

INTERNATIONAL MONETARY FUND

# The Financial Impact of Carbon Taxation on Corporates

Japan

Jochen M. Schmittmann

SIP/2023/034

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 in March 2023. This paper is also published separately as IMF Country Report No 23/128.

**2023**  
**MAY**



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**IMF Selected Issues Paper**  
Asia and Pacific Department

**The Financial Impact of Carbon Taxation on Corporates**  
**Prepared by Jochen M. Schmittmann**

Authorized for distribution by Ranil Salgado  
May 2023

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**ABSTRACT:** Japan’s commitment to achieve net zero emissions by 2050 will likely require substantial carbon pricing. Corporates appear to be able to absorb a sharp increase in carbon taxes on average, but there is a substantial weak tail of firms that could face financial stress. The analysis underscores the need to align the private sector and public policies with Japan’s climate targets to ensure a smooth transition to net zero.

**RECOMMENDED CITATION:** SCHMITTMANN, J. M. 2023. “The Financial Impact of Carbon Taxation on Corporates.” IMF Selected Issues Paper (SIP/2023/034). Washington, D.C.: International Monetary Fund.

JEL Classification Numbers:	G32, H25, Q51, Q54
Keywords:	Carbon Taxation, Carbon Pricing, Debt-at-Risk, Climate Change, Japan.
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SELECTED ISSUES PAPERS

# **The Financial Impact of Carbon Taxation on Corporates**

Japan

Prepared by Jochen M. Schmittmann <sup>1</sup>

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<sup>1</sup> The author would like to thank Yun Gao (OAP) for excellent research assistance and the Japanese authorities for providing helpful comments.



# JAPAN

## SELECTED ISSUES

March 2023

Approved By  
**Asia and Pacific  
Department**

Prepared By Jochen Schmittmann

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# THE FINANCIAL IMPACT OF CARBON TAXATION ON CORPORATES<sup>1</sup>

## A. Introduction

**1. Japan's transition to net zero carbon emissions will require a transformation of the economy.** Japan is committed to reaching net zero greenhouse gas (GHG) emissions by 2050, with an upgraded interim target for a 46 percent reduction in GHG emissions by 2030, relative to 2013 levels. These targets will require a substantial transformation of the Japanese economy, presenting risks and opportunities to businesses, and associated policies will have distributional consequences. Pricing carbon emissions at much higher rates than currently will likely be necessary, either through a carbon tax or an emission trading scheme, as part of a green transformation policy package (IMF 2022a).<sup>2</sup>

**2. Companies and by extension the financial sector face risks from the transition to net zero.** Climate transition risk drivers are public policy shifts including carbon pricing, technology shifts, and changes in investor and consumer preferences (IMF 2019a). Parts of the economy with large GHG emissions are most exposed. In Japan, this includes the electricity and power, transport, and industrial sectors (see next section). Decarbonization of the electricity and power sector is particularly important in Japan given the large contribution of this sector to total emissions and its continued high usage of fossil fuels.

**3. This note presents a simple approximation of the impact of higher carbon taxes on Japanese firms.** Our calculations assume that firms fully absorb a carbon tax levied on their emissions. In practice, output prices and quantities, production processes, inputs, and the overall structure of the economy would all adjust. Modeling this is highly complex and requires a general equilibrium approach with strong assumptions that is beyond the scope of this note. Our results should be interpreted as a likely upper bound of the impact of carbon pricing on firms and a complement to the Bank of Japan/Financial Services Agency climate stress scenario analysis (2022) and banks' efforts to quantify climate risk exposures. The analysis provides insights into which sectors and firms are vulnerable. It underscores the need to prepare the most exposed corporates for the transition to reduce risks. This requires firms to develop strategies to comply with lower emissions. The financial sector plays a role in monitoring and pricing risks, and in working with corporates to address transition risks. Public policy needs to support firms in the transition through investment in decarbonization and green technologies, clarity on mitigation policies to enable

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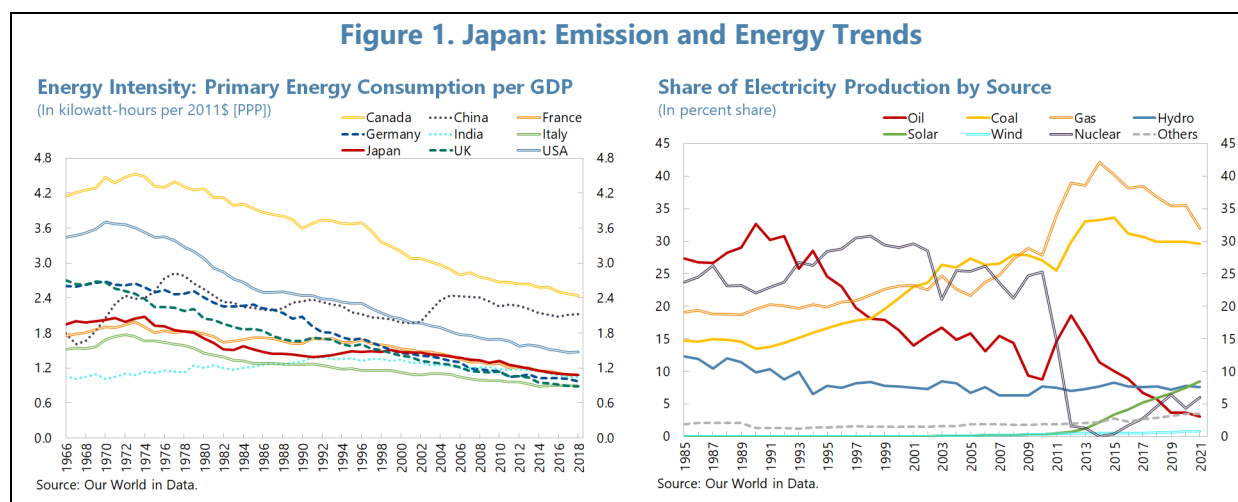
<sup>1</sup> Prepared by Jochen M. Schmittmann (OAP). Yun Gao (OAP) provided excellent research assistance.

<sup>2</sup> In addition to petroleum and coal taxation, in 2012 Japan introduced a carbon pricing mechanism, the Tax for Climate Change Mitigation (TCCM), on fossil fuel. The current TCCM tax rate is 289 yen (about \$2) per ton of CO<sub>2</sub>. Voluntary cap-and-trade emission trading mechanisms are in place in Tokyo Metropolitan City and Saitama Prefecture.

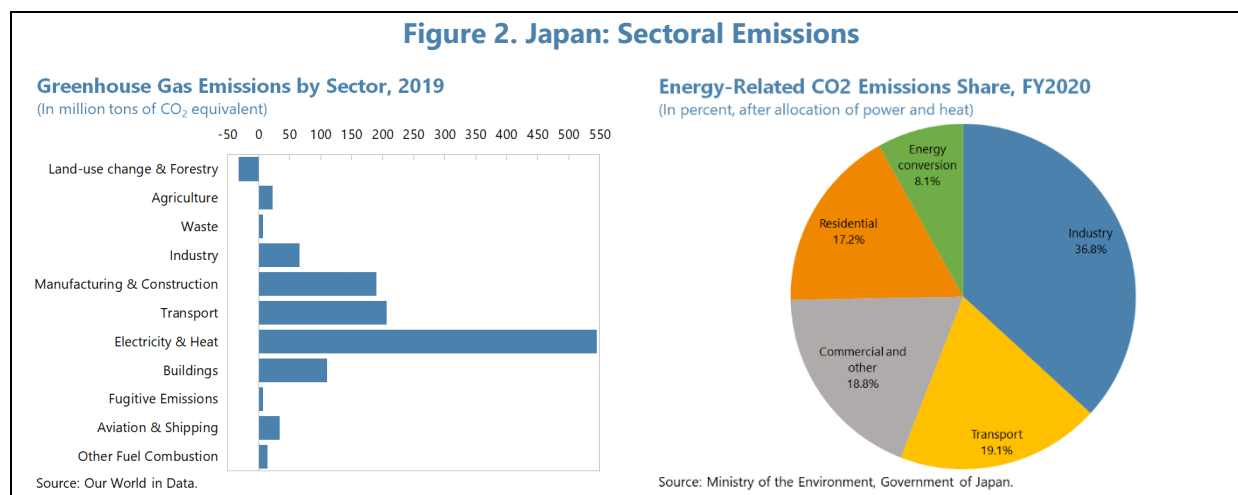
corporate planning, support for green and transition finance, and climate risk assessments and management.

## B. Emission Trends in Japan

**4. Reliance on fossil fuels remains high (Figure 1).** The emission-intensity of GDP has fallen less over the last three decades in Japan than in most other major advanced economies. Decarbonizing energy production is particularly challenging—the emission intensity of energy production has been stagnant since the 1960s and is now higher in Japan than in most other major advanced economies. Fossil fuels account for about 85 percent of primary energy production. Renewable energy production has almost doubled since 2011, but at the same time nuclear energy production dropped following the accident at the Fukushima Daiichi nuclear power plant in 2011.



**5. Electricity and heat production are the largest sources of emissions, but they mostly serve as inputs for other sectors (Figure 2).** Electricity and heat production account for close to half of Japan's GHG emissions underscoring the need to decarbonize this part of the economy to achieve carbon neutrality. Transport, manufacturing and construction, buildings, and industry are also important emission sources, even when not counting emissions from purchased electricity and heat in these sectors. Since electricity and heat are mostly inputs for other sectors, another way to look at the sectoral emission profile is to allocate electricity and heat related emissions to the sectors that use these as inputs (right hand side chart, CO<sub>2</sub> only). With this, industry is the largest source of emissions at 36.8 percent followed by transport, commercial activities (commerce, services, offices, etc.), and residential.



## C. Methodology and Data

**6. We approximate the financial impact of carbon tax scenarios on Japanese firms.** We use firm level emission and balance sheet data to calculate changes in listed firms' interest rate coverage ratios (ICR) for two carbon tax levels: \$75 and \$150 per ton of CO<sub>2</sub> equivalent.<sup>3</sup> The \$75 carbon tax corresponds to the level estimated by IMF staff as necessary on average by 2030 to limit global warming to 2° Celsius (IMF 2019b). The \$150 scenario stands for the higher carbon tax levels that could be required if climate action continues to be delayed and climate policies are not fully credible (IMF 2022c). ICRs are defined as earnings before interest and taxes (EBIT) divided by interest payments. We calculate current ICRs and ICRs under the two carbon tax scenarios. ICRs under carbon tax scenarios are calculated by subtracting the product of the assumed carbon tax level and a firm's GHG emissions from EBIT.

**7. The approach makes the simplifying assumption that firms fully absorb any carbon tax.** The assumption implies that firms do not adjust output prices and quantities, and production inputs. In practice, the entire production chain and consumers' choices would adjust to carbon taxation which should lead to lower carbon emissions. The no-pass-through assumption should therefore imply that our estimates of the firm level impact of carbon taxation provide an upper bound of the financial impact on firms.

**8. The scope of measurement of firms' emissions affects the assessment of the impact of carbon pricing.** Scope 1 emissions cover direct emissions from owned or controlled sources. Scope 2 emissions cover indirect emissions from the generation of purchased electricity, steam, heating, and cooling consumed by the reporting company.<sup>4</sup> We present results for firms' combined scope 1 and 2 GHG emissions and scope 1 emissions only. For firms that generate emission intensive inputs

<sup>3</sup> Our approach follows the analysis in Grippa and Mann (2020) conducted in the context of the Norway Financial Sector Assessment Program. A methodological difference is that we use actual firm level emissions data instead of applying industry level average emissions.

<sup>4</sup> Scope 3 emissions cover firms' entire upstream and downstream value chain. This measure of emissions is difficult to compile, and data availability is limited.

for other industries, the analysis overstates the carbon pricing impact. For example, the scope 1 emissions of a utility company will mostly appear as scope 2 emissions of other firms that purchase electricity from the utility. On the other hand, only including scope 1 emissions would downward bias the results for downstream industries that purchase most of their power inputs. In addition, the analysis does not consider any foreign carbon pricing or border adjustment mechanisms which would affect imported inputs and exports.

**9. Our sample includes listed Japanese firms.** Financial and emission data are obtained from Bloomberg. The sample is close to the entire universe of Japanese listed firms excluding financials for which ICR as a measure of financial health is not comparable. For about half the dataset by revenues and assets, we have firm level emission data. For another 20 percent of firms by revenues and assets, we have at least one year of emissions data. For these firms we fill in missing years by assuming that the ratio of emissions to revenue remains constant. For the remaining 30 percent of firms that do not report emissions, we assume that emission intensities are equal to the average of their respective industries. We confirm the robustness of our results for the full sample in unreported results for emission reporting firms only.<sup>5</sup>

## D. Results

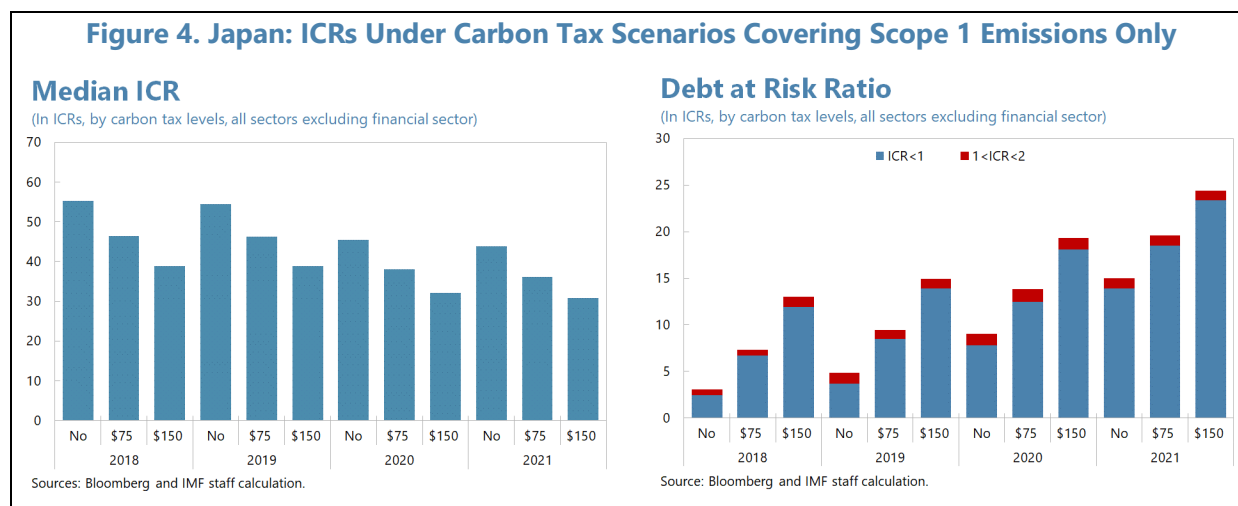
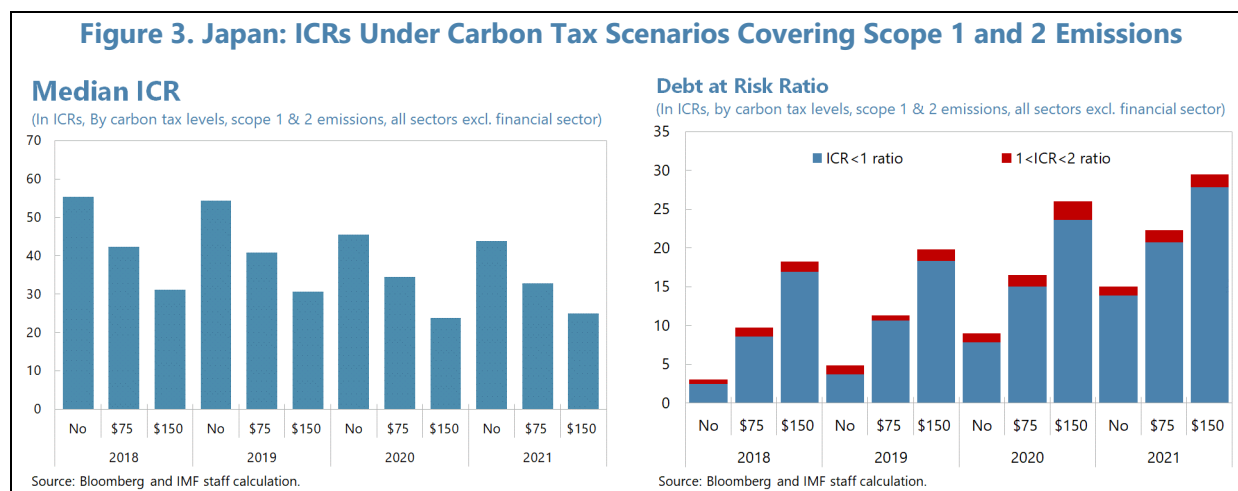
**10. Median ICRs across all sectors remain high even under a \$150 carbon tax, but there is a significant weak tail of firms with high debt at risk (Figure 3).** The median actual ICR in 2021 for Japanese listed firms is high at 44, although below pre-pandemic levels (55 in 2018). With a carbon tax at \$75 on scope 1 and 2 emissions, the ICR for the sample drops to 33, and with a tax at \$150 in declines to 25. These median ICR numbers with carbon taxation fully absorbed by firms are still comfortable—averages are even much higher—but there is a sizeable tail of firms in a weak financial situation. The share of firms in 2021 for which EBIT does not cover interest payments (ICR < 1) is 14 percent and another 1 percent of firms have an ICR between 1 and 2. This weak tail of firms has substantially increased as a consequence of the pandemic—in 2018 only about 2.5 percent of firms had an ICR below 1. With a carbon tax at \$75 on scope 1 and 2 emissions, the share of firms with an ICR below 1 increases to 21 percent and with a carbon tax at \$150, the share increases to 28 percent. In a scenario where only scope 1 emissions are taxed, the impact on firms is expectedly smaller (Figure 4). In this case, the share of firms with an ICR below 1 increases to 19 percent with a carbon tax at \$75 and to 23 percent with a carbon tax at \$150.

**11. At a sectoral level, energy, materials, and utilities are severely affected by carbon pricing (Figure 5).** This is unsurprising given high scope 1 emissions in these sectors, and it suggests a particular vulnerability in these sectors to transition risks. In practice, companies in these sectors would at least partially pass on higher carbon taxes to firms in other sectors and consumers. At the same time, demand would also shift, for example, toward renewable energy, so that even if our strong full cost absorption assumption is relaxed, these sectors are likely most at risk from the

<sup>5</sup> Results are qualitatively similar, and conclusions remain unchanged. For the smaller sample of emission reporting firms, ICRs tend to be higher.



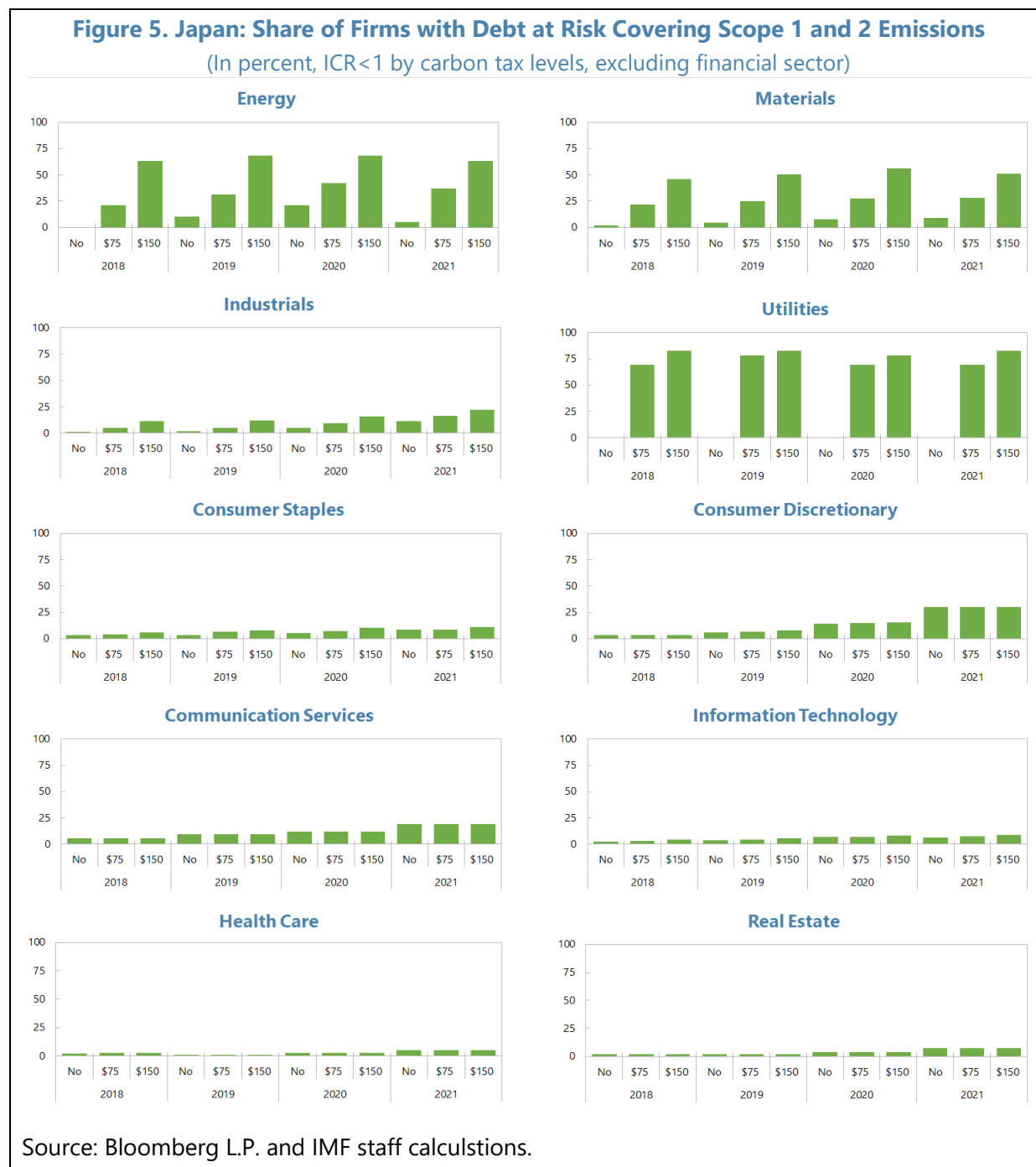
net zero transition.<sup>6</sup> Carbon pricing would have a smaller but still substantial effect on firms in other industries. The percentage of firms with debt at risk with a carbon price at \$150 on scope 1 and 2 emissions would be 35 percent in the consumer discretionary classification, 27 percent for industrials, 19 percent for communication services, and 15 percent for consumer staples. For firms in these industries, a substantial part of the impact stems from scope 2 emissions.



**12. Banks’ exposure to transitions risks is determined by their lending portfolio and other asset holdings.** While a translation of our firm-level results of exposure to carbon taxation into banks’ risk exposures is beyond the scope of this note, sectoral lending data can provide some insights. Japanese G-SIBs’ exposure to energy and utilities is in the 6-8 percent range, and most smaller banks have smaller exposures to these sectors (IMF 2022b). There are substantial bank loan exposures to other, less affected sectors, and a full analysis would require detailed loan exposure

<sup>6</sup> The high transition risk exposure assessment for the energy and utilities sectors is in line with recommendations by the Task Force on Climate-Related Financial Disclosures (TCFD), stock market pricing of climate risks (see IMF 2022b), and the assessment of Japanese G-SIBs.

data. Scenario-based analysis by the Bank of Japan and the Financial Services Agency (2022) suggests that “the annual average of estimated transition risk credit costs [...] is considerably lower than the average annual net profits of each bank”. The analysis also shows that transition risk credit costs are concentrated in high emission sectors including energy, power, steel, and automotive.



## E. Conclusion and Policy Implications

**13. The simple analysis demonstrates the need for parts of Japan's corporate sector to step up readiness to comply with the country's net zero emission commitment.** There is a significant weak tail of firms following the pandemic that is not able to cover interest payments out of profits. With carbon taxes at \$75 or \$150 on scope 1 and 2 emissions, the share of firms with ICRs below 1 would increase by 7 percent and 14 percent, respectively. On a sectoral level, energy, utility, and materials companies are most exposed to carbon pricing given their high direct emissions, while downstream sectors are significantly impacted through emissions related to purchased power and electricity.

**14. Policies should focus on aligning companies with national level emission reduction targets and managing climate transition risks.** At the firm level, efforts are needed to incorporate public policies that will require much lower emissions into business strategies. This should be complimented by better climate related corporate disclosures. The financial sector and particularly banks need to consider transition risks in their lending decisions which will help to allocate capital in line with climate targets. The efforts aimed at quantifying and managing climate financial risks by Japanese policymakers and financial institutions are appropriate in this context. Beyond risk management, the public sector plays a pivotal role in helping the economy transition to net zero. Important elements are investments into decarbonization, support for green technologies, predictable emission pricing pathways, and support for green and transition finance. Some hard-to-abate and high-emission sectors may find the transition particularly challenging and government policies to support emission reductions in these sectors will likely be needed.

## References

Bank of Japan and Financial Services Agency, 2022, "Pilot Scenario Analysis Exercise on Climate-Related Risks Based on Common Scenarios", August 2022. Available at [https://www.boj.or.jp/en/announcements/release\\_2022/rel220826a.htm/](https://www.boj.or.jp/en/announcements/release_2022/rel220826a.htm/)

Grippa, P., and S. Mann, 2020, "Climate-Related Stress Testing: Transition Risks in Norway", IMF Working Paper WP/20/232, Washington DC.

International Monetary Fund, 2019a, "Sustainable Finance", Global Financial Stability Report, Chapter 6, October 2019, Washington DC.

\_\_\_\_\_, 2019b, "How to Mitigate Climate Change", Fiscal Monitor, October 2019, Washington DC.

\_\_\_\_\_, 2022a, "Climate Change Policy Options", Japan Selected Issues, IMF Country Report No. 22/100, Washington DC.

\_\_\_\_\_, 2022b, "Climate Finance in Japan", Japan Selected Issues, IMF Country Report No. 22/100, Washington DC.

\_\_\_\_\_, 2022c, "Near-Term Macroeconomic Impact of Decarbonization Policies", World Economic Outlook, Chapter 3, October 2021, Washington DC.