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POLICY BRIEF

CARBON PRICE POLICIES AND INTERNATIONAL COMPETITIVENESS IN G20 COUNTRIES

Task Force 2
CLIMATE CHANGE AND ENVIRONMENT

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موجز السياسة

سياسات تسعير الكربون والقدرة التنافسية الدولية لدى دول مجموعة العشرين

فريق العمل الثاني
تغير المناخ والبيئة

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ABSTRACT

A major challenge in implementing carbon pricing policies is to account for their economic outcomes. Notably, competitiveness is the key economic performance indicator to be considered. Extant theory mainly emphasizes the negative effect of carbon pricing on competitiveness; however, there is no consensus in the empirical literature. This may be due to the fragmented implementation of carbon pricing, ignoring country-specific characteristics and lack of well-designed mitigation policies. The above challenges are significant for the Group of Twenty (G20). Thus, we propose the implementation of country-specific carbon pricing policies while accounting for any negative effects of such policies on the competitiveness of G20 economies.

يتمثل أحد التحديات في تنفيذ سياسات تسعير الكربون في مراعاة نتائجها الاقتصادية. والجدير بالذكر أن القدرة التنافسية تعد مؤشر الأداء الاقتصادي الرئيسي الذي يتعين أخذه في الحسبان. وتؤكد النظرية بشكل أساسي على التأثير السلبي لتسعير الكربون في القدرة التنافسية، ولكن الأبحاث التجريبية لم تصل إلى إجماع حول هذا الأمر. فيمكن أن يحدث هذا بسبب التنفيذ الغير متناسق لتسعير الكربون، وتجاهل الخصائص الفريدة لكل بلد، والافتقار إلى سياسات تخفيف جيدة التصميم. إن التحديات المذكورة أعلاه مهمّة للغاية لمجموعة العشرين. وفي موجز السياسة هذا نقترح سياسات تسعير كربون خاصة بكل بلد، مع مراعاة أي آثار سلبية لهذا التسعير في القدرة التنافسية لاقتصادات مجموعة العشرين.

CHALLENGE

The negative effect of carbon pricing on competitiveness stems from the following challenges. First, the mechanism underlined in the Paris Agreement Article 6 (PAA6)[1] to mitigate emissions is an uneven policy measure for the Group of Twenty (G20), although many member countries have implemented some kind of carbon pricing policy. The two main consequences of this fragmented adoption are unfair competition between countries with and without carbon pricing policies, and carbon leakage[2] (Kossoy et al. 2015; Jorge, Dale, and Jefferiss 2020). Second, the G20 is home to developed as well as developing economies. Moreover, there are considerable differences even within these categories in terms of socio-economic, energy-environmental, and institutional characteristics. These challenges greatly invalidate the implementation of "one size fits all" carbon pricing for the G20, and it can undermine the competitiveness of certain member countries (Klenert et al. 2018). Third, there is a lack of a well-designed policy and regulatory framework for mitigating both carbon emissions and the negative effects of carbon pricing on competitiveness across different sectors in G20 economies, especially developing economies.

As the literature shows, carbon pricing has a number of advantages as compared with other emissions mitigation measures:

1. They modify the relative prices, and as a result, firms and consumers not only consider their private costs and benefits, but also account for the social costs incurred, when making decisions that cause carbon emissions.
2. They address the heterogeneity of greenhouse gas emitters, thus minimizing the costs of pollution control.
3. They contribute to dynamic efficiency.
4. They are considered the best instrument to effectively control energy and carbon rebound.
5. International carbon price policies can best ensure that there are no leakages that could generate more carbon emissions than would otherwise occur.
6. They allow for the decentralization of policy decisions and have relatively low information requirements.
7. They are capable of intervening in the effective and fair pricing of energy and electricity markets.

1. We use "carbon price" and "Paris Agreement Article 6 (PAA6) mechanism" interchangeably throughout this policy brief.
2. A carbon leakage occurs when businesses relocate to countries with weaker climate policies, which, in turn, increases emissions levels in those countries.

To the best of our knowledge, only Ellis, Nachtigall, and Venmans (2019) investigate the effect of carbon pricing on international competitiveness within the G20 context, i.e., the study considers all members and the authors' policy recommendations were commensurate to each G20 member's economic situation. Other studies generally focus on specific members or a sub-group of countries. Contrariwise, we reviewed the literature on all member countries and country-appropriate policies in this policy brief.

PROPOSAL

Making evidence-based policy recommendations to address the issues originating from the aforementioned challenges is of particular importance for the G20. We outlined the reasons thereof below.

Issues of carbon pricing and its competitiveness effects for the G20

- G20 countries account for around 85% of the global gross domestic product (GDP) and 75% of world trade (International Energy Agency, 2018a). To maintain this share of world trade, G20 countries must remain highly competitive.

- According to the International Energy Agency's (2018a, 2018b) reports on the G20, fossil fuels comprise a large share of overall energy consumption. The G20 alone accounts for 77% of global energy consumption, and coal still occupies the largest share (on average 44% for the electricity generation mix). The overall shares of oil, gas, coal, and nuclear energy supply have only marginally changed in the last three decades. Thus, the G20 was responsible for 81% of energy-related global CO2 emissions in 2015. The group is also witnessing a slowdown in its annual energy efficiency gains (Climate Transparency, 2019), further highlighting the importance of carbon pricing/the PAA6 mechanism and other emission mitigation policies.

- Twelve G20 countries have implemented some kind of carbon pricing policy (Klepper and Peterson 2017). The rest of the countries should consider carbon pricing based on their idiosyncratic features, since this measure has more advantages compared with other emissions mitigation measures.

- We propose a package of evidence-based policy recommendations to address the challenges discussed above. Accordingly, we summarize the findings of approximately 300 empirical studies examining the effect of carbon pricing on the competitiveness in G20 countries. The merit of this package is that it supports the implementation of country-specific carbon pricing policies (implicit or explicit), while also considering mitigation measures for the possible negative effects on competitiveness.

Proposal I

The G20 should implement country-specific carbon pricing policies.

Obviously, one demotivation for the member countries, who have not yet implemented carbon pricing (see Figure A1), to join a 'club' would be imposing on them the same carbon price implemented in advanced G20 countries, ignoring diverse characteristics of the member countries. G20 countries are a special case in this regard.

First, the G20 comprises both developed and developing economies. These economies have substantially diverse socio-economic, energy-environmental, and institutional characteristics. In addition, the majority of the developing economies in the G20 are more reliant on carbon-intensive energy sources and energy-intensive industries as compared to the developed economies. This suggests that a uniform carbon pricing regime would most likely undermine the competitiveness of developing economies. Such transition economies may even lack the socio-economic institutions and infrastructure as well as regulatory frameworks necessary for successful implementation of explicit carbon pricing measures, such as the Emission Trading System (ETS) and carbon taxation. Thus, these challenges expose the impracticality of a "one size fits all" carbon pricing policy. We thus advocate for the adoption of country-specific policies.

Reducing overall emissions while maintaining high levels of economic development is the core of sustainable development (Mikayilov, Hasanov, and Galeotti. 2018, inter alia). However, a tradeoff exists between carbon pricing and competitiveness. A unified G20 policy would be more effective in reducing CO_2 emissions. However, as empirical studies show, such a measure would reduce the competitiveness of developing economies relying on energy-intensive sectors with low efficiency (Smale et al. 2006; Bassi, Yudken, and Ruth 2009; Aldy and Pizer 2015; Li et al. 2018). The magnitude of this adverse effect also depends on the size of the tradable sector in a given economy. In this regard, it would be incorrect to assume that net oil exporters of the G20 would not be considerably affected by high carbon prices, as oil, which is subjected to lower international competitiveness when compared with other tradable goods, constitutes a large proportion of their exports. First, if oil-importing countries implement the PAA6 mechanism to import less oil to reduce emissions and encouraging clean energy transition, there would be little that the oil-exporting countries could do in response. Second, high carbon prices would be a serious problem for net oil exporters such as Saudi Arabia and Russia, since they aim to develop non-oil tradable sectors as the main part of their diversification strategy for long-term sustainable and balanced economic growth (see, e.g., Saudi Vision 2030; World Bank Group 2013; European Bank for Reconstruction and Development 2012). Diversification can mitigate environmental pollution if it is based on high technology and innovation as well as

less energy-intensive non-oil tradable sectors (see, e.g., Deep Decarbonization Pathway Project 2015). Thus, a unified carbon price that caters to developed G20 economies would not be feasible for developing economies that have not yet implemented the PAA6 mechanism and related policies.

If we do maintain the status quo, then countries without carbon pricing would enjoy unfair competitiveness while continuing to pollute the environment; carbon leakages would increase as well. Therefore, an effective tradeoff is needed. The literature indicates that the best tradeoff policy option is to apply carbon price measures (explicit or implicit) while considering the idiosyncratic characteristics of all member countries (Cosbey and Tarasofsky 2007; International Energy Agency 2010; Aldy and Stavins 2012; Lin and Li 2011; Nordhaus 2015). Such a policy will reduce CO2 emissions to some extent and will not be as harmful to competitiveness as a unified carbon pricing policy would be, especially for the developing members of the G20. We advocate for carbon pricing as an emissions reduction measure because it has several advantages over other emission reduction measures. It has been previously suggested as a solution for G20 countries as well (see Edenhofer et al. 2017).

Thus, country-specific carbon pricing policies should consider, for example, the social, economic, energy, environmental, cultural, political, and institutional characteristics of each country (Klenert et al. 2018). One way to implement this proposal is to consider both explicit and implicit carbon price measures. Empirical studies show that the implicit measures of carbon pricing (e.g., removing fossil fuel energy incentives or raising the prices of energy products), are more convenient for developing economies and easier to implement as compared with explicit measures (e.g., ETS), because the latter requires market establishments, associated infrastructure, and legislation (G20 Leaders 2009; Aldy and Stavins 2012; Lin and Aijun 2011; Atansah et al. 2017; Klenert et al. 2018).

Some countries have already implemented energy price reforms or removed energy incentives. Other developing members, such as Argentina, Indonesia, and Mexico, are voluntarily reviewing the possibility of removing fossil fuel incentives (World Bank Group 2019). In this regard, the recent energy price reform experience of the G20 host Saudi Arabia should be seen as a successful case in setting up country-specific implicit carbon pricing. Saudi Arabia has been implementing energy price reforms, a gradual increase in domestic energy prices to bring them up to international reference levels, since December 2015 in order to make economy and society more energy efficient and increase government budget revenues (Fiscal Balance Program 2019 Update; Gonand, Hasanov, and Hunt 2019).

Another key point here is that implicit measures should be treated as an integral part of the emissions mitigation policy strategy. They should be designed to be consistent and complementary with other measures in the strategy. This may require a well-designed policy and regulatory framework. For example, Saudi Arabia successfully implemented the Circular Carbon Economy strategy; the gradual removal of fossil fuel incentives can be considered an integral part of the strategy to reduce carbon emission, that is, one of the "4 Rs."

For all countries to act together, mechanisms of coordination and collective action as well as public support and policy willingness must coexist. G20 countries should also commit to the PAA6 mechanism—regardless of whether explicit or implicit measures will be used—when reducing CO2 emissions in ways that best fit their respective characteristics. Countries within the same region should prepare regional action plans to reduce emissions without damaging competitiveness (Hahn and Stavins 1999; Ellerman and Buchner 2007). Additionally, a long-term action plan for country groups and individual countries should be formulated, with its implementation status regularly reported.

Proposal II

The G20 should implement policies to mitigate both carbon emission and any negative effects of carbon pricing on competitiveness in different sectors of G20 economies.

The rationale behind Proposal II is that different sectors respond differently to carbon prices and other climate policies. The literature reveals that such policies often risk the competitiveness of energy-intensive sectors vis-à-vis other sectors. This is particularly the case for developing countries (Smale et al. 2006; Liu et al. 2015; Pradhana et al. 2017; Li et al. 2018).

"Mitigation" here mainly refers to recycling the revenues obtained from carbon prices back to the sectors in order to help them smoothly transit toward energy-efficient technologies and renewable energy sources. This way, the sectors reduce carbon emissions, do not lower production levels and their competitiveness is not undermined (Goulder 1995; Goulder and Parry 2008; Aldy and Stavins 2012; Klenert et al. 2018). Such measures would also increase the public and social acceptability of carbon pricing, especially in developing countries (Klenert et al. 2018). This proposal can be implemented primarily by encouraging sectors to invest in energy-efficient technologies and facilitating the transition toward renewable energy sources (Aldy and Stavins 2012; Klenert et al. 2018).

In some countries, especially resource-rich ones, reforming energy prices as an implicit measure of carbon price is a substantial measure. With the removal of fossil fuel incentives, the profit margins of some sectors cannot be maintained at previous levels. In these countries, survey-based micro-econometric studies are needed to accurately and reliably measure the role of energy price mechanisms as well as to design mitigation policies that minimize any loss in competitiveness from removal of fossil fuel incentives. As noted above, Saudi Arabia offers a prime example of success among the G20. Along with increasing domestic prices of energy products, it has designed support packages for industrial sectors in order to mitigate the adverse effects of the price increases, and, thus, maintain international competitiveness of important sectors (Fiscal Balance Program 2019 Update; National Transformation Program 2017). The Fiscal Balance Program (Fiscal Balance Program 2019 Update), a key part of the Saudi Vision 2030, notes that

"The cost base of energy intensive industries could be materially impacted … as a result of energy pricing reform. It is important that over … time … they are able to transform, so that they become energy efficient and globally competitive; and the government will provide targeted support to do so."

Therefore, the Saudi government has designed an industrial support package that comprises industry-agnostic and -specific measures with six main themes, namely implementation support and capability building, performance management, efficiency financing, temporary funding support, enabling Infrastructure, and regulations (Fiscal Balance Program 2019 Update).

Baranzini and Carattini (2017), Carattini et al. (2017), and Klenert et al. (2018) conclude that, while prudent carbon pricing policies and maintaining competitiveness are prioritized, the allocation of "carbon revenues" should also be a focus of socially acceptable policymaking. To increase the public acceptability of carbon price policies, experts suggest that a portion of revenues should be returned to the public and private sectors through different channels (Baranzini and Carattini 2017; Kotchen, Turk, and Leiserowitz 2017; Klenert et al. 2018). These revenues could be appropriately portioned and recycled in different directions, such as to firms to sustain their competitiveness, households to compensate initially higher energy prices, or the government to invest in clean energy.

Thus, depending on the country-specific socio-political characteristics, the suggested policies can be summarized as follows: In countries with satisfactory government reliability and where efficiency and competitiveness are main issues, recycling the revenues to firms via transfers, or tax relaxations, is preferable. If the barriers to implement the PAA6 mechanism are related to revenue distribution, then supporting poor income groups is a more relevant recycling policy. Alternatively, when citizens are not satisfied with the environmental quality brought about by the carbon pricing, clean/green spending can be considered as a better policy option to implement (Atansah et al. 2017; Klenert et al. 2018). Recent ongoing initiatives to remove fossil fuel incentives and support households through the "household support program," support the private sector through the "industry support program," and invest in clean energy sectors in Saudi Arabia (Fiscal Balance Program 2019 Update) are successful measures that can be considered by other member countries.

In certain cases, carbon pricing policies should be assessed and managed by firms. Authorities should consider whether other taxes should be reduced, or abolished, when a carbon tax is imposed. Thus, sectoral competitiveness is not adversely affected. It should also be considered that the competitiveness of non-energy intensive sectors may increase, while the opposite may be true for the case of energy-intensive sectors when carbon pricing policies are implemented. When carbon taxes are imposed, fiscal authorities should implement specific measures to stimulate transition to clean energy, so that the losses from tax implementation are compensated by efficiency gains (Aldy and Stavins 2012; Klenert et al. 2018).

Finally, developing countries contribute to a large share of the current global carbon emissions, since they mainly use fossil fuel energy sources. However, developed economies have historically emitted more carbon (Mikayilov, Hasanov, and Galeotti 2018). Therefore, a better strategy to mitigate global emissions would be for highly developed countries to invest in energy transition projects in developing economies. This could be accomplished by transferring the revenues obtained from the implementation of carbon pricing policies in the former countries toward clean energy projects in the latter countries[3].

3. See https://www.greenclimate.fund

Key Recommendations

G20 countries should implement country-specific carbon pricing policies. While a unified G20 policy would reduce more CO2 emissions, it would be detrimental to the competitiveness[4] of developing economies, given that many of these economies rely on energy-intensive sectors that are not optimally energy efficient. As a result, a unified carbon price would not be suitable for G20 economies.

At the same time, emissions, unfair competitiveness, and carbon leakages are expected to increase if a fragmented and business-as-usual carbon policy prevails. There seems to be a necessary tradeoff between carbon pricing and competitiveness; indeed, empirical research claims that the best tradeoff policy option would be the implementation of carbon price measures while factoring in the idiosyncrasies of G20 countries. In case of developed countries, the relevant measures are:

a. to continue increasing the share of green energy,
b. fair transition to green energy without "migrating" emission-intensive production to developing countries,
c. to invest in energy transition projects in developing economies, and
d. demonstrating examples of transition toward renewables and assisting other countries in this transition.

For developing economies, the relevant policies are:

a. to implement explicit or implicit carbon pricing that accounts for country-specific features,
b. establishing a low-carbon price regime,
c. energy price reforms and removal of energy incentives for resource-rich countries as part of an implicit carbon pricing policy, and
d. public acceptability in implementation of pricing policies.

4. International competitiveness is a broad topic and can be defined in different ways; see Kharlamova and Vertelieva (2013) for a comprehensive review of the definitions of competitiveness.

The G20 should implement policies to mitigate both carbon emissions and any negative effects of carbon pricing on competitiveness in different sectors of G20 economies. The suggested policies are summarized as follows:

1. recycling the revenues obtained from implementation of carbon prices back into the relevant sectors in order to help these sectors smoothly transition toward energy-efficient technologies and renewable energy sources,

2. encouraging sectors to invest in energy-efficient technologies and facilitating the transition toward renewable energy sources,

3. reforming energy prices as an implicit measure of carbon pricing, especially in resource-rich countries, while providing support packages to mitigate the adverse effects of price increases as well as maintaining international competitiveness of certain sectors, and

4. prudent allocation of “carbon revenues” such as household support packages for (and to increase) public acceptability.

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Disclaimer
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REFERENCES

Aldy, Joseph E., and Robert N. Stavins. 2012. "The Promise and Problems of Pricing Carbon: Theory and Experience." Journal of Environment and Development 21, no. 2: 152–80. https://doi.org/10.3386/w17569.

Aldy, Joseph E., and William A. Pizer. 2015. "The Competitiveness Impacts of Climate Change Mitigation Policies." Journal of the Association of Environmental and Resource Economists 2, no. 4: 565–95. https://doi.org/10.3386/w17705.

Arlinghaus, Johanna. 2015. "Impacts of Carbon Prices on Indicators of Competitiveness: A Review of Empirical Findings." OECD Environment Working Papers, No. 87, OECD Publishing. Accessed June 19, 2020. https://doi.org/10.1787/19970900.

Atansah, Priscilla, Masoomeh Khandan, Todd Moss, Anit Mukherjee, and Jennifer Richmond. 2017. "When Do Subsidy Reforms Stick? Lessons from Iran, Nigeria, and India." Center for Global Development. Accessed June 19, 2020. https://www.cgdev.org/sites/default/files/when-do-subsidy-reforms-stick-lessons-iran-nigeria-and-india.pdf.

Baranzini, Andrea, and Stefano Carattini. 2017. "Effectiveness, Earmarking and Labeling: Testing the Acceptability of Carbon Taxes with Survey Data." Environmental Economics and Policy Studies 19: 197–227. https://doi.org/10.1007/s10018-016-0144-7.

Bassi, Andrea M., Joel S. Yudken and Matthias Ruth. 2009. "Climate Policy Impacts on the Competitiveness of Energy-Intensive Manufacturing Sectors." Energy Policy, 37 no. 8: 3052-60.

Bataille, Chris, Benjamin Dachis, and Nicholas Rivers. 2009. "Pricing Greenhouse Gas Emissions: The Impact on Canada's Competitiveness." C.D. Howe Institute Commentary 280, February.

Beale, Elizabeth, Dale Beugin, Bev Dahlby, Don Drummond, Nancy Olewiler, and Christopher Ragan. 2015. "Provincial Carbon Pricing and Competitiveness Pressures." Canada's Ecofiscal Commission. Accessed June 19, 2020). https://ecofiscal.ca/wp-content/uploads/2015/11/Ecofiscal-Commission-Carbon-Pricing-Competitiveness-Report-November-2015.pdf.

Branger, Frédėrick and Phillipe Quirion. 2014. "Would Border Carbon Adjustments Prevent Carbon Leakage and Heavy Industry Competitiveness Losses? Insights From a Meta-Analysis of Recent Economic Studies. Ecological Economics 99: 29-39. https://doi.org/10.1016/j.ecolecon.2013.12.010

Carattini, Stefano, Andrea Baranzini, Philippe Thalmann, Frédéric Varone, and Frank Vöhringer. 2017. “Green taxes in a Post-Paris World: Are Millions of Nays Inevitable?” Environmental and Resource Economics 68, no. 1: 97–128. https://doi.org/10.1007/s10640-017-0133-8.

Carbone, Jared C., and Nicholas Rivers. 2017. “The Impacts of Unilateral Climate Policy on Competitiveness: Evidence from Computable General Equilibrium Models.” Review of Environmental Economics and Policy 11, no. 1: 24–42. https://doi.org/10.1093/reep/rew025.

Casey, Brendan J., Wayne B. Gray, Joshua Linn, and Richard Morgenstern. 2020. “How Does State-Level Carbon Pricing in the United States Affect Industrial Competitiveness?” NBER Working Papers 26629, National Bureau of Economic Research, Inc. RePEc:nbr:nberwo:26629.

Clarke, Harry, and Robert Waschik. 2012. “Australia’s Carbon Pricing Strategies in a Global Context.” The Economic Record 88: 22–37. https://doi.org/10.1111/j.1475-4932.2012.00798.x.

Climate Transparency. 2019. “Brown to Green: The G20 Transition towards A Net-Zero Emissions Economy.” Climate Transparency (Accessed: 19 June, 2020). https://www.climate-transparency.org/wp-content/uploads/2019/11/Brown-to-Green-Report-2019.pdf.

COMETR. 2007. “Competitiveness Effects of Environmental Tax Reforms. Publishable Final Report to the European Commission, DG Research and DG Taxation and Customs Union (Summary Report)." Accessed June 19, 2020. https://pure.au.dk/portal/files/128999763/COMETR_Summaryreport.pdf.

Cosbey, Aaron, and Richard Tarasofsky. 2007. “Climate Change, Competitiveness and Trade.” A Chatham House Report. (Accessed: 19 June, 2020). https://www.iisd.org/sites/default/files/publications/climate_trade_competitive.pdf.

Da Silva Freitas, Lucio Flavio, Luiz Carlos de Santana Ribeiro, Kênia Barreiro de Souza, and Geoffrey John Dennis Hewings. 2016. “The Distributional Effects of Emissions Taxation in Brazil and Their Implications for Climate Policy.” Energy Economics 59: 37–44. https://doi.org/10.1016/j.eneco.2016.07.021.

Deep Decarbonization Pathway Project. 2015. “Russia – Economic Diversification” Deep Decarbonization Pathway Project. (Accessed: 19 June, 2020). http://deepdecarbonization.org/wp-content/uploads/2015/07/DDPP-Country-case-study_Russia_Diversification.pdf.

Dissou, Yazid, and Terry Eyland. 2011. “Carbon Control Policies, Competitiveness, and Border Tax Adjustments.” Energy Economics 33, no. 3: 556–564. https://doi.org/10.1016/j.eneco.2011.01.003.

Edenhofer, Ottmar, Flachsland Christian, Knopf Brigitte, and Kornek Ulrike. 2017. “Carbon Pricing for Climate Change Mitigation and Financing the SDGs.” G20 Insights. (Accessed: 19 June, 2020). https://www.g20-insights.org/policy_briefs/carbon-pricing-for-climate-change-mitigation-and-financing-the-sdgs/.

Ellerman, A. Denny, and Barbara K. Buchner. 2007. “The European Union Emissions Trading Scheme: Origins, Allocation, and Early Results.” Review of Environmental Economics and Policy 1, no. 1: 66–87. https://doi.org/10.1093/reep/rem003.

Ellis, Jane, Daniel Nachtigall, Frank Venmans. 2019. “Carbon Pricing and Competitiveness: Are they at Odds?” OECD Environment Working Papers No. 152. (Accessed: 19 June, 2020). https://doi.org/10.1787/19970900.

European Bank for Reconstruction and Development. 2012. "Diversifying Russia: Harnessing Regional Diversity." European Bank for Reconstruction and Development. (Accessed: 19 June, 2020). https://www.ebrd.com/cs/Satellite?c=Content&cid=1395237438947&d=Default&pagename=EBRD%2FContent%2FDownloadDocument.

Fiscal Balance Program 2019 Update. Vision 2030. Kingdom of Saudi Arabia. (Accessed: 19 June, 2020). https://vision2030.gov.sa/sites/default/files/attachments/Fiscal%20Balance%20Program%202019%20Update_0.pdf

G20 Leaders. 2009. “Leaders’ Statement: The Pittsburgh Summit.” G20 Pittsburgh Summit. (Accessed: 19 June, 2020). https://www.oecd.org/g20/summits/pittsburgh/G20-Pittsburgh-Leaders-Declaration.pdf.

Gonand, Frédéric, Fakhri J. Hasanov, and Lester C. Hunt. 2019. "Estimating the Impact of Energy Price Reform on Saudi Arabian Intergenerational Welfare using the MEGIR-SA Model." The Energy Journal, International Association for Energy Economics 0, no. 3.

Goulder, Lawrence H. 1995. “Environmental Taxation and the ‘Double Dividend’: A Reader’s Guide.” International Tax and Public Finance 2, no. 2: 157–183. https://doi.org/10.3386/w4896.

Goulder, Lawrence H., and Ian W. H. Parry. 2008. “Instrument Choice in Environmental Policy.” Review of Environmental Economics and Policy 2, no. 2: 152–174. https://doi.org/10.2139/ssrn.1117566.

Grottera, Carolina, Amaro Olimpio Pereira Jr., and Emilio Lèbre La Rovere. 2015. “Impacts of Carbon Pricing on Income Inequality in Brazil, Climate and Development.” Climate and Development 9, no. 1: 80–93. https://doi.org/10.1080/17565529.2015.1067183.

Hahn, Robert W., and Robert N. Stavins. 1999. “What Has the Kyoto Protocol Wrought? The Real Architecture of International Tradeable Permit Markets.” The AEI Press. (Accessed: 19 June 2020). https://scholar.harvard.edu/files/stavins/files/what_has_kyoto_wrought.pdf.

International Energy Agency. 2018a. “Energy Transitions in G20 Countries - Energy Transitions Towards Cleaner, more Flexible and Transparent Systems.” International Energy Agency. (Accessed: 19 June, 2020). https://www.iea.org/reports/energy-transitions-in-g20-countries-energy-transitions-towards-cleaner-more-flexible-and-transparent-systems.

International Energy Agency. 2018b. “Energy Transitions in G20 Countries—Energy Data Transparency and Market Digitalization.” International Energy Agency. (Accessed: 19 June, 2020). https://www.iea.org/reports/energy-transitions-in-g20-countries-energy-data-transparency-and-market-digitalization.

Jakob, Michael et al. 2018. “Green Fiscal Reform for a Just Energy Transition in Latin America.” Economics Discussion Papers, No. 2018–86, Kiel Institute for the World Economy. Accessed June 19, 2020. http://www.economics-ejournal.org/economics/discussionpapers/2018-86.

Jorge, Blazquez, Spencer Dale, and Paul Jefferiss. 2020. “The Role of Carbon Prices in The Energy Transition”. In Decarbonization Pathways for Oil and Gas, March 2020, 121. Oxford: The Oxford Institute for Energy Studies.

Kharlamova, Ganna, and Olga Vertelieva. 2013. “The International Competitiveness of Countries: Economic-Mathematical Approach.” Economics & Sociology 6, no. 2: 39–52. https://doi.org/10.14254/2071-789X.2013/6-2/4.

Klenert, David, Linus Mattauch, Emmanuel Combet, Ottmar Edenhofer, Cameron Hepburn, Ryan Rafaty, and Nicholas Stern. 2018. “Making Carbon Pricing Work for Citizens.” Nature Climate Change 8: 669–77. https://doi.org/10.1038/s41558-018-0201-2.

Klepper, Gernot, and Sonja Peterson. 2017. “The G20 Countries Should Lead the Way in Decarbonizing their Economies and Making the Paris Climate Agreement Work.” G20 Insight. Accessed June 19, 2020. https://www.g20-insights.org/policy_briefs/the-g20-countries-should-lead-the-way-in-decarbonizing-their-economies-and-making-the-paris-climate-agreement-work.

Kneller, Richard, and Edward Manderson. 2012. “Environmental Regulations and Innovation Activity in UK Manufacturing Industries.” Resource and Energy Economics 34, no. 2: 211–35. https://doi.org/10.1016/j.reseneeco.2011.12.001.

Kossoy, Alexandre, Grzegorz Peszko, Klaus Oppermann, Nicolai Prytz, Noémie Klein, Kornelis Blok, Long Lam, Lindee Wong, and Bram Borkent. 2015. State and Trends of Carbon Pricing 2015. Washington: World Bank.

Kotchen, Matthew J., Zachary M. Turk, and Anthony A. Leiserowitz. 2017. “Public Willingness to Pay for a US Carbon Tax and Preferences for Spending the Revenue.” Environmental Research Letter 12, no. 9: 094012. https://doi.org/10.1088/1748-9326/aa822a.

Li, Zhaoling, Hancheng Dai, Lu Sun, Yang Xie, Zhu Liu, Peng Wang and Helmut Yabar. 2018. “Exploring the Impacts of Regional Unbalanced Carbon Tax on CO2 Emissions and Industrial Competitiveness in Liaoning Province of China. Energy Policy 113: 9-19. https://doi.org/10.1016/j.enpol.2017.10.048

Lin, Boqiang, and Aijun Li. 2011. “Impacts of Carbon Motivated Border Tax Adjustments on Competitiveness Across Regions in China.” Energy 36, no. 8: 5111–8. https://doi.org/10.1016/j.energy.2011.06.008.

Liu, Liwei, Chuxiang Chen, Yufei Zhao and Erdong Zhao. 2015. "China's Carbon-Emissions Trading: Overview, Challenges and Future." Renewable and Sustainable Energy Reviews, 49, no. c: 254-66. https://doi.org/10.1016/j.rser.2015.04.076

Mafizur, Rahman Mohammad. 2011. “The Proposed Carbon Tax in Australia: Impacts on Income Distribution, Employment and Competitiveness.” Presented at the International Conference on Income Distribution Theory and Policy, October 15–16, 2011. Wuhan: Zhongnan University of Economics and Law.

Marino, Marianna, Pierpaolo Parrotta, and Giacomo Valletta. 2019. “Electricity (De) regulation and Innovation.” Research Policy 48, no. 3: 748–58. https://doi.org/10.1016/j.respol.2018.11.005.

Mikayilov, Jeyhun I., Fakhri J. Hasanov, and Marzio Galeotti. 2018. “Decoupling of CO2 Emissions and GDP: A Time-Varying Cointegration Approach” Ecological Indicators 95, no. 1: 615–28. https://doi.org/10.1016/j.ecolind.2018.07.051.

National Transformation Program. 2020. Vision 2030. Kingdom of Saudi Arabia. Accessed June 19, 2020). https://vision2030.gov.sa/en/programs/NTP.

Nordhaus, William. 2015. “Climate Clubs: Overcoming Free-Riding in International Climate Policy.” American Economic Review 105, no. 4: 1339–70. https://doi.org/10.1257/aer.15000001.

Pearce, David and Warwick McKibbin. 2007. "Two issues in carbon pricing: Timing and Competitiveness." CAMA Working Papers 2007-2009, Centre for Applied Macroeconomic Analysis, Crawford School of Public Policy, The Australian National University.

Pradhana, Basanta K., Joydeep Ghosh, Yun-Fei Yao, and Qiao-Mei Liang. 2017. "Carbon Pricing and Terms of Trade Effects for China and India: A General Equilibrium Analysis." Economic Modelling 63: 60–74. https://doi.org/10.1016/j.econmod.2017.01.017.

Reinaud, Julia. 2008. "Issues behind Competitiveness and Carbon Leakage. Focus on Heavy Industry." OECD/International Energy Agency. Accessed June 19, 2020. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.177.7190&rep=rep1&type=pdf.

Rentschlera, Jun, Martin Kornejew, and Morgan Bazilian. 2017. "Fossil Fuel Subsidy Reforms and Their Impacts on Firms." Energy Policy 108: 617–23. https://doi.org/10.1016/j.enpol.2017.06.036.

Rivers, Nicholas. 2010. "Impacts of Climate Policy on the Competitiveness of Canadian Industry: How Big and how to Mitigate?" Energy Economics 32, no. 5: 1092–1104. https://doi.org/10.1016/j.eneco.2010.01.003.

Rivers, Nicholas and Brandon Schaufele. 2014. "The Effect of British Columbia's Carbon Tax on Agricultural Trade." Canadian Journal of Agricultural Economics 00: 1–23. https://doi.org/10.1111/cjag.12048.

Saddler, Hugh, Frank Muller, and Clara Cuevas. 2006. "Competitiveness and Carbon Pricing Border Adjustments for Greenhouse Policies." Discussion Paper No 86, The Australia Institute. Accessed June 19, 2020. https://www.tai.org.au/sites/default/files/DP86_8.pdf.

Sanni, Maruf. 2018. "Drivers of Eco-Innovation in the Manufacturing Sector of Nigeria." Technological Forecasting and Social Change 131: 303–14. https://doi.org/10.1016/j.techfore.2017.11.007.

Santos, Luan, Rafael Garaffa, André F. P. Lucena, and Alexandre Szklo. 2018. "Impacts of Carbon Pricing on Brazilian Industry: Domestic Vulnerability and International Trade Exposure." Sustainability 10: 2390. https://doi.org/10.3390/su10072390.

Sbroiavacca, Nicolás Di, Gustavo Nadal, Francisco Lallana, James Falzon, and Katherine Calvin. 2016. "Emissions Reduction Scenarios in the Argentinean Energy Sector." Energy Economics 56: 552–563. https://doi.org/10.1016/j.eneco.2015.03.021.

Shukla, P. R. 1996. “The Modelling of Policy Options for Greenhouse Gas Mitigation in India.” Ambio Greenhouse Gas Emissions: Mitigation Strategies in Asia and the Pacific 25, no. 4: 240–48.

Smale, Robin, Murray Hartley, Cameron Hepburn, John Ward and Michael Grubb. 2006. "The Impact of CO2 Emissions Trading on Firm Profits and Market Prices. Climate Policy 6 no. 1: 31-48. https://doi.org/10.1080/14693062.2006.9685587

Tian, Xu, Hancheng Dai, Yong Geng, Zhen Huang, Toshihiko Masui, and Tsuyoshi Fujita. (2017). “The Effects of Carbon Reduction on Sectoral Competitiveness in China: A Case of Shanghai.” Applied Energy 197: 270–8. https://doi.org/10.1016/j.apenergy.2017.04.026.

Timilsina, Govinda R., Omar O. Chisari, and Carlos A. Romero. 2013. “Economy-Wide Impacts of Biofuels in Argentina.” Energy Policy 55: 636–47. https://doi.org/10.1016/j.enpol.2012.12.060.

World Bank Group. 2013. “Russian Federation Export Diversification through Competition and Innovation: A Policy Agenda.” Accessed June 19, 2020). https://openknowledge.worldbank.org/handle/10986/15821.

Wang, Xin, Ji Feng Li, and Ya Xiong Zhang. 2010. “An Analysis On the Short-Term Sectoral Competitiveness Impact of Carbon Tax in China.” Emerging Markets: Economics. https://doi.org/10.2139/ssrn.1635834

World Bank Group. 2019. “State and Trends of Carbon Pricing 2019.” Accessed June 19, 2020. https://openknowledge.worldbank.org/handle/10986/31755.

Zhang, ZhongXiang and Andrea Baranzini 2004. “What Do We Know About Carbon Taxes? An Inquiry Into Their Impacts on Competitiveness and Distribution of Income.” Energy Policy 32, no. 4: 507–18. https://doi.org/10.1016/S0301-4215(03)00152-6.

Zhao, Yu-Huan. 2011. “The Study of Effect of Carbon Tax on the International Competitiveness of Energy-intensive Industries: An Empirical Analysis of OECD 21 Countries, 1992-2008.” Energy Procedia 5: 1291–302. https://doi.org/10.1016/j.egypro.2011.03.225

APPENDIX

Appendix A

Brief overview of the literature on international competitiveness effects of carbon pricing in the G20 context

A number of studies have investigated the various economic aspects of carbon pricing. International competitiveness (competitiveness hereafter) is an important economic indicator for any country. Scholars use different measures/proxies such as productivity, output, employment, investment, and innovation to understand it. COMETR (2007), inter alia, describes the theoretical background of the effects of environmental taxation on competitiveness. The report concludes that there is no consensus on the nature of the effect of carbon pricing on competitiveness (whether it is positive, negative, or has no relationship). Similar to theoretical studies, the empirical literature is also inconclusive on the relationship between carbon pricing and competitiveness. There is extensive research on different countries and country groups (e.g., developing vs. developed economies), but with mixed findings. We review some of these studies on G20 countries herewith.

For developing G20 countries, Grottera et al. (2015) find a negative effect of carbon pricing on competitiveness. Similar results are found by da Silva et al. (2016) for Brazil, and Shukla (1996) and Pradhana et al. (2017) for India. Conversely, Timilsina, Chisari, and Omero (2013) and Sbroiavacca et al. (2016) find a positive effect for Argentina; and Santos et al. (2018) for Brazil. Yet, Jakob et al. (2018) conclude that, for Latin American countries, the effect may vary substantially across countries with different socio-economic conditions and political cultures. Wang et al. (2011) find that high carbon prices would place an additional burden on certain industries, although low carbon prices would have no significant effect on overall competitiveness. Tian et al. (2017) suggest that a low rate of carbon pricing may change the competitive structure of sectors and yield higher outputs. Lin and Li (2011) find that carbon-motivated border tax adjustments may affect competitiveness in China. In the case of Saudi Arabia, Rentschler, Kornejew, and Bazilian (2017) find a negative, but weak, effect on firms.

In the case of developed countries, Saddler, Muller, and Cuevas (2006), Pearce and McKibbin (2007), and Mafizur (2011) find a negative effect, while Clarke and Waschik (2012) find no significant effect for Australia. For Canada, Rivers (2010) determines a negative association, while Dissou and Eyland (2011) find a positive one. Yet, Bataille, Dachis, and Rivers (2009) and Beale et al. (2015) find a weak and insignificant effect; further, Rivers and Schaufele (2014) find no conclusive relationship. For EU countries, Arlinghaus (2015) uncovers no relationship. Kneller and Manderson (2012) find a negative correlation for the U.K. In the U.S., Bassi, Yudken, and Ruth. (2009) find that carbon pricing could have substantially negative effects on the competitiveness of energy-intensive manufacturing, while Zhao (2011) finds a statistically negative effect of carbon tax on the international competitiveness of energy-intensive industries. Aldy and Pizer (2015) contend there is no significant relationship, whereas Casey et al. (2020) explain that the degree of carbon price effects on competitiveness may vary across regulations.

Meanwhile, studies investigating countries by groups also reveal conflicting results. In a study of 21 OECD countries, Zhao (2011) finds negative, positive, and low-level influences depending on the implementation of carbon taxation in the exporting or importing countries, or both. Branger and Quirion (2014) find a negative effect, while Reinaud (2008), Dechezlepre and Sato (2017), and Carbone and Rivers (2017) find weakly negative effects. Cosbey and Tarasofsky (2007) and Aldy (2016) uncover a relatively modest effect. Zhang and Baranzini (2004) conclude no effect of carbon pricing on competitiveness. In a study of both OECD and G20 countries, Ellis, Nachtigall, and Venmans (2019) find that, in the short term, the effect is weak (either positive or negative); their results remain inconclusive regarding which sectors could benefit or lose and regarding the effects on long-run competitiveness.

As the above discussion indicates, many studies show a negative effect of carbon pricing on competitiveness (or its components), while others find a positive effect. At the same time, scholars also contend that there could be no significant relationship for G20 countries. Despite the lack of consensus, our survey of empirical studies on the effect of carbon pricing on international competitiveness allows us to conclude that this effect is indeed negative, especially for energy-intensive sectors and mainly in developing economies. The positive and insignificant effects could be attributed to different factors:

1. The time duration since the implementation of the PAA6 mechanism may be too short to accurately assess the effects.
2. The implemented price levels may have been too low, and hence, produced no noticeable effect on competitiveness.
3. The allowances/incentives for the sectors/agents "compensated" for the effects of carbon pricing policies.
4. There is an unavailability of cases wherein energy-intensive activities are not supported by free allowances and/or incentives by public authorities, which makes it difficult to assess the "true" effect of carbon pricing on competitiveness.
5. Due to the unavailability of sufficient experience of carbon pricing policies, it is difficult to conduct econometric research using longer time-series data. Therefore, many available research studies are optimization-based studies relying on a set of assumptions.
6. The effects from different sectors may have offset each other, such that economy-wide effects become negligible or are not assessable.

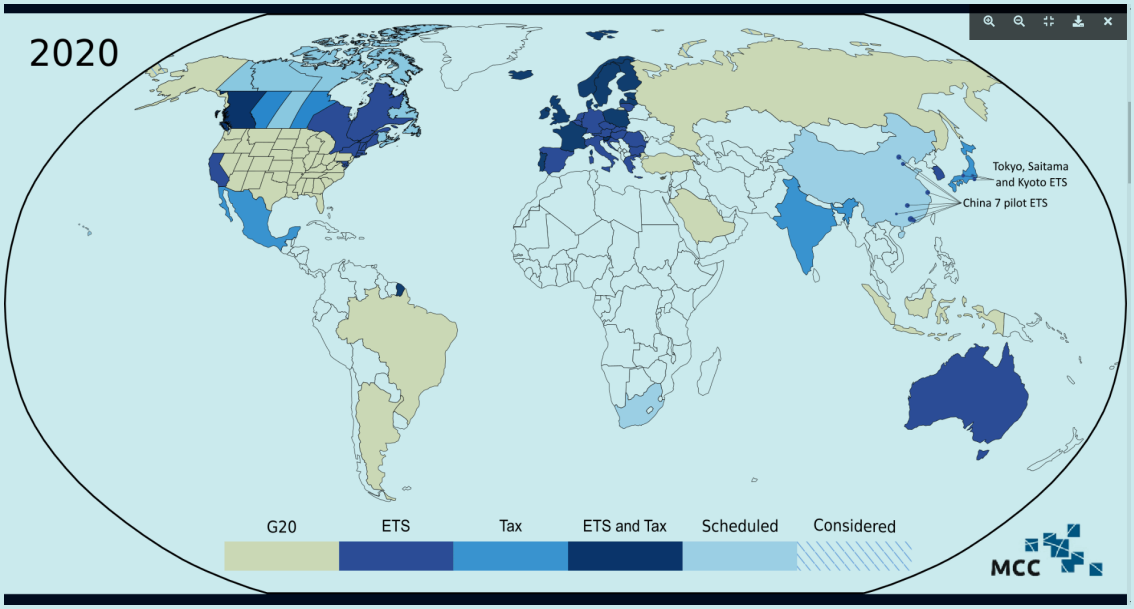

Figure A1: **Carbon price in G20 countries**
Source: **Klenert et al. (2018)**

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