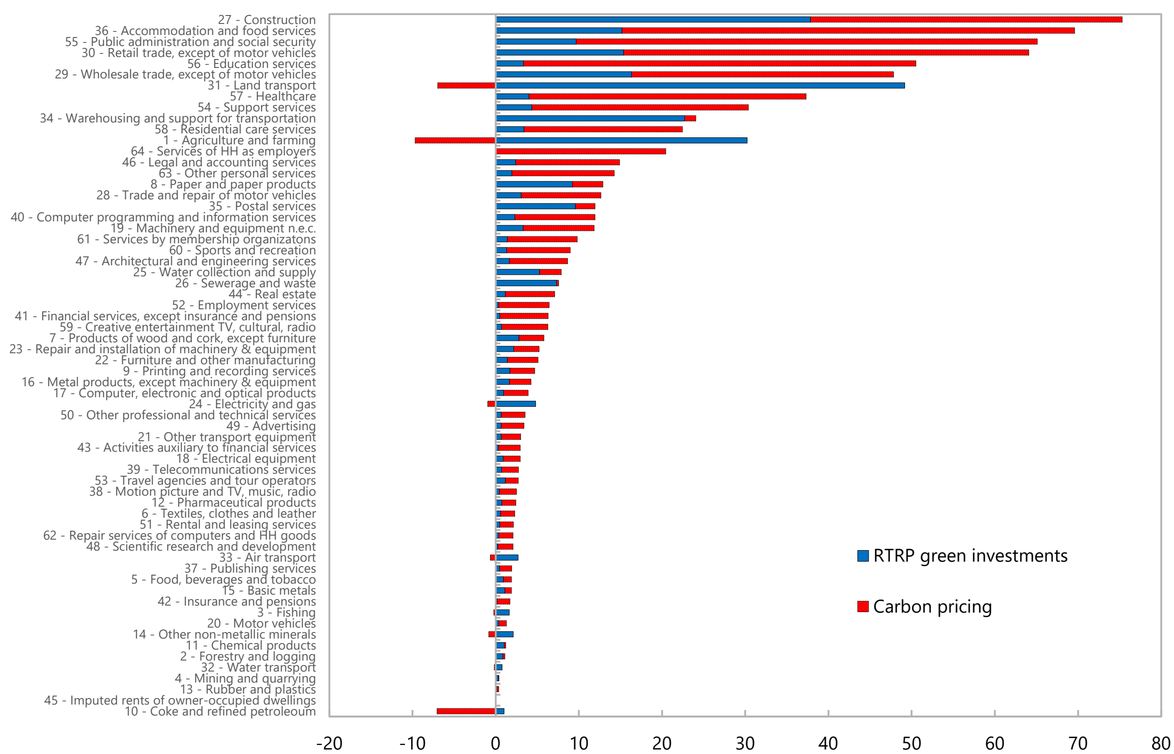
(Percent, relative to 2019Q4)



Source: IMF staff calculations.
Note: The difference between the baseline and the alternative scenarios corresponds to the carbon pricing shock. The baseline scenario assumes an increase in the price of CO2 emissions from €25 to €100 per ton and an expansion of the coverage of the ETS system, with the revenue from those measures used to finance a reduction in labor taxes. The alternative scenario is the same as the baseline but without the redistribution of revenues via lower labor taxes.

Employment Changes Due to Green Policies

(Thousands of persons)



Source: IMF staff calculations.

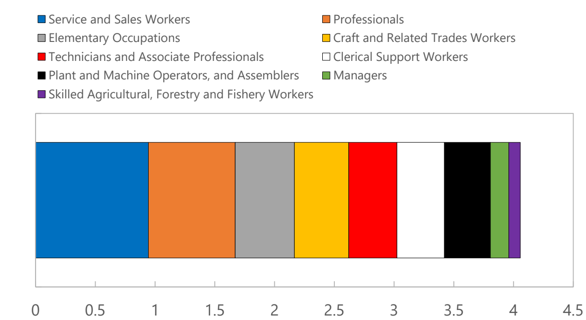
8. The impact of green investments and carbon pricing is heterogenous across sectors. Coke and Refined Petroleum would experience large declines in employment, which will be offset by significant increases in the other sectors. In the baseline scenario, the positive effects on sectoral employment are mainly due to the carbon pricing shock—more specifically, from the positive effects of labor tax reductions that were made possible by the additional fiscal revenues. In some sectors, the increase in green investment also plays an important role. For example, carbon pricing would negatively impact employment in land transport and agriculture, but this effect would be more than offset by the increase in employment triggered by the green investments in these sectors.

From Changes in Sectoral Employment to Changes in Occupations

9. We map changes in sectoral employment associated with the two greening shocks to changes in occupations. We do so by using the distribution of occupations by sectors in the 2019 Labor Force Survey for Spain. For this exercise we consider a 1-digit and 2-digit disaggregation of occupations according to the ISCO classification.

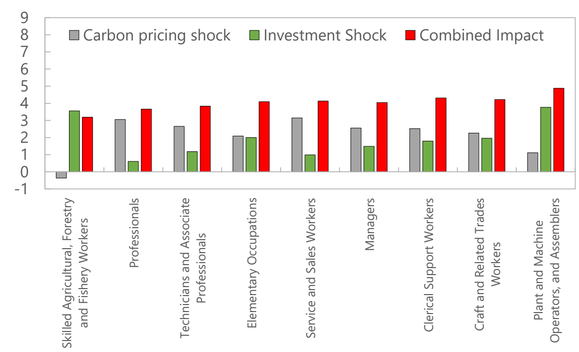
10. More than half of the overall increase in employment is concentrated in three occupations. Services and sales workers, professionals, and elementary occupations together would contribute more than 2 percentage points to the 4-percent increase in employment due to the greening shocks. The growth of employment in services and sales workers and professionals is largely driven by the carbon pricing shock, while in the case of elementary occupations both shocks contribute more or less in the same proportion. The impact of the investment shock is more prominent among skilled workers in primary occupations and among plant and machine operators and assemblers. However, their shares in total employment tend to be small, resulting in a limited contribution to employment growth.

Contributions to the Change in Employment by One-Digit Occupation Groups
(Percentage points)



Sources: Eurostat and IMF staff calculations.

Change in Employment by One-Digit Occupation Groups
(Percent, with respect to 2019Q4)



Sources: Eurostat and IMF staff calculations.

11. Within occupations, there is heterogeneity in the contributions to employment growth by sub-categories. In the case of services and sales workers, the main sub-categories include personal service and sales workers, while the contribution of personal care and protective services workers is more contained. For professionals, the contributions by sub-categories are more evenly distributed, with the largest contribution from teaching professionals. The same observation is valid for elementary occupations, with relatively larger contributions by cleaners and helpers and by laborers in mining, construction, manufacturing and transport. Among the categories with relatively smaller contributions, it is worth mentioning some sub-categories with particularly large contributions, such as: building and related trades workers within craft and related trades; drivers and mobile plant operators within plant and machine operators and assemblers; and skilled agricultural workers within skilled workers in primary activities.

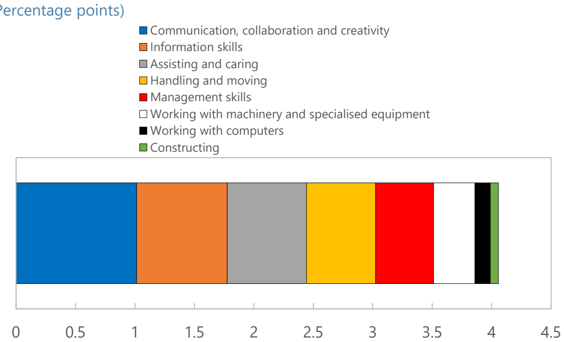
From Changes in Occupations to Changes in Skills

12. The changes in occupations are then mapped to changes in skills. We do so by using the distribution of skills for each 1-digit ISCO occupation, as reported in the skills-occupation matrix tables recently published by ESCO. For this exercise we consider a 1-digit and 2-digit disaggregation of skills according to the ESCO classification.

13. As in the case of occupations, more than 60 percent of the growth in employment can be attributed to just three sets of skills, though with great heterogeneity across sub-categories. Communication, collaboration and creativity, information skills, and assisting and caring contribute with 2.4 percentage points to the 4-percent increase in employment. In terms of sub-categories, there are two that have particularly large contributions: monitoring, inspecting and testing within information skills, and protecting and enforcing within assisting and caring. These categories include sub-skills that could be associated with the green economy such as testing vehicles and monitoring environmental conditions (within monitoring, inspecting and testing) and complying with environmental protection laws and standards (within protecting and enforcing).

Contributions to the Change in Employment by One-Digit Skill Groups

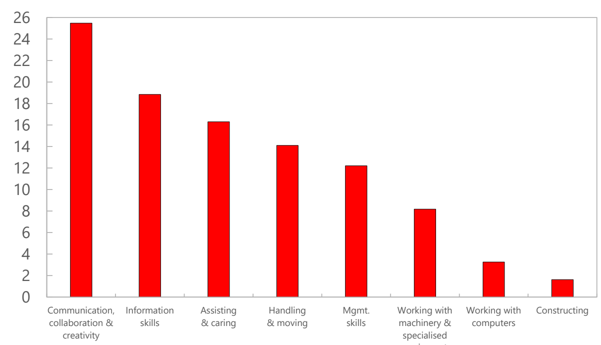
(Percentage points)



Sources: Eurostat and IMF staff calculations.

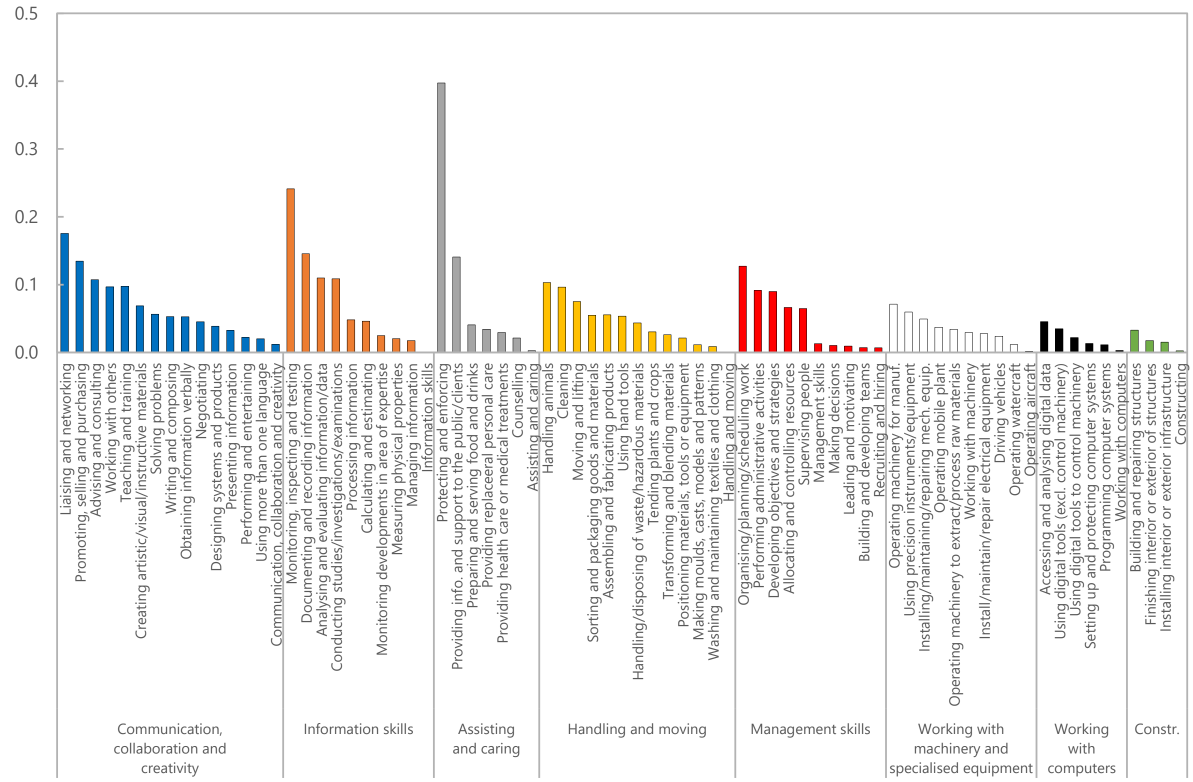
Distribution of Skills

(Percent of total employment, 2019)



Sources: Eurostat, ESCO and IMF staff calculations.

Contributions to the Change in Employment by Two-Digit Skill Groups
(Percentage points)



Sources: Eurostat and IMF staff calculations.

C. Conclusions and Policy Recommendations

14. This paper provides a tractable framework, which takes into account input-output linkages across sectors, to assess the labor market impact of green investments and policies. Such framework is used to quantify changes in sectoral employment, occupations and skills stemming from: (i) the announced green investments in the recovery plan; and (ii) a possible increase in carbon pricing and expansion of ETS, based on the scenarios developed by Aguilar, González and Hurtado (2022).

15. Productive green investments can help support employment growth and lead to labor reallocation during the green transition. The green investments contemplated in the recovery plan correctly target sectors that need upscaling to adapt to the green transition. Nevertheless, the results discussed in this chapter may change if information on green investments or the distribution of occupations across sectors is available at a more granular level. Ensuring effective implementation of these investments and continued proper identification of future investment projects are critical for the positive effects from green investments to materialize.

16. Even in an optimistic scenario, some sectors—the most polluting ones—would suffer employment losses and their workers would likely need to transition to expanding sectors. Coke and Refined Petroleum would be the main sector that could suffer employment losses from the combined effect of the greening shocks because the negative impact from carbon pricing is not offset by the positive impact from the investment projects. For this shrinking sector, it is crucial to strengthen ALMPs, with focus on training, to facilitate reallocation. Spain has introduced reforms to promote reskilling and requalification of workers, including in shrinking sectors. The 2021 labor reform incorporated training incentives to the short-time work schemes (ERTEs and the new RED mechanism). In particular, the Sectoral-RED Mechanism, which targets economic sectors that are experiencing structural changes, requires companies to develop a requalification plan for affected workers. Spain's RTRP also contemplates reforms to strengthen ALMPs with the aim of improving labor matching and addressing skill mismatches. The proposed legal framework foresees the creation of personalized itineraries to support training and re-skilling of low-employability groups, focusing on the development of those skills that companies demand the most.

17. The design of carbon pricing policies is critical for the employment outcomes during the green transition. Our baseline results rely crucially on the assumption that carbon pricing proceeds would be redistributed in the form of a uniform reduction of labor taxes. Given that the reduction of labor taxes equalizes across sectors and occupation, the redistribution would lead to positive employment effects across-the-board without creating any incentives for labor reallocation. A different use of the proceeds from carbon pricing would in principle result in a different outcome.

18. There are other greening policies the effect of which could in principle be analyzed using the framework of this paper. Sectoral climate policies, including regulations and standards, will be essential to address sector-specific obstacles to reducing emissions, particularly in the transport, building and power sectors. For a detailed discussion on these complementary policies to support the green transition see Spain: Selected Issues (2022).

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Annex I. Estimation of Output and Employment Multipliers Using the Input-Output Approach

The Input-Output Structure of the Economy

We model the Spanish economy as consisting of n competitive sectors, denoted by $\{1,2,\dots,n\}$. Each sector produces a distinct product using intermediate goods produced by other sectors and labor as inputs. The production function is Cobb-Douglas, and the output of industry i can be written as:

$$y_i = z_i l_i^{\alpha_i} \prod_{j=1}^{n} x_{ij}^{a_{ij}}, \tag{1}$$

where l_i is the amount of labor hired by firms in sector i, x_{ij} is the quantity of good j used for production of good i as intermediate inputs, and z_i is the labor productivity in sector i. α_i and a_{ij} are the labor and intermediate input shares, characterized by the following equations (assuming p_i is the price of good i and w is the equilibrium wage):

$$\alpha_i = \frac{wl_i}{p_i y_i}, a_{ij} = \frac{p_j x_{ij}}{p_i y_i} \tag{2}$$

$$\alpha_i + \sum_{j=1}^{n} a_{ij} = 1$$

The Propagation of Supply/Productivity Shocks

Production function (1) can be re-written as:

$$\log y_i = \log z_i + \alpha_i \log l_i + \sum_{j=1}^{n} a_{ij} \log x_{ij}, \tag{3}$$

which describes the direct impact of a supply shock to labor productivity z. Suppose that industry j is hit by a negative shock to productivity z_j that reduces its production and thus increases the price of good j, for example a higher tax imposed to the final product, the increase in prices would affect all industries that use good j as an intermediate input for production, thus creating a direct impact on j's consumer industries. The direct multiplier is then just the coefficient of the input output matrix, a_{ij} (assuming a partial equilibrium, so prices in other sectors as well as wages do not respond. The change in sectoral employment is:

$$\Delta \log l_i = \frac{\Delta \log y_i}{\alpha_i} = \frac{a_{ij}}{\alpha_i} \Delta \log z_j \tag{4}$$

The input-output connections across sectors can be summarized with a matrix:

$$A = [a_{ij}],$$

which we refer to as the economy's input-output matrix. Plugging equations (2) into the log-linearized production function (3), we get:

$$\log\left(\frac{p_i}{w}\right) = \sum_{j=1}^{n} a_{ij} \log\left(\frac{p_j}{w}\right) - \log z_i$$
$$\Rightarrow \hat{p} = -(\mathrm{I} - \mathrm{A})^{-1} \log z\,,$$

where the relative price vector is defined as $\hat{p} = (\log\left(\frac{p_1}{w}\right), \log\left(\frac{p_2}{w}\right), \ldots, \log(\frac{p_n}{w}))'$. Combining households' Cobb-Douglas utility function and define $H \equiv (I - A)^{-1}$, we can further write the log output of each industry as.[1]

$$\ln y = H \ln z + constant$$
$$\Rightarrow \ln y_i = \sum_{j=1}^{n} h_{ij} \ln z_j + constant \quad (5)$$

Equation (5) captures the direct and indirect spillover of supply shocks (or productivity shocks): the initial impact characterized in equation (4) will also result in further propagation to the downstream sectors through the input-output linkages. The prices of goods produced by industries affected in the first round of propagation will increase, creating an indirect negative effect on their own customer industries, and so on.

The reason that productivity shocks do not propagate upstream to the suppliers is a result of modeling assumptions: (a) Cobb-Douglas preferences and technologies, (b) a single factor of production (in this case labor), and (c) constant returns to scale. (b) and (c) together ensure that productivity shocks only affect upstream sectors through wage changes, prices relative to the wage are not affected.[2]

Supply Shock Multipliers

The direct and indirect multipliers of the sectoral supply shock—i.e., the green investment shock—are summarized in the charts below.

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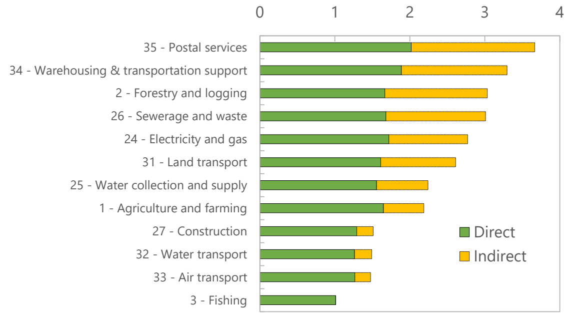
[1] For the proof equation (5), see Acemoglu et al. (2015) and Carvalho and Tahbaz-Salehi (2019).

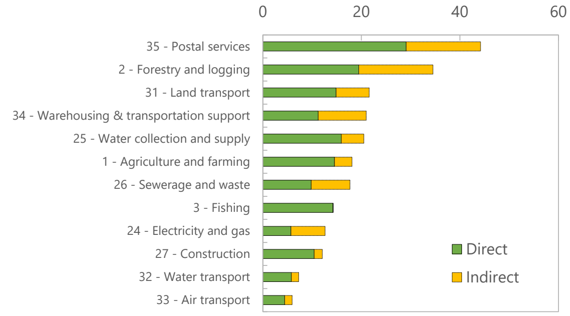
[2] For more discussions on the features of the model and possible extensions (including imperfect competition, and non-constant return to scale, etc.), see Carvalho and Tahbaz-Salehi (2019).

Green Investments: Output Multiplier by Sector
(Increase in gross output--measured in Euros--per Euro of additional output in a given industry)



Sources: IMF staff calculations.
Note: The chart shows the 12 two-digit sectors with the largest multipliers.

Green Investments: Employment Multiplier by Sector
(Increase in employment--measured in persons--per 1 million additional output in each industry)



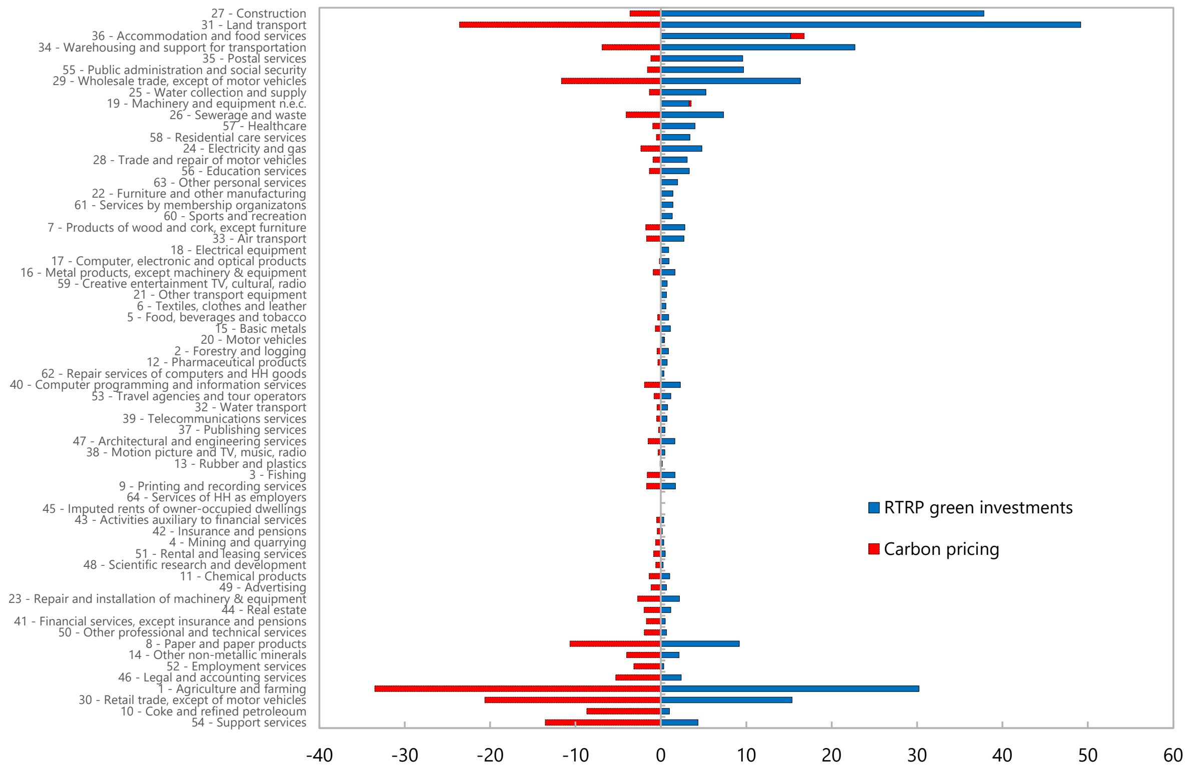
Sources: IMF staff calculations.
Note: The chart shows the 12 two-digit sectors with the largest multipliers.

Annex II. Results for the Alternative Carbon Pricing Shock Scenario, Not Taking into Account the Redistribution of Revenue Proceeds

Annex II. Figure 1. Employment Changes Due to Green Policies

Employment Changes Due to Green Policies

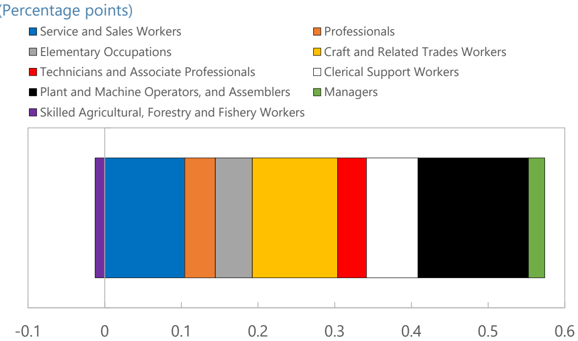
(Thousands of persons)



Source: IMF staff calculations.

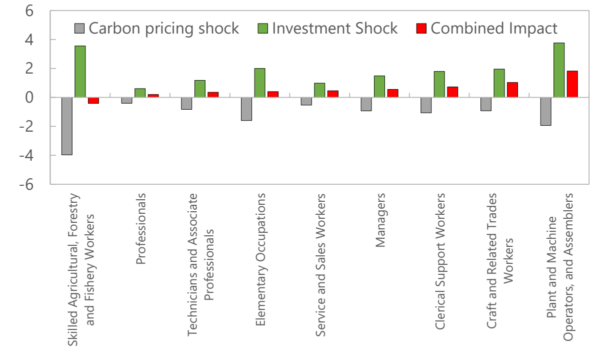
Annex II. Figure 1. Employment Impact Across Occupations and Skills Groups

Contributions to the Change in Employment by One-Digit Occupation Groups
(Percentage points)



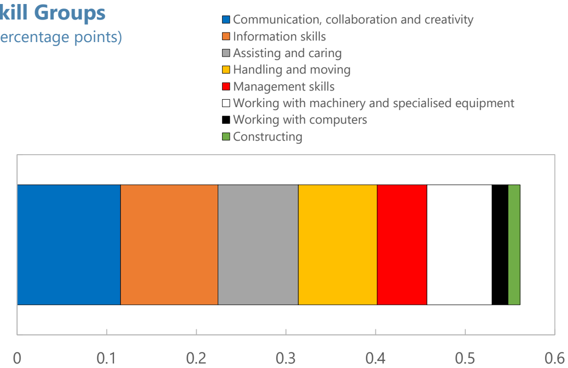
Sources: Eurostat and IMF staff calculations.

Change in Employment by One-Digit Occupation Groups
(Percent, with respect to 2019:Q4)



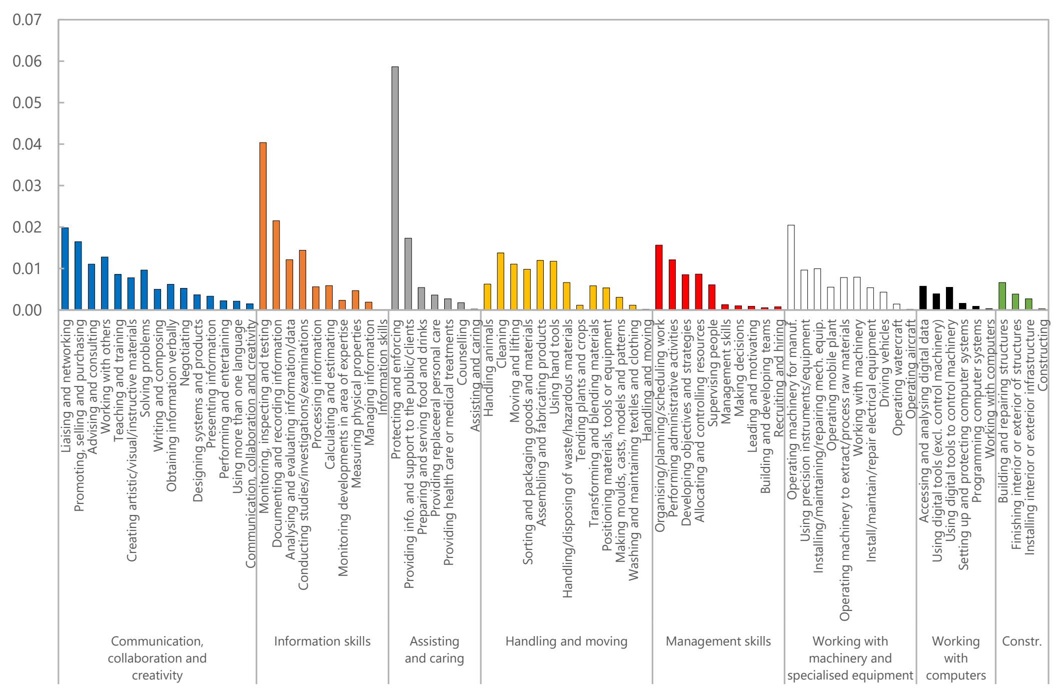
Sources: Eurostat and IMF staff calculations.

Contributions to the Change in Employment by One-Digit Skill Groups
(Percentage points)



Sources: Eurostat and IMF staff calculations.

Contributions to the Change in Employment by Two-Digit Skill Groups
(Percentage points)



Sources: Eurostat and IMF staff calculations.