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# Winners and Losers of Energy and Climate Policy – How Can the Costs Be Redistributed?

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Achieving climate policy goals requires comprehensive measures to reduce greenhouse gas emissions, particularly in the energy and transport sectors. There are different ways to achieve the goals. Depending on which one policymakers choose, countries, industries or population groups will have to shoulder costs of the realignment. Who should bear more and who less of the burden? This edition of the CESifo Forum examines this critical and complex issue in the EU, the US, and in the low- and middle-income economies of the world. The authors also discuss ways how more socially-balanced and better politically-feasible energy and climate policies can be developed and implemented.

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## RESEARCH REPORT



## REFORM MODEL



## DICE DATA ANALYSIS



## MACRO DATA INSIGHTS

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*Gustav Fredriksson and Georg Zachmann*

## Assessing the Distributional Effects of the European Green Deal*

The European Green Deal marks an important step in the EU's combat against climate change. The Deal increased the EU's 2030 greenhouse gas emissions reduction target from 40 percent to at least 55 percent below 1990 levels and established a goal of climate neutrality by the mid-century (European Commission 2019). In July 2021, the European Commission presented its "Fit for 55" package which contains a series of policy proposals for meeting the higher 2030 target.[1] The proposals include a reduction in the allowances in the existing emissions trading system (i.e., for industry and power sector emissions), the introduction of a new trading system for building and road transport emissions, and more ambitious national targets for sectors covered by the Effort Sharing Regulation (ESR). They also entail the introduction of a carbon border adjustment mechanism (CBAM).

Countries and households will be unevenly impacted by such policies and, more generally, by accelerating decarbonization until and beyond 2030. There is consequently a risk that the costs of the Green Deal fall disproportionately on poorer countries and poorer households. This is important to avoid, since EU climate policy is intended to reflect the principle of a fair burden sharing across and within countries (European Commission 2019). Moreover, the political acceptance of climate policies within countries risks being jeopardized if the burden falls disproportionately on poorer households (Büchs et al. 2011).

The impact on countries and households will vary across the policy instruments of the Green Deal. This article focuses on the distributional effects of carbon pricing, as it will be a key policy instrument in coming decades. We examine two issues. First, we consider the between- and within-country distributional implications of more stringent carbon pricing policies in the context of the Green Deal. This includes a within-country assessment of the CBAM. Second, we discuss remedies for any adverse distributional

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[1] The proposals can be found here: https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/delivering-european-green-deal_en#documents.

effects that might arise from the carbon pricing in the Green Deal.

To examine how countries and households are impacted by the carbon pricing mechanisms, we use a conceptual framework that decomposes the distributional effects from a carbon price into what we call a "supply-side" and a "demand-side".

On the *supply-side,* the cost of meeting comparable emission targets through carbon pricing will vary significantly between *countries*. Some countries will find it easier to reduce emissions due to, for instance, being able to scrap old polluting installations that were likely to close anyway. Similarly, the emissions profiles of countries differ, as some have more emissions in sectors that are relatively cheap to decarbonize. *Households*, meanwhile, are affected on the supply-side by nominal changes in labor, transfer, and capital income arising from carbon pricing, and these changes will affect household groups differently.

On the *demand-side,* some *countries* have poorer populations than others, and will therefore find a given carbon price more burdensome relative to national consumption expenditure. *Households*, on the other hand, are unevenly impacted by carbon price-induced changes in consumption prices.

We use this conceptual framework in the following section to characterize the distributional effects from more carbon pricing in the context of the Green Deal. We thereafter discuss remedies for mitigating any adverse distributional outcomes that might arise from the carbon pricing schemes.

## WHAT ARE THE DISTRIBUTIONAL EFFECTS FROM MORE CARBON-PRICING IN THE GREEN DEAL?

### Between Countries

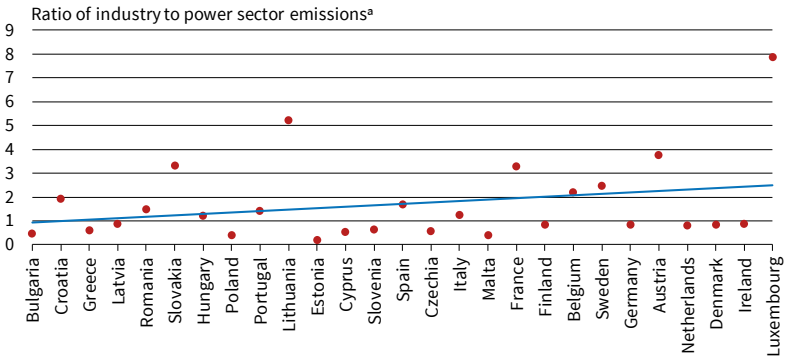
The Green Deal requires member states to increase their pace of decarbonization by 2030 and until 2050. In the following, we consider the between-country distributional effects of meeting the higher abatement through carbon pricing. To simplify the analysis, we assume a single uniform carbon price, covering all sectors and countries in the EU, initially exists and is increased as a result of the Green Deal.[2]

The higher carbon price will induce abatement by countries. On the supply-side, some countries will find it cheaper than others to reduce emissions. Part of the reason is that abatement opportunities differ *within* a given sector. Some member states can, for instance, still close polluting installations that have exceeded their economic lifetime, while others will have to conduct significant additional investments to reduce emissions within a given sector. But there are also differences in abatement opportunities *across* sectors. This can be seen by comparing countries' EU ETS emissions profiles. The EU ETS (currently) covers emissions from the power sector and industry. Richer member states typically have a high share of industrial emissions, which are costly to abate. Poorer member states, in contrast, typically emit relatively more in their power sectors, and these emissions are often cheaper to reduce.[3] Figure 1 portrays the different EU ETS emissions profiles by plotting the ratio of industry emissions to power sector emissions in 2019 by member state. Countries are ordered from left to right in terms of ascending GDP per capita adjusted for purchasing power. The blue trend line indicates that the share of industry in total EU ETS emissions is lower on average for poorer countries. The nine poorest countries have, on average,[4] a ratio of 0.67 industry to power sector emissions, while this ratio increases to 1.45 for the next nine richest countries, and to 1.02 for the nine richest countries.[5]

Figure 2 provides a stylized depiction of how heterogeneous emissions profiles can lead to uneven changes in abatement costs. The figure assumes there exists two countries A and B that partake in a joint carbon market like the EU ETS. The total abatement is determined by an emissions cap. Each country can reduce one unit of emissions at a cost corresponding

Figure 1

**Ratio of Industry to Power Sector Emissions in 2019 by Country**




[a] Industry emissions refer to the categories "Fuel combustion in manufacturing industries and construction (CRF1A2)" and "Industrial processes and product use (CRF2)" in EEA (2021) while "Fuel combustion in public electricity and heat production (CRF1A1A)" is used as a proxy for power sector emissions. The blue line is a linear trend line that best fits the data.
Source: Authors' compilation based on data from EEA (2021) and Eurostat (2021a).



[2] While this allows us to more clearly identify the supply- and demand-side considerations, we note that the distributional effects also depend on the scope of the carbon pricing scheme. For instance, the creation of a separate emissions trading system for road transport and building emissions, as proposed in the "Fit for 55" package, will impact countries unevenly. We return to this point in the next section, where we discuss ways of mitigating adverse distributional effects across countries for different scopes of carbon pricing schemes.

[3] The cheaper abatement in the power sector vis-à-vis industry is corroborated by a number of studies. The European Commission's Impact Assessment accompanying the 2030 Climate Target Plan, for instance, shows that power sector emissions decrease by a larger extent than industrial emissions in all scenarios (see Table 6 in European Commission 2020). Enerdata (2014) similarly finds that emissions from the power sector are comparatively easy to mitigate and account for most of the EU ETS abatement by 2030 in its scenarios.

[4] A weighted average was taken by country group.

[5] As a robustness test, we repeated the exercise using data from the EU ETS data viewer of the European Environment Agency, available here: https://www.eea.europa.eu/data-and-maps/dashboards/emissions-trading-viewer-1. We used the category "21-99 All industrial installations (excl. combustion)" as a proxy for industry emissions and "20 Combustion of fuels" as a proxy for power sector emissions. The country orderings did not change, as the industry to power sector emissions ratios for the three country groups were 0.42, 0.77, and 0.64, respectively.

to its marginal abatement cost (MAC). Panel (a) of Figure 2 shows the MAC curves for both countries and for the joint market (i.e., the sum of both countries' curves). The MACs are increasing in the level of abatement as it gets increasingly costly to reduce emissions. It is assumed that country B's emissions are easier to reduce, meaning it can abate comparatively cheaply (as reflected by its flatter MAC curve). The $CO_2$ allowance price is determined in the joint market by the MAC of meeting the cap. The price equalizes the MACs across countries and leads to abatement costs for each country corresponding to the shaded triangles in Panel (a).

Panel (b) shows the impact of tightening the cap.[6] This increases the $CO_2$ allowance price and both countries' abatement. Abatement costs increase to a larger extent for country A since its MAC curve is steeper. The figure therefore suggests how countries might be unevenly impacted by more stringent climate targets. In practice, some countries will face higher total abatement cost relative to their current emissions than other countries. This implies that, if the allocation of emission rights is solely based on current emissions ("grandfathering"), they might be worse off.

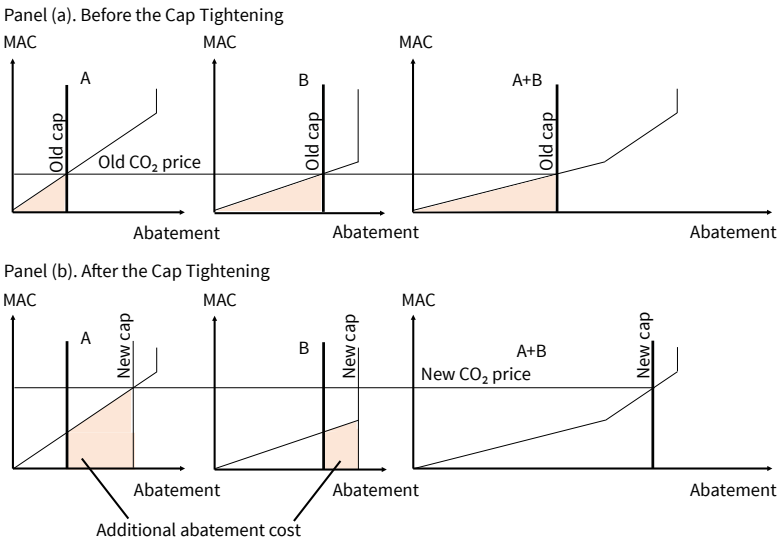
We now consider the demand-side argument. Some countries will find a given carbon price more intrusive than others as the carbon cost will constitute a higher share of their national consumption expenditure. Households in Poland (per-capita emissions of 10.4 tonnes), for instance, will on average find a carbon price of 60 EUR more burdensome than German households (per-capita emissions of 10.1 tonnes) relative to their consumption expenditure (actual individual consumption per-capita in Poland in 2020 was less than EUR 9,000 and almost EUR 23,000 in Germany).[7] Correspondingly, a carbon price of 60 EUR/tonnes would impact consumption by around EUR 500 in both countries (without recycling), but represent six percent of Polish actual individual consumption and only two percent of German actual individual consumption. These percentage values, on the one hand, exaggerate the effect as some of the per-capita emissions can be abated at a lower cost than the carbon price. On the other hand, in poorer countries, consumers might have a higher share of carbon-intensive products in their overall consumption basket (fuels, goods) than consumers in richer countries (services). On aggregate, based on such demand-side considerations, poorer countries might therefore be more affected by decarbonization if allowances are distributed based on historical emissions.

[6] We assume for simplicity that the allowance allocation after the cap tightening does not create any rents from allowance exports.

[7] The per-capita emissions statistics were retrieved from Eurostat (2021b) and the actual individual consumption statistics from Central Statistics Office Ireland (2021) who sourced them in turn from Eurostat.

Figure 2

**Stylized Impact of Tightening an Emissions Cap on Abatement Costs[a]**




[a] The figure is not drawn to scale. "A" and "B" refer to two hypothetical countries, while "A+B" is the joint market for allowances.
Source: Authors' compilation.



## Within Countries

The additional abatement from the Green Deal will also have distributional implications within countries. We focus our attention on how households might be unevenly impacted if the abatement is met through higher carbon prices. The overall impact can be decomposed into an expenditure-side effect and an income-side effect.[8] The former can be considered demand-side in nature while the latter relates more to the supply-side. We elaborate on both effects below.

The expenditure-side effect refers to how households are affected by changes in the prices of goods and services. Carbon pricing will make emissions-intensive goods and services, such as petrol and heating fuels, more expensive compared to goods and services with a lower carbon content. This has an uneven impact across households since their expenditure patterns differ. Poorer households typically spend a larger share of their income on energy goods, meaning their consumption becomes relatively more costly. A carbon price therefore falls more heavily on the consumption expenditure of poorer households, which hurts them more on the expenditure-side (Burtraw et al. 2009; Goulder et al. 2019; Landis 2019; Hasset et al. 2009; Mathur and Morris 2014).

Rising consumption prices are only part of the overall effect of a carbon price, however. Households are also impacted on the supply-side, through the income-side effect. This incidence channel has until fairly recently been ignored in the literature. The income-side effect denotes how households are impacted by changes in nominal capital rents, wages,

[8] The expenditure-side effect and income-side effect are commonly referred to as the "uses-side effect" and "sources-side effect," respectively.

Table 1

**Overview of the Demand- and Supply-side Distributional Effects between and within Countries from a Carbon Price (before Revenue Redistribution within Countries)**

| | Demand-side | Supply-side |
|---|---|---|
| Between countries | Carbon pricing especially hurts poorer countries, since a given carbon price reduces consumers' expenditure budgets there by a higher percentage | Richer countries are hurt more by a carbon price as their abatement opportunities are typically costlier |
| Within countries | Poorer households, whose consumption is typically more emissions-intensive, are particularly hurt by a carbon price | Richer households, who generally derive more income from capital and labor, are hurt more by a carbon price |

Note: Red (blue) denotes low-income households or low-income countries being relatively worse (better) off. The "demand-side" and "supply-side" within countries are proxies for the expenditure-side effect and income-side effect, respectively.

Source: Authors' compilation.

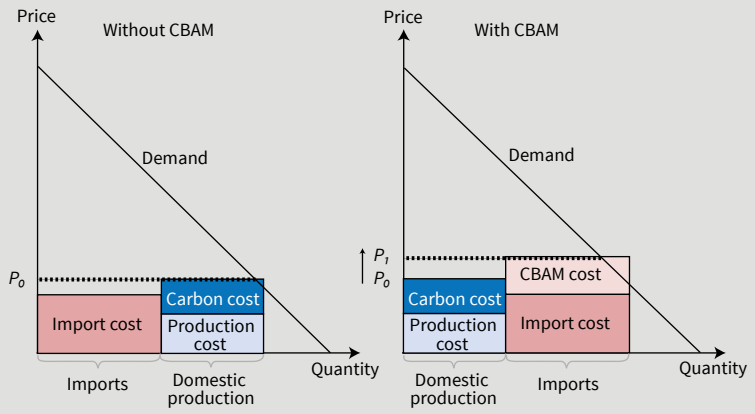
and transfer income. Richer households are typically hurt more on the income-side because they derive larger income shares from capital and labor, whose returns decrease as a result of carbon pricing. Poorer households, in contrast, earn relatively more transfer income, which is less affected by carbon pricing, especially if the transfers are indexed to inflation (Fullerton et al. 2011; Cronin et al. 2019). Poorer households are

## WITHIN-COUNTRY DISTRIBUTIONAL EFFECTS OF THE CARBON BORDER ADJUSTMENT MECHANISM

The carbon border adjustment mechanism, proposed by the European Commission in the "Fit for 55" package (see European Commission 2021a), will have complex distributional implications. The CBAM is intended to prevent carbon leakage by requiring EU importers of certain carbon-intensive products to buy an amount of allowances proportional to the products' carbon content. The CBAM is meant to ultimately replace the free allowance allocation in the EU ETS, which has been used to prevent carbon leakage to date. The CBAM would apply to sectors currently in the EU ETS, and the price of the CBAM allowances would mirror the EU ETS price. By requiring importers to pay for the carbon content, the CBAM will likely increase the prices of covered goods. This is shown stylistically in Figure 3. Prior to the CBAM introduction, the market price equals $P_0$ and imports are cheaper than domestically produced goods (left figure). The CBAM increases the cost of imports, making them more expensive than domestic substitutes in the figure. The market price consequently rises to $P_1$ (right figure).

Figure 3

**Stylized Depiction of the Effect of CBAM on Market Prices[a]**




[a] The height of the red (blue) bars corresponds to the marginal cost of producing imported (domestic) varieties.

Source: Authors' compilation. © ifo Institute

The European Commission analyzed the distributional effects of the CBAM in the Impact Assessment accompanying the CBAM proposal (see European Commission 2021b). The analysis was conducted using a computable general equilibrium framework for various CBAM scenarios. The overall finding was that the CBAM is regressive, although the distributional effects are likely small in magnitude owing to a limited impact of the CBAM on consumption prices and household incomes.

The Impact Assessment decomposed the overall effect into the expenditure- and income-side. The expenditure-side effect was typically regressive, as the consumption of poorer households became disproportionately expensive in most countries. On the income-side, the CBAM was also generally regressive. The CBAM increased capital returns and wages, which benefited richer households in particular as they derive relatively more income from capital and labor. It should, however, be noted that part of the regressive income-side effect likely stemmed from the recycling mechanism (a reduction in labor income taxes) especially benefiting richer households.

therefore better shielded from factor income losses, which hurts them less on the income-side.

Another important component of the income-side is the way in which carbon revenue is redistributed to households (Goulder et al. 2019). It is well-recognized in the literature that the choice of revenue recycling mechanism matters considerably for the overall incidence of a carbon pricing policy. Landis and Heindl (2019) have found, for instance, that recycling carbon revenues in a progressive manner can help fully offset the regressive expenditure-side of carbon pricing schemes for many EU member states.[9] The importance of revenue recycling for distributional outcomes within countries is also shown for Belgium in particular by Vandyck and van Regemorter (2014) and for the United States by Burtraw et al. (2009) and Bento et al. (2009).

Even in the absence of revenue recycling, however, the income-side can fully offset the regressive expenditure-side. Rausch et al. (2010) and Rausch et al. (2011) were two of the first studies to take the income-side into account by analyzing the impact of carbon pricing on households in the United States using a computable general equilibrium framework. They found that the income-side offsets the expenditure-side even when ignoring revenue recycling, making the overall impact of the carbon pricing policy proportional to slightly progressive.[10] Rausch and Schwarz (2016) similarly show that the incidence from carbon pricing, in the absence of revenue recycling, is not necessarily regressive and is influenced by production and household characteristics. These studies highlight the importance of taking the income-side into account when assessing the distributional impact of carbon pricing policies within countries.

### Summarizing the Distributional Effects

Table 1 summarizes the channels through which countries and households are unevenly impacted by more stringent carbon pricing in the Green Deal. The demand-side tends to disproportionately hurt lower-income countries and households, while the supply-side falls more heavily on richer countries and households.

## HOW CAN THE POTENTIAL ADVERSE DISTRIBUTIONAL EFFECTS FROM THE GREEN DEAL BE ADDRESSED?

### Between Countries

The distribution of cost from carbon pricing between countries can be shaped by (1) the way carbon markets are segmented, (2) the way allowances are allocated across countries, and/or (3) financial transfers.

Segmenting carbon markets allows having different carbon prices across countries and/or sectors. This is currently the case within the non-ETS sector, where Germany has an explicit carbon price of 25 EUR/tonne while Poland has none. And sectoral segmentation will likely continue under the Green Deal, as transport emissions will have a different carbon price than power sector emissions. The way in which politics allocates targets across countries and sectors will have distributional impacts.

Economists do not like segmenting markets, as this reduces efficiency, and the same allocation of cost can in principle be achieved by allocating fully fungible emission rights between countries. Such allocation is today conducted based on two principles: historical emissions and GDP. While different and more targeted allocations might be possible, opening up a zero-sum discussion on allocation of allowances between 27 member states is politically not easy.

Finally, a targeted allocation of cost between countries can also be achieved by financial transfers. While this is in principle equivalent to allocating fungible emission allowances, such financial transfers can in political practice be combined with conditionalities. The EU itself currently sells a number of emission allowances to finance special funds that are then used for specific purposes. By their design, the just transition, the innovation, and the modernization fund quite clearly focus on specific countries.

Overall, there will be a need to weigh the demand- and supply-side considerations to ensure an equitable and politically acceptable burden sharing. If the demand-side is prioritized, the abatement costs of poorer countries can be alleviated through compensatory measures. These can come in the form of generous allowance allocation in the EU ETS or lower non-ETS targets. Measures of the sort have already been implemented. The Phase IV rules of the EU ETS, for instance, allocate a disproportionately high share of auctioning revenue to lower-income member states (relative to their baseline emissions). Moreover, the non-ETS targets under the ESR are largely based on countries' economic capacity, which resulted in low targets for poorer member states. Such a demand-side emphasis would allow the EU to compensate poorer countries for part of their abatement costs. This is evidenced by Babonneau et al. (2018) for the non-ETS, who show that extending the non-ETS burden sharing rules under the original ESR to 2050 would benefit low-income countries relative to richer ones.

There is, however, a need to balance the demand-side considerations with the supply-side. Allocating too much of the additional non-ETS abatement to richer countries, who typically already have higher targets, would increase their costs considerably. Sartor et al. (2015) caution that failing to take into account abatement cost differences when design-

[9] Carbon pricing policies that leave low-income households better off relative to high-income households are called "progressive"; policies that make low-income households comparatively worse off are said to be "regressive"; while policies with a neutral impact are called "proportional."

[10] Specifically, Rausch et al. (2010) found that the impact is proportional to slightly progressive, while Rausch et al. (2011) found evidence of a roughly proportional impact.

ing burden-sharing rules in the non-ETS means that some countries might be unable to meet their targets. Moreover, the overall cost to the EU would increase if more abatement is undertaken in richer countries where emissions reductions are generally costlier. It can also be argued that poorer member states are already largely compensated for their carbon cost (e.g., through the overallocation of EU ETS auctioning allowances), meaning additional compensation might be too costly in terms of sacrificed cost effectiveness.

Integrating carbon markets could make it easier to increase the burden for low-income countries (to enhance cost-effectiveness) while ensuring they remain compensated. Vielle (2020) found that poorer member states would reap the largest gains from linking non-ETS markets. Market integration allows countries to trade allowances which, in theory, can equalize MACs across polluters, thereby improving cost-effectiveness (Böhringer 2014; Goulder and Parry 2008; Böhringer et al. 2006). Richer countries, who typically have higher MACs, benefit from lower total abatement costs, while poorer countries, whose MACs tend to be lower, gain revenue from exporting allowances. In practice, large overall cost savings could likely be achieved from non-ETS market integration (Sartor et al. 2015; Vielle 2020; Tol 2009) or from linking ETS with non-ETS markets (Böhringer et al. 2009; Babonneau et al. 2016).

One final point merits consideration. As highlighted by Sartor et al. (2015), increased flexibility, through for instance non-ETS market integration, will on its own not deliver the necessary financing and abatement required for low-income countries' low-carbon transition. It is therefore important that policies specifically aimed at supporting the decarbonization of low-income countries' non-ETS sectors are also implemented.

### Within Countries

We have already seen that carbon pricing does not necessarily result in regressive within-country outcomes, even in the absence of revenue recycling. In the event that low-income households are disproportionately hurt, however, revenue recycling is an effective tool for making the incidence less regressive. The recycling can come in various forms, including per-capita lump sum transfers (Williams III et al. 2015; Burtraw et al. 2009) and the reduction of other regressive taxes. The carbon revenue could also be invested in projects that especially benefit low-income households. These include measures that improve energy efficiency in low-income housing, promote skill formation for vulnerable occupation groups during the energy transition, or make public transport more accessible for rural low-income households (Zachmann et al. 2018; European Commission 2021c).

There is furthermore evidence that transfer indexation can shield poorer households on the income-side. Fullerton et al. (2011), Cronin et al. (2019), and Goulder et al. (2019) show that indexing transfers to inflation can help compensate low-income households for higher consumption prices created by carbon pricing. These households benefit in particular from the indexation since they typically derive higher income shares from transfers.

## CONCLUSION

The European Green Deal will affect different countries and different households unevenly. Moreover, distributional impacts can be decomposed into a supply- and demand-side.

On the supply-side, some poorer countries might benefit from cheap abatement opportunities, while on the demand-side carbon price-induced increases in final prices will represent a lower fraction of consumption expenditures for richer countries. Within countries, poorer households might be less affected by changes in nominal factor returns and transfers (supply-side), while they might feel increases in consumption prices more (demand-side). To properly address distributional effects, all major channels need to be fairly assessed.

The cost distribution across countries can be influenced by segmenting carbon markets, allocating allowances, and using financial transfers across countries. Revenue redistribution will become increasingly important if carbon markets are further integrated.

Within countries, progressively recycling carbon revenue and indexing transfers to inflation can lower costs for poorer households.

This article has two major caveats. First, we restrict our attention to carbon pricing, and therefore do not address the distributional effects of other climate policy instruments in the Green Deal (e.g., standards). Second, and relatedly, we do not consider how outcomes are impacted by the use of overlapping instruments for decarbonization in coming decades.

## REFERENCES

Babonneau, F., A. Haurie and M. Vielle (2016), "Assessment of Balanced Burden-Sharing in the 2050 EU Climate/Energy Roadmap: A Metamodeling Approach", *Climatic Chang* 134, 505–519.

Babonneau, F., A. Haurie and M. Vielle (2018), "Welfare Implications of EU Effort Sharing Decision and Possible Impact of a Hard Brexit", *Energy Economics* 74, 470–489.

Bento, A. M., L. H. Goulder, M. R. Jacobsen and R. H. von Haefen (2009), "Distributional and Efficiency Impacts of Increased US Gasoline Taxes", *American Economic Review* 99, 667–699.

Böhringer, C. (2014), "Two Decades of European Climate Policy: A Critical Appraisal", *Review of Environmental Economics and Policy* 8, 1–17.

Böhringer, C., T. Hoffmann and C. Manrique-de-Lara-Peñate (2006), "The Efficiency Costs of Separating Carbon Markets under the EU Emissions Trading Scheme: A Quantitative Assessment for Germany", *Energy Economics* 28, 44–61.

Böhringer, C., T. F. Rutherford and R. S. Tol (2009), "THE EU 20/20/2020 Targets: An Overview of the EMF22 Assessment", *Energy Economics* 31, S268–S273.

Büchs, M., N. Bardsley and S. Duwe (2011), "Who Bears the Brunt? Distributional Effects of Climate Change Mitigation Policies", *Critical Social Policy* 31, 285–307.

Burtraw, D., R. Sweeney and M. Walls (2009), "The Incidence of U.S. Climate Policy: Alternative Uses of Revenues from a Cap-and-Trade Auction", *National Tax Journal* 62, 497–518.

Central Statistics Office Ireland (2021), *Actual Individual Consumption – An International Comparison,* https://www.cso.ie/en/releasesandpublications/in/aic/actualindividualconsumption-aninternationalcomparison/.

Cronin, J. A., D. Fullerton and S. Sexton (2019), "Vertical and Horizontal Redistributions from a Carbon Tax and Rebate", *Journal of the Association of Environmental and Resource Economists* 6, http://dx.doi.org/10.1086/701191.

Enerdata (2014), *Costs and Benefits to EU Member States of 2030 Climate and Energy Targets,* http://globaltrends.thedialogue.org/publication/costs-and-benefits-to-eu-member-states-of-2030-climate-and-energy-targets/.

European Commission (2019), *Communication from the Commission The European Green Deal, COM(2019) 640 final,* https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1588580774040&uri=CELEX:52019DC0640.

European Commission (2020), *Impact Assessment Accompanying the Document Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions Stepping up Europe's 2030 Climate Ambition Investing in a Climate-neutral Future for the Benefit of Our People, SWD(2020) 176 final,* https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX percent3A52020SC0176.

European Commission (2021a), *Proposal for a Regulation of the European Parliament and of the Council Establishing a Carbon Border Adjustment Mechanism, COM(2021) 564 final*, 2021/0214 (COD), https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX percent3A52021PC0564.

European Commission (2021b), *Impact Assessment Report Accompanying the Document Proposal for a Regulation of the European Parliament and of the Council Establishing a Carbon Border Adjustment Mechanism, SWD/2021/643 final,* https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX percent3A52021SC0643&qid=1628080168792.

European Commission (2021c), *Proposal for a Directive of the European Parliament and of the Council Amending Directive 2003/87/EC Establishing a System for Greenhouse Gas Emission Allowance Trading within the Union, Decision (EU) 2015/1814 Concerning the Establishment and Operation of a Market Stability Reserve for the Union Greenhouse Gas Emission Trading Scheme and Regulation (EU) 2015/757, COM(2021) 551 final,* 2021/0211 (COD), https://ec.europa.eu/info/sites/default/files/revision-eu-ets_with-annex_en_0.pdf.

European Environment Agency (EEA, 2021), *Greenhouse Gas Emissions by Source Sector,* https://ec.europa.eu/eurostat/databrowser/view/ENV_AIR_GGE__custom_1182144/default/table?lang=en.

Eurostat (2021a), *GDP per Capita in PPS,* https://ec.europa.eu/eurostat/databrowser/view/tec00114/default/table?lang=en.

Eurostat (2021b), *Greenhouse Gas Emissions per Capita,* https://ec.europa.eu/eurostat/databrowser/view/t2020_rd300/default/table?lang=en.

Fullerton, D., G. Heutel and G. E. Metcalf (2011), "Does the Indexing of Government Transfers Make Carbon Pricing Progressive?", *National Bureau of Economic Research Working Paper* 17678.

Goulder, L. H. and I. W. Parry (2008), "Instrument Choice in Environmental Policy", *Review of Environmental Economics and Policy* 2, 152–174.

Goulder, L. H., M. A. Hafstead, G. Kim and X. Long (2019), "Impacts of a Carbon Tax across US Household Income Groups: What Are the Equity-Efficiency Trade-Offs?", *NBER Working Paper* 25181.

Hassett, K. A., A. Mathur and G. E. Metcalf (2009), "The Incidence of a U.S. Carbon Tax: A Lifetime and Regional Analysis", *The Energy Journal* 30, 155–177.

Landis, F. (2019), "Cost Distribution and Equity of Climate Policy in Switzerland", *Swiss Journal of Economics and Statistics* 155, https://doi.org/10.1186/s41937-019-0038-2.

Landis, F. and P. Heindl (2019), "Renewable Energy Targets in the Context of the EU ETS: Whom Do They Benefit Exactly?", *The Energy Journal* 40, 129-169.

Mathur, A. and A. C. Morris (2014), "Distributional Effects of a Carbon Tax in Broader U.S. Fiscal Reform", *Energy Policy* 66, 326–334.

Rausch, S. and G. A. Schwarz (2016), "Household Heterogeneity, Aggregation, and the Distributional Impacts of Environmental Taxes", *Journal of Public Economics* 138, 43–57.

Rausch, S., G. E. Metcalf and J. M. Reilly (2011), "Distributional Impacts of Carbon Pricing: A General Equilibrium Approach with Micro-data for Households", *Energy Economics* 33, S20–S33.

Rausch, S., G. E. Metcalf, J. M. Reilly and S. Paltsev (2010), "Distributional Implications of Alternative U.S. Greenhouse Gas Control Measures", *The B.E. Journal of Economic Analysis & Policy* 10, (Symposium), Article 1, https://doi.org/10.2202/1935-1682.2537.

Sartor, O., I. Bart, I. Cochran and A. Tuerk (2015), *Enhanced Flexibility in the EU's 2030 Effort Sharing Agreement: Issues and Options,* Climate Strategies, https://climatestrategies.org/publication/enhanced-flexibility-in-the-eus-2030-effort-sharing-agreement-issues-and-options/.

Tol, R. S. (2009), "Intra-Union Flexibility of Non-ETS Emission Reduction Obligations in the European Union", *Energy Policy* 37, 1745–1752.

Vandyck, T. and D. van Regemorter (2014), "Distributional and Regional Economic Impact of Energy Taxes in Belgium", *Energy Policy* 72, 190–203.

Vielle, M. (2020), "Navigating Various Flexibility Mechanisms under European Burden-Sharing", *Environmental Economics and Policy Studies* 22, 267–313.

Williams III, R. C., H. Gordon, D. Burtraw, J. C. Carbone and R. D. Morgenstern (2015), "The Initial Incidence of a Carbon Tax across Income Groups", *National Tax Journal* 68, 195–214.

Zachmann, G., G. Fredriksson and G. Claeys (2018), *The Distributional Effects of Climate Policies*, Bruegel Blueprint Series, https://www.bruegel.org/2018/11/distributional-effects-of-climate-policies/.

*Ottmar Edenhofer, Matthias Kalkuhl* and *Christina Roolfs*

# Carbon Pricing and Revenue Recycling: An Overview of Vertical and Horizontal Equity Effects for Germany*

The European Green Deal and the proposed Fit for 55 package requires a tremendous and rapid reduction of greenhouse gas emissions to achieve climate neutrality by 2050. With the introduction of a second European carbon pricing scheme for the building and transport sectors, carbon pricing is supposed to become the cornerstone of European climate policy. Since ambitious emissions targets require a high carbon price—probably over 100 euros per ton by 2030—a socially balanced reform package is needed to avoid financial hardship for vulnerable and low-income households.

Socially unbalanced impacts from carbon pricing may arise as follows: first, carbon pricing puts in most high-income countries a larger burden on low-income households compared to their high-income counterparts as energy and many energy-intensive goods constitute basic goods. Without any compensatory measures, carbon pricing therefore tends to increase the spread across income groups and the overall societal inequality in real incomes (e.g., Fullerton 2011; Grainger and Kolstad 2011; Klenert et. al. 2018). Carbon-price impacts across different income levels represent the "vertical" dimension of inequality. Second, carbon pricing places a larger burden on $CO_2$-intensive households, independent of their position in the income distribution. Differences in $CO_2$ intensity—after controlling for income—represent the "horizontal" dimension of inequality. While increasing horizontal inequality may not increase overall inequality in real incomes, it is a politically–economically relevant dimension because of the individual loss-aversion eventually resulting in public resistance (Fischer and Pizer 2018). Figure 1 illustrates the income (vertical) and $CO_2$-intensity (horizontal) dimensions relevant for carbon pricing. Addressing both these dimensions paves the way for socially balanced climate policies.

To achieve a socially balanced climate policy, carbon-price revenues can be used to redistribute the carbon-price burden away from low-income and carbon-intensive households. This article assesses the vertical and horizontal inequality effects of various compensation schemes that partly use channels of existing transfer and tax policies. We illustrate these measures for the carbon price on transport and heating fuels introduced in Germany in 2021, looking at the direct incidence of increased gasoline, diesel, heating oil, and natural gas prices on German households. So far, a carbon price of 30 euros per ton $CO_2$ is planned for the year 2022, but calls for higher prices also already exist. We show which compensation measures actually provide relief to disadvantaged households and which do not. In assessing the performance of carbon pricing and relief measures as discussed or planned in Germany, this article also provides potential lessons for other high-income countries.

We find that equal-per-capita payments outperform all other considered compensation measures in terms of relieving low-income households. There is,

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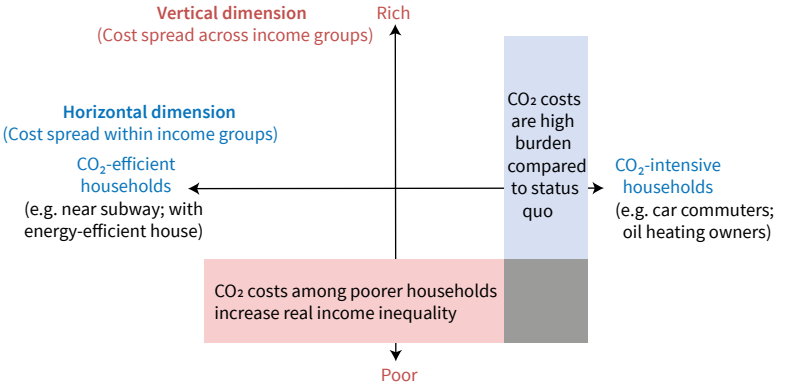
however, a trade-off between horizontal ($CO_2$-intensity) and vertical (income) inequality reduction. Pure per-capita payments make low-income households better off than a relief measure that also addresses horizontal inequality. A pragmatic solution to provide relief to hardship cases and low-income households is to combine equal-per-capita payments with hardship compensation (such as oil heating compensation and long-distance commuting compensation). Combining equal-per-capita payments with hardship compensation produces the least variability in burden across the different household types while simultaneously making poorer households better off.

Figure 1

**The Vertical and Horizontal Inequality Dimensions of the Carbon-Price Burden**




Source: Authors' compilation.



## WELFARE-ECONOMICS BACKGROUND

Existing works on carbon pricing emphasize how labor income cuts and equal-per-capita lump-sum transfers can make carbon pricing progressive, addressing the vertical dimension (e.g., Boyce and Riddle 2007; Burtraw et al. 2009; Dorband et al. 2019; Klenert et al. 2018; Rausch et al. 2010). Horizontal equity effects are increasingly being studied from a descriptive rather than a normative perspective (e.g., Pizer and Sexton 2019). Hänsel et al. (2021) have developed a welfare-economics framework that incorporates the vertical and horizontal dimensions through differences in households' labor productivity and energy productivity. The latter heterogeneity addresses factors that are—in the short to medium term—exogeneous to households, and describe how much primary energy is needed to enjoy a certain utility level from energy-intensive services. Thus, horizontal inequality can be understood as a technological heterogeneity of housing capital, transport capital (cars, but also access to public transport networks), or climate conditions (affecting demand for energy). The implementation of a climate target and the corresponding carbon prices devalue these capital stocks, implying a differentiated carbon-price impact even within income groups.

If horizontal heterogeneity arises from exogenous factors, taxes, or transfers that are specific to the horizontal household type can eliminate any horizontal inequality effects from carbon pricing. The welfare economic analysis of Hänsel et al. (2021), however, emphasizes that, from a normative perspective, it is not optimal to eliminate all horizontal differences: because energy-efficient households can better convert an additional transfer to utility, diverting resources to energy-intensive households tends also to reduce aggregate welfare while horizontal equality increases. For a wide range of social inequality-aversion parameters, a large share of the horizontal inequality should be reduced—but not completely eliminated—by type-specific transfers.

While type-specific transfers constitute welfare-maximizing policies, they require household types to be observable. If the household type is non-observable, non-linear energy taxes are incentive-compatible second-best policies (Hänsel et al. 2021). But non-linear taxes require household-specific monitoring of energy consumption as the tax rate changes according to the amount of individual energy consumption. Because of the potentially high administrative costs of non-linear energy taxes, as well as household-specific transfers, it is crucial to identify institutionally feasible compensation schemes that address vertical and horizontal effects. If compensation schemes could be integrated into existing tax or transfers policies, transaction costs could be considerably reduced. The subsequent analysis therefore focuses on measures that could be implemented at low administrative costs in the German policy context.

## EFFECT OF DIEFFERENT RELIEF MEASURES

This section assesses the carbon-price incidence for various relief measures for increased transport and heating oil prices for German households, based on data from the German sample survey on income and consumption (*Einkommens- und Verbrauchsstichprobe*), the environmental economic accounts (*Umweltökonomischen Gesamtrechnungen*), and the micro-census (*Mikrozensus*). The incidence calculation considers direct emissions and static household behavior (no behavior adjustment in response to changing prices). A detailed model description and data documentation are in Roolfs et al. (2021). The incidence calculation is also accessible online via http://www.mcc-berlin.net/co2preisrechner (in German).

We consider the following relief measures which recycle and redistribute carbon-price revenues to compensate households. German names are given in parentheses:

1. Equal-per-capita payment (*Pro-Kopf-Zahlung*): Each person receives an equal share of the carbon-price revenues.
2. Electricity price reduction (*Strompreis-Reduktion*): A revenue-neutral reduction of the renewable en-

ergy levy (*EEG-Umlage*)[1] reduces the electricity price. This is achieved by using carbon-price revenues to partially cover the funding objective of the levy.

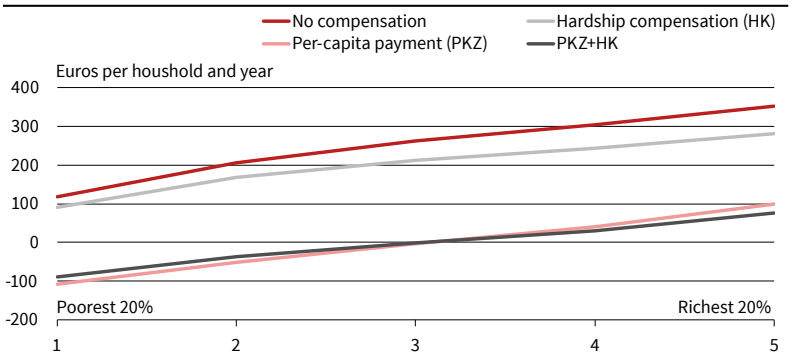
3. Long-distance commuting compensation (*Fernpendler-Kompensation*): Compensation for carbon-price related additional costs for households commuting more than 20 km. The compensation is independent of the travel mode, so it is also paid for by commutes by public transport or electric car and calculated from the average carbon emissions from one km traveled by car. It constitutes a modification of the existing commuting allowance of 30 eurocents per km that can be deducted from income tax.
4. Oil heating compensation (*Ölheizung-Kompensation*): Redistributes carbon-price revenues to households owning an oil heating system. Households are compensated by a fixed amount per year to exactly compensate the cost difference to an average household without oil heating. The compensation can be converted into an equivalent oil heating replacement subsidy to substitute heat pumps for oil heaters.
5. Landlord-pay regime (*Vermieter-Umlage*): Under this option, landlords cover 50 percent of tenants' heat-related carbon-price costs (i.e., natural gas and heating oil). This means that tenants are partially relieved of higher expenditures due to carbon pricing. The option is controversially discussed in Germany to increase incentives for landlords to reduce carbon emissions.[2]
6. Hardship-based compensation (*Härtefallkompensation*): Combines long-distance commuting compensation and oil heating compensation to address two important hardship cases (i.e., to avoid large horizontal inequality effects).

[1] The EEG (*Erneuerbare-Energien-Gesetz*) or Renewable Energy Sources Act is a series of German laws to encourage the generation of renewable electricity. It entails feed-in tariffs for renewable energy production. These tariffs are funded by the EEG levy (*EEG-Umlage*) raised from electricity consumers.

Figure 2

**Relief Potential along the Vertical Inequality Dimension (Income) for Selected Compensation Measures**

Absolute Burden on Private Households, Revenue Cycling Options (50 EUR $CO_2$-price)

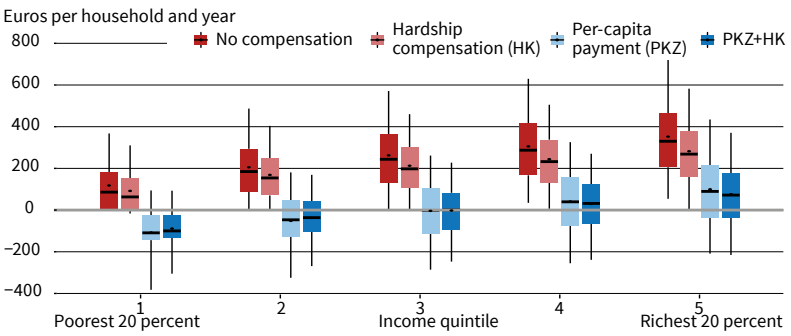



Source: Data from Einkommens - und Verbrauchsstichprobe (EVS), Umweltökonomische Gesamtrechnungen, and Mikrozensus; authors' calculation. © ifo Institute

Figure 3

**Relief Potential along the Horizontal ($CO_2$ Intensity/Social Hardship) and Vertical (Income) Inequality Dimension**

Absolute Burden on Private Households, Revenue Cycling Options (50 EUR $CO_2$-price)




Source: Data from Einkommens- und Verbrauchsstichprobe (EVS), Umweltökonomische Gesamtrechnungen, and Mikrozensus; own calculation. © ifo Institute

To compare the incidence of the carbon price by different relief measures, we also report the incidence without any compensation measures ("no compensation").

Starting with the vertical dimension, some compensation measures are generally assumed to positively impact low-income households. Among these are equal-per-capita payments, reduced electricity prices by lowering the renewable energy levy, and landlord compensation. Intuitively, one would expect a high relief for low-income households both from the landlord-pay regime (because landlords pay 50 percent of tenants' heat-related carbon-price costs) and with an electricity price reduction (because the share of electricity costs declines with household income).

Figure 2, however, suggests that equal-per-capita payments outperform both measures in terms of reducing the burden on low-income households, and the landlord-pay regime has almost no relieving effect. The reason is that equal-per-capita payments purely add to household income, while the electricity price reduction funded by carbon-price revenues also relieves parts of the industry that additionally benefit from a reduced levy. Similarly, the landlord-pay regime touches only a fraction of the burden imposed on low-income households by carbon pricing. The reason is that low-income households are not necessarily tenants and, if they are, 50 percent of the heat-related carbon price is not necessarily the largest cost item for them.

Figure 3 shows the distributional effects of two relief measures addressing vertical and horizontal effects. Whereas equal-per-capita payments primarily target income differences (vertical dimension), the hardship-based compensation aims at relieving $CO_2$-intensive households (horizontal dimension). As a reference, we plot the incidence without compensation (in red).

Both equal-per-capita payments and hardship-based compensation reduce the burden on all

[2] There seems to be some empirical support for such incentive effects in a United States case study, see Myers (2020).

Table 1

**Relief Potential for Different Socioeconomic Groups for Various Compensation Measures for a Carbon Price of 50 EUR**

| | All house-holds | Long-distance commuter | Tenants | Urban areas | Rural areas | House-holds with car | House-holds with oil heating | Long-distance commu-ters with oil heating |
|---|---|---|---|---|---|---|---|---|
| *Share of population (%)* | *100* | *26* | *53* | *48* | *21* | *79* | *21* | *5* |
| No compensation | 250 | 409 | 177 | 225 | 275 | 296 | 358 | 536 |
| Landlord-pay regime | 245 | 407 | 140 | 220 | 272 | 295 | 344 | 526 |
| Long-distance commuting compensation | 224 | 311 | 159 | 201 | 247 | 266 | 332 | 435 |
| Oil heating compensation | 224 | 383 | 156 | 203 | 131 | 268 | 233 | 411 |
| Electricity price reduction | 95 | 211 | 66 | 76 | 112 | 126 | 200 | 340 |
| Long-distance commuting compensation + Electricity price reduction | 85 | 133 | 59 | 68 | 100 | 113 | 190 | 258 |
| Equal-per-capita payment | – 5 | 47 | – 40 | – 21 | 12 | 20 | 101 | 165 |
| Long-distance commuting compensation + Equal-per-capita payment | – 5 | – 16 | – 37 | – 20 | 10 | 17 | 100 | 101 |

Source: Data from Einkommens- und Verbrauchsstichprobe (EVS), Umweltökonomische Gesamtrechnungen, and Mikrozensus; own calculation.

income groups. Equal-per-capita payments relieve low-income households the most and produce a net gain for households in the lowest income quintile. This is a clear illustration of how equal-per-capita payments address the vertical dimension of inequality concerns related to carbon pricing. For hardship-based compensation, the burden for all income groups is reduced, but the measure does not produce a net gain for any income group. High-income households see the largest burden reduction. Low-income households receive the smallest relief compared to all income groups under the hardship-based measure. As a result, hardship-based compensation reduces the overall burden on households compared to no compensation, and reduces the burden spread across income groups, but it does not fully transfer carbon-tax revenues back to households. One solution to compensating hardship cases while achieving a progressive effect—with a large relief for low-income households—is to combine equal-per-capita payments with hardship compensation. To again be revenue neutral, the per-capita payments are reduced to reserve funds for hardship compensation. In this case, low-income households receive a net relief, and the burden increases progressively. Nevertheless, the burden spread is reduced compared with pure per-capita payments. The combination allows both vertical and horizontal equity aspects to be balanced.

Different compensation measures distribute the burden across socioeconomic groups differently, as Table 1 shows for a carbon price of 50 euros per ton. The color scheme helps to rank the burden. Red and orange shades represent “very large” and “large” burdens on respective socioeconomic groups. Yellow stands for a “medium” burden, and blue represents net gains of varying magnitudes. The compensation measures are ranked top to bottom in terms of their overall ability to relieve as many socioeconomic groups as possible.

Intuitively, no compensation always results in the most considerable burden for every household. Long-distance commuters with oil heating are hit the most under any compensation scheme. In terms of the overall population, per-capita payments and the combination of per-capita and long-distance commuting compensations outperform all other schemes. Long-distance commuters benefit most under the combination of per-capita and long-distance commuting compensations, which is a dramatic improvement for this group over the pure long-distance commuting compensation scheme. Tenants benefit most under per-capita payments, which are much better for this group than a landlord-pay regime. Rural areas are hit more than urban ones under all compensation schemes, except under an oil-heating-based compensation scheme where rural areas are better off. However, in absolute terms, compensation measures involving per-capita payments are vastly superior to all others for both urban and rural areas. Similarly, households with a car, those with oil heating, and long-distance commuters with oil heating all benefit most under per-capita payments or a combination of per-capita and long-distance commuting compensations. Lastly, we compare the performance of the combination of per-capita and long-distance commuting compensations with pure per-capita payments. Significant improvements can be achieved for long-distance commuters with oil heating if per-capita payments are combined with long-distance commuting compensation.

From the perspective of the horizontal inequality generated by carbon pricing and the relief measures, it is apparent that compensation schemes involving

per-capita payments also produce the least variability in burden across different household types. The distance from each type of household to the average household in the first column is smallest for compensation schemes involving per-capita payments. Overall, we can conclude that compensation measures involving equal-per-capita payments outperform other compensation schemes in terms of the resulting vertical as well as horizontal inequality. Nevertheless, as Figure 2 also illustrates, there is a trade-off between horizontal and vertical inequality reduction: pure per-capita payments would make low-income households better off than a policy that also addresses horizontal inequality.

## PATHWAYS TO FAIR CARBON PRICES

The advantage of a carbon price is that it establishes a technology-neutral incentive for innovations in climate-friendly alternatives and for the reduction in the use of $CO_2$-intensive goods and technologies. But it also generates revenues that can be used to relieve the burden on citizens or the economy. In Germany, the revenues from national carbon pricing and from European emissions trading flow exclusively into the Energy and Climate Fund (*EKF*). In 2021, 40 percent of these funds will be used to reduce the renewable energy levy and thus ease the burden on private households and companies. In 2022, only 32 percent will be used for this purpose. The remaining revenue will be used for subsidy programs.

However, this analysis makes it clear that an increase in carbon prices can and should be combined with compensation schemes. In this way, the costs of climate protection can be fairly distributed and social hardship can be avoided with low or reasonable administrative efforts. Regarding the effect of relief measures, there are various misconceptions in the public perception that do not stand up to closer analysis. For example, it appears that a reduction in electricity costs and, even more so, a per-capita rebate can ensure a socially fair carbon price. In contrast, passing on part of the increased costs to landlords and raising the commuter allowance do not have a substantial relieving effect on poorer households.

Since significantly higher carbon prices—and thus also significantly higher costs for households—are needed to achieve ambitious climate targets, the share of direct relief measures should be increased. In the short term, this could be done using a further subsidy to finance the German feed-in tariff system for renewable energy supply and, in turn, lower the renewable energy levy. In the medium term, the legal and administrative conditions for direct reimbursements via per-capita payments could be created. Because renewable energy will become competitive when carbon prices rise sharply, the financing requirements via the renewable energy levy will decrease. Expenditure programs for $CO_2$-free infrastructure—for a hydrogen economy for example—could be financed by revenues from carbon pricing of the industry, while revenues from household pricing should increasingly be returned to households. Financial hardship for certain groups, such as long-distance commuters or households with oil-fired heating systems, could be prevented with low-cost time-limited compensation, without weakening the incentive effect of carbon pricing (see also the last row in Table 1). A socially just carbon price—even with high prices above 100 euros per ton—is possible and necessary.

## REFERENCES


Boyce, J. and M. Riddle (2007), "Cap and Dividend: How to Curb Global Warming While Protecting the Incomes of American Families", *Working Papers* wp150, Political Economy Research Institute, University of Massachusetts at Amherst.

Burtraw, D., R. Sweeney and M. Walls (2009), "The Incidence of U.S. Climate Policy: Alternative Uses of Revenues from a Cap-and-Trade Auction", *National Tax Journal* 62, 497–518.

Dorband, I., M. Jakob, M. Kalkuhl and J. Steckel (2019), "Poverty and Distributional Effects of Carbon Pricing in Low- and Middle-Income Countries – A global Comparative Analysis", *World Development* 115, 246–257.

Fischer, C. and W. A. Pizer (2018), "Horizontal Equity Effects in Energy Regulation", *Journal of the Association of Environmental and Resource Economists* 6, S209–S237.

Fullerton, D. (2011), "Six Distributional Effects of Environmental Policy", *Risk Analysis* 31, 923–929.

Grainger, C. A. and C. D. Kolstad (2010), "Who Pays a Price on Carbon?", *Environmental and Resource Economics* 46, 359–376.

Hänsel, M. C., M. Franks, M. Kalkuhl and O. Edenhofer (2021), "Optimal Carbon Taxation and Horizontal Equity: A Welfare-Theoretic Approach with Application to German Household Data", *CESifo Working Paper* 8931.

Kalkuhl, M., M. Amberg, T. Bergmann, M. Kellner and C. Roolfs (2021), *MCC $CO_2$-Preis-Rechner (Version 1.0),* URL: www.mcc-berlin.net/co2preisrechner.

Klenert, D., L. Mattauch, E. Combet, O. Edenhofer, C. Hepburn, R. Rafaty and N. Stern (2018), "Making Carbon Pricing Work for Citizens", *Nature Climate Change* 8, 669–677.

Myers, E. (2020), "Asymmetric Information in Residential Rental Markets: Implications for the Energy Efficiency Gap", *Journal of Public Economics* 190, 104251.

Pizer, W. A. and S. Sexton (2019), "The Distributional Impacts of Energy Taxes", *Review of Environmental Economics and Policy* 13, 104–123.

Rausch, S., G. Metcalf, J. Reilly and S. Paltsev (2010), "Distributional Implications of Alternative U.S. Greenhouse Gas Control Measures", *NBER Working Paper* 16053.

Roolfs, C., M. Kalkuhl, M. Amberg, T. Bergmann and M. Kellner (2021), *Documentation of the $CO_2$-price Incidence Webtool 'MCC $CO_2$-Preis-Rechner' (Version 1.0),* URL: http://doi.org/10.5281/zenodo.5094561.

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# The Intertemporal Distribution of Climate Policy Burdens and the Decision of the German Constitutional Court

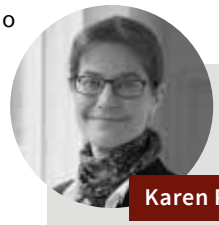
Germany has recently raised its climate targets. Greenhouse gas emissions are to be reduced by at least 65 percent by 2030 compared with 1990 levels, and climate neutrality is to be accomplished by 2045. The decision to increase Germany's climate ambitions was triggered by the EU's strengthening of its targets as well as the ruling by the German Constitutional Court on the partial unconstitutionality of Germany's Climate Protection Act - a law that was passed not even two years prior. This article discusses fundamental issues on sharing the burden of climate policy over successive generations and addresses implications of the Constitutional Court ruling and the subsequent reform of Germany's Climate Protection Act on the effectiveness of climate protection.

It was with the yellow vest movement in France and the introduction of national $CO_2$ pricing that the distributional effects of climate policies have come increasingly to the fore in Germany. The focus of this debate has primarily been on the repercussions of today's energy policies on the burden of various societal groups. However, climate and energy policies not only concern people living today, but they will also affect the prosperity of tomorrow's generations. In the political debate, though, these so-called intertemporal distributional effects have for a long time been accorded only secondary importance.

Yet, the decision of the German Federal Constitutional Court (BVG 2021a) regarding the partial unconstitutionality of the German climate law (the so-called Climate Protection Act) together with the ruling of a Dutch court on the climate protection obligations of the Royal Shell Group (De Rechtspraak 2021) have now brought the intertemporal component of the distribution discussion into increased focus. Both courts emphasize that the obligation to protect the climate follows from the protection of the civil rights and freedoms of future generations.

The decision of the Constitutional Court is thus not only remarkable for granting climate protection a rank that is quasi-constitutional, but also because it explicitly called for a fair intertemporal distribution of climate protection costs. Given the German climate law from 2019, the BVG saw the danger that the burdens of climate protection that will be placed on future generations could become so high that they would restrict their civil rights.

In the following, we first discuss the repercussions that the temperature target approach on which the BVG based its decision has on the temporal distribution of climate protection costs as compared to mitigation pathways that do not assume an explicit temperature target. We then go on to discuss the implications of the BVG decision and its planned implementation.



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## HOW ARE INTERTEMPORAL EMISSION REDUCTIONS DETERMINED?

One of the reasons why intergenerational distributional effects have received relatively scant attention in the political and economic debate so far are different perceptions of what the ultimate goal of climate protection is supposed to be. One can, roughly, distinguish two different (but related) approaches: Minimizing the expected costs of climate change (labelled "expected value perspective" in the following) and limiting climate change to an upper boundary of temperature increase (labelled the "target perspective").

### The "Expected Value" Perspective

From an economic perspective, climate policy is primarily about taking environmental and climate damages from greenhouse gas emissions into account in production, consumption and investment decisions. Policies are optimal from an economic perspective (i.e., lead to the highest welfare) if the price paid for an additional ton of emissions is equal to the monetarized damages that are caused by this emission today and in the future.

Of course, determining the exact level of damages from climate change is subject to high methodological challenges and uncertainty. Much of the damage occurs in ecosystems whose value to humans is not determined by markets. Without having market prices to refer to, estimating the costs of ecosystem deterioration is difficult. Moreover, damages from climate change will accrue not merely in the next few years, but over the next centuries. Assessing inferred costs depends on a lot of determinants (e.g., economic and population development, both of which depend on climate change). Moreover, the value of future damage from today's perspective also depends on how these damage are weighted compared to today's (i.e., whether and how they are discounted).

Estimates of damages therefore vary widely. In a review study, Tol (2009) found damage estimates

from different models, ranging from \$8/$tCO_2$ to \$1,500/$tCO_2$, with a mean of \$151/$tCO_2$. Even when only using one model but assuming different weights for future damage, Nordhaus (2019) arrived at estimates per ton of $CO_2$ ranging from \$23 (discount rate of 5 percent) to \$970 (discount rate of 0.1 percent). Depending on the level and development of damages used in policy making, different emission and temperature pathways can be optimal from an economic perspective (see Figure 1).

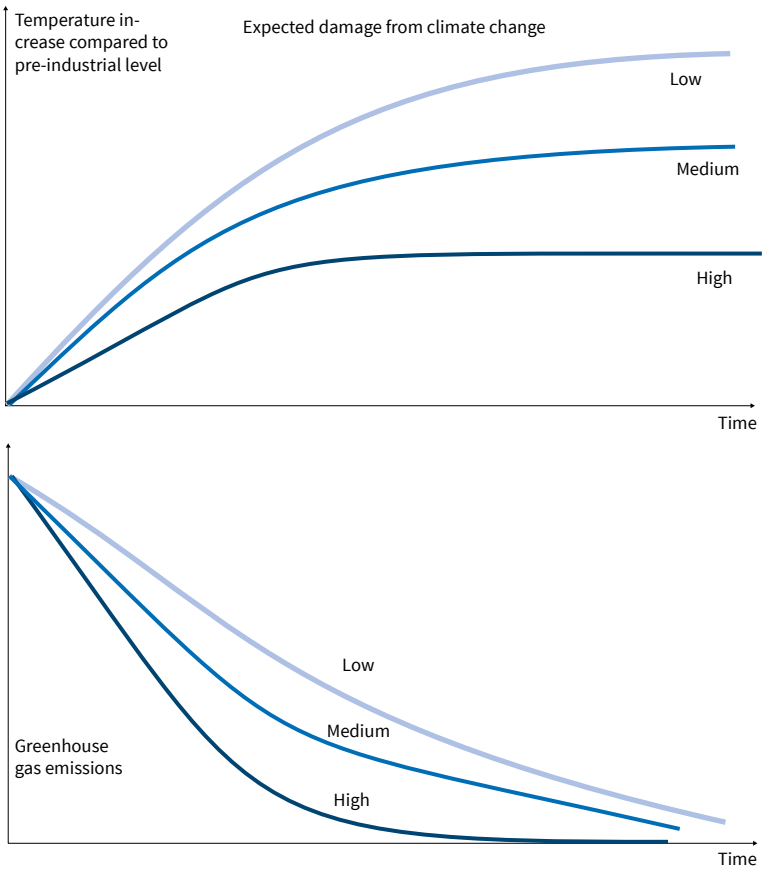
This approach does not necessarily lead to a fixed maximal temperature increase – even if climate damages could potentially become catastrophic. As long as the occurrence of such a catastrophic outcome is merely possible, but not certain, it would increase the expected value of damages but not institute an upper limit to climate change.[1] If there is no predetermined temperature target, however, there is also no fixed ex ante quantity of emissions that is still permissible. Accordingly, low emission reductions today would not have to be compensated 1:1 by increased emission reductions in the future. So, the link between emission reduction costs today and emission reduction costs in the future is much less obvious if climate policy is developed in accordance with the "expected value" logic instead of a "temperature target" logic (see below).

However, despite being not so obvious, the link between emission reduction today and the burden placed on future generations is of course also presented when policy follows the expected value approach. Based on the findings of sixteen studies, the Council of Economic Advisors to the US President concluded that delaying policies to achieve a given global emission reduction goal by a decade could increase the cost of achieving this goal by an average of 40 percent from today's perspective (Council of Economic Advisors 2014). The cost increase of such a delay would naturally be borne in particular by future generations.

[1] Basically, this is comparable to a person who engages in an activity in which there is a certain probability that he will be killed. As long as the benefits of the activity outweigh the expected costs, the activity will generally not be abandoned.

Figure 1

**Achieving Long-term Temperature Targets**[a]
Depending on the Amount of Expected Damage




[a] This figure demonstrates alternative temperature and emission reduction pathways depending on the level of expected damage.
Source: Author's compilation.

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## The "Target" Perspective

In contrast to the typical economic approach, the Paris Climate Agreement (UNFCCC 2015) and the BVG decision both follow a target logic. Both (implicitly and explicitly) specify maximum temperature increases that are not to be exceeded. Following this logic, only a certain amount of greenhouse gases may be released into the atmosphere until this target is reached and, once this global "emissions budget" has been used up, no more emissions are allowed.[2]

Behind the specification of fixed temperature targets are the so-called *planetary boundaries*. According to Rockström et al. (2009), exceeding these boundaries could have harmful or even catastrophic consequences for mankind.[3] From this follows the call to limit the increase in the average global temperature to 2° Celsius compared to pre-industrial times (*safe operating space for humanity*). In the negotiation of the Paris Agreement, this science-based temperature target was further tightened under pressure from small and particularly vulnerable island states. The agreement aims at "holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change" (Art. 2, UNFCCC 2015).

With regard to the distributional effects of climate policy decisions, the target perspective implies that failures in climate policy today always implies a direct increase of the burden of later generations. Whatever is additionally emitted today has to be emitted less in the future. This means that in the simplified representation shown in Figure 2, the area under

[2] This is, of course, a gross oversimplification of the physics of climate. For a detailed account (IPCC 2013).
[3] Planetary boundaries are defined not only for climate change, but also for other ecosystems and processes, including biodiversity loss and ocean acidification, as well as a change in the use of land as a resource (Rockström et al. 2009).

the emission curve must be the same for all emission paths, i.e., the sum of future emissions has to be the same and in accordance with the remaining emission budget.[4] Depending on how emission reductions are spread over time, the costs of climate protection will differ for different generations.

### Implications of the Two Perspectives?

The difference between the two perspectives lies primarily in the way they address very large risks. Should temperature increases beyond a certain level be prevented if they have potentially catastrophic consequences, but it is not certain that these consequences will arise? The consequence of this would be that extremely high climate protection costs would be justified, since the catastrophic outcome must be ruled out no matter what. Or should certain risks be accepted if avoiding them could lead to high welfare losses if the catastrophe does not arise after all? Trying to answer these question by simply referring to traditional cost-benefit analysis is of little use, since this type of analysis is not well suited to problems involving potentially infinite damage with a small but not negligible probability of occurrence (Weitzman 2011).

Of course, the optimal design of climate policies under the "expected value" as well as the "target" approach are both subject to uncertainty. It will neither be possible to precisely determine the optimal level of emission reduction from using expected damages to price $CO_2$-emissions. Nor will it be possible to precisely design emission trajectories to achieve specific temperature targets. For policymakers, however, uncertainty about damages proves particularly problematic when aiming to justify specific climate policies by referring to concrete (but very uncertain) damage estimates. Using deceptively simple (but ultimately also uncertain) temperature targets as a foundation for climate policy is seemingly easier to accept.

The uncertainty of damage estimates is probably one of the most important reasons why they are rarely used in the political process to determine the strength of climate policies. Accordingly, the climate policy discussion today is primarily based on temperature targets and thus emission budgets. Discussions about the level of $CO_2$ prices are therefore rarely based on damage estimates, but on intended emission reductions.

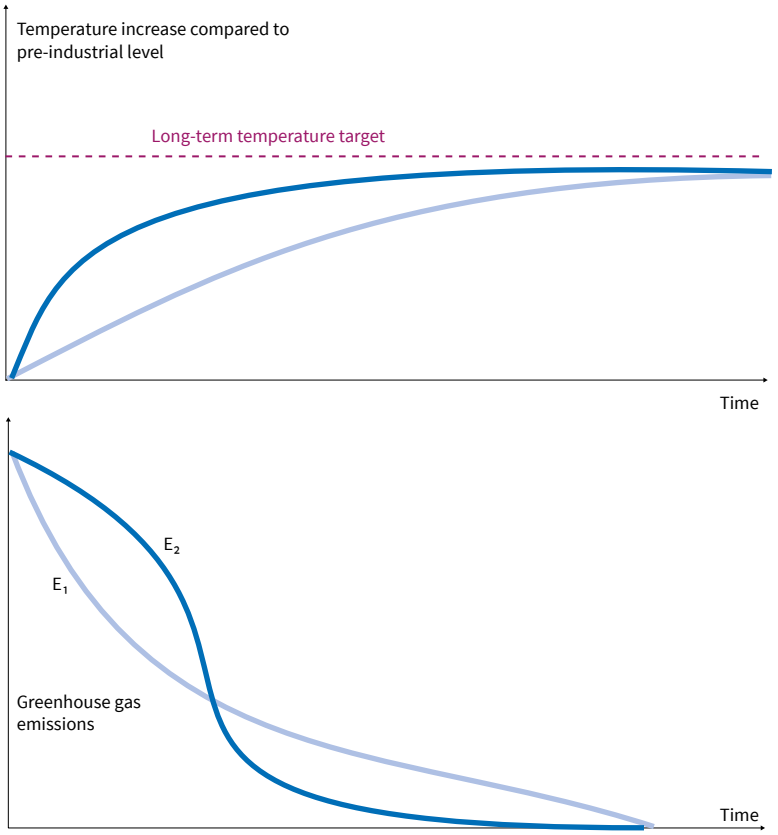
## THE RULING OF THE GERMAN CONSTITUTIONAL COURT

In its ruling, the German Constitutional Court, BVG, also adopts the "target" perspective. To this end, a maximum number of emissions permissible for Germany is derived from the global emission budget. In this approach, it follows the German Advisory Council on the Environment (SRU 2020): "The constitutionally relevant temperature threshold of well below 2°C and preferably 1.5°C can in principle be converted into a remaining global $CO_2$ budget, which can then be allocated to states" (BVG 2021b). This method of allocating the global budget to individual states is by no means uncontroversial, as the budgets available in the future also depend on the emissions trends in the rest of the world. The fact remains, however, that the BVG has followed this approach.

Following the implicit logic of the budget approach that it is the overall number of emissions that matters rather than the specific timing of emission reductions, the BVG does not require the legislator to ensure that emissions in Germany reach net zero in a specific year. However, even if more time is allotted until climate neutrality is supposed to be reached, this does not imply more leeway for climate policy if the emission budget is taken seriously. It basically implies moving from a curve like $E_2$ in Figure 2 to a curve like $E_1$. So, while emissions do not have to go to net zero as fast, emissions have to decline at a higher rate initially to avoid emitting more overall.

Figure 2

**Achieving a Long-term Temperature Target[a]**
through Alternative Temperature and Emission Reduction Pathways




[a] The two lines in each graph represent two alternative emission path ways leading to the same temperature target.
Source: Author's compilation.

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[4] Figure 2 shows so-called net emissions, i.e., emissions from the use and combustion of fossil resources minus $CO_2$ emissions taken out of the atmosphere, i.e., negative emissions. Regarding the problem of negative emissions, see WBGU (2020) or Geden and Schenuit (2020).

The BVG does not call into question the German policy target of reaching climate neutrality by 2050. It does, however, stress that it matters along which path climate neutrality is reached (i.e., which curve in Figure 2 is chosen). It explicitly requires that emission reduction paths must adhere to some fundamental notion of intergenerational equity. This is interpreted as a distribution of burdens from climate protection that does not endanger the freedom or civil rights of any generation. Still, in contrast to an almost simultaneous court ruling in the Netherlands, in which the Royal Shell Group was given specific climate targets (a 45 percent-reduction in $CO_2$ emissions compared to 2019), the BVG leaves the legislator some flexibility to set its own emissions pathways.

In the 2019 version of the German climate law not much was said about the emission reduction trajectory. A target for 2030 (– 55 percent) was included but beyond that, no specific targets were laid out. The only provision with respect to future goals was made by requiring the federal government to establish annually decreasing emission levels by statutory order for further periods after 2030 (KSG 2019). While the Court did not rule the 2030 target as unconstitutional and did not prescribe specific interim targets, it requested more transparency on the reduction path from 2031 to 2050.

From an economic perspective, the ruling addresses an important point: a transformation with too little information about future reduction targets leads to higher transition risks. These risks increase due to unexpected, rapid changes in the framework conditions for companies and can thus be reduced by a policy framework that is reliable in the long term. Therefore, the argumentation of the Federal Constitutional Court that a failure to set concrete targets beyond 2030 can imply a higher and unpredictable burden for future generations is sensible. In defining future targets, however, a compromise must be found between setting more concrete targets and taking uncertainties about future mitigation options into account.

## REFORM OF THE GERMAN CLIMATE LAW

The BVG gave the legislature until the end of 2022 to conduct the necessary reforms to the climate law. This would have opened up the possibility – in line with the BVG decision – of transparently evaluating the restructuring of the interim targets leading to the achievement of climate neutrality. Model calculations, for example, could have contrasted the targets and the required measures (and thus the costs incurred by different generations). From an economic perspective, a flatter emissions reduction path (i.e., higher abatement in the coming years followed by a smaller level later on), could well have increased the intertemporal cost-effectiveness of emissions abatement (Gollier 2021).

Unfortunately, however, the opportunity of a well-founded reform was not seized, as an adapted climate law was presented just a few days after the ruling was published. Then, this new law was hastily passed at the end of June 2021. It raised the climate target for 2030 to 65 percent which is roughly in line with what the Expert Council on Climate Issues considers necessary for translating the EU target level to the national level (Expertenrat für Klimafragen 2021). For other targets, however, such clear rationale was not given. This applies to bringing forward climate neutrality to 2045, to setting new annual reduction targets for the years 2031 to 2040, and also to the adjustment of sectoral targets until 2030. The implications with respect to measures and instruments required to reach these targets remain, however, unclear. Consequently also the distribution of burdens between different generations cannot be assessed. In this sense, the new law falls short of the intentions of the Constitutional Court.

## HOW (IN)FLEXIBLE SHOULD TARGETS BE?

The German climate law of 2019 does not only specify an overall emission reduction target for 2030, but it also specified yearly targets on a sectoral level (e.g., for energy, industry, buildings, etc.). These targets were amended but not abolished in the reform. Also, in 2024 new yearly sectoral targets are to be set for 2031 to 2040. Hagen and Pittel (2021) argue that these targets can increase the costs of emission reduction for the economy as a whole, as there is less room to react to dynamic technology developments.

It will not always be clear from the outset which emission reduction technologies will prevail, nor when they will prevail. Just one example: hydrogen and synthetic fuels will foreseeably play a major role in energy-intensive industry (e.g., steel production) and transportation (especially heavy-goods and air traffic). However, it can neither be predicted – especially on an annual basis – how quickly the required amounts of hydrogen will become available nor when industries will shift to the new technologies at a large scale.

The current (and future) law does not account for this uncertainty, which is inherent in any innovation process. It does, however, mandate that policy has to react within three months to deviations from the predefined reduction path. Given technological and behavioral uncertainties as well as potential exogenous shocks that affect emissions, such a myopic, discretionary approach to climate policy is less likely to provide long-term incentives for innovation and to initiate necessary and timely structural change. Costs of reaching the climate goals might therefore increase substantially.

However, given the immense cumulative costs of achieving even a 90-95 percent emission reduction by 2050 (960 billion to 3,354 billion euros , see Energiesysteme der Zukunft et al. 2019), it is particularly

important that climate protection is implemented as cost-effectively as possible, not least from a distributional perspective.

## CONCLUSION

By focusing on specific temperature targets as well as on national emissions budgets derived from them, politicians and the public alike are becoming increasingly aware of the question of intergenerational equity in the distribution of the burdens of climate protection. Both the setting of targets and their translation into concrete policies are going to be crucial for the level and distribution of burdens. Policies that are too short-term can significantly increase the costs of achieving long-term climate goals. Formulating year-by-year targets for emissions reductions further encourages such incremental thinking and can negatively impact business expectations and innovation. In Germany, the opportunity for a comprehensive reform of the climate law that would have fostered long-term planning was unfortunately not taken.

## REFERENCES


Bundesministerium für Umwelt, Naturschutz und nukleare Sicherheit (BMU, 2021), *Entwurf eines Ersten Gesetzes zur Änderung des Bundes-Klimaschutzgesetzes,* https://www.bmu.de/filead- min/Daten_BMU/Download_PDF/Glaeserne_Gesetze/19._Lp/ksg_aendg/ Entwurf/ksg_aendg_bf.pdf.

Bundesverfassungsgericht (BVG, 2021a), *Beschluss des Ersten Senats vom 24. März 2021 – 1 BvR 2656/18 -, Rn. 1-270,* http://www.bverfg.de/e/rs20210324_1bvr265618.html.

Bundesverfassungsgericht (BVG, 2021b), *Constitutional complaints against the Federal Climate Change Act partially successful,* Press Release No. 31/2021 of 29 April, https://www.bundesverfassungsgericht.de/SharedDocs/Pressemitteilungen/EN/2021/bvg21-031.html.

Council of Economic Advisors (2014), *The Cost of Delaying Action to Stem Climate Change,* https://scholar.harvard.edu/files/stock/files/cost_of_delaying_action.pdf.

De Rechtspraak (2021), *Royal Dutch Shell Must Reduce $CO_2$ Emissions,* https://www.rechtspraak.nl/Organisatie-en-contact/Organisatie/Rechtbanken/Rechtbank-Den-Haag/Nieuws/Paginas/Royal-Dutch-Shell-must-reduce-CO2-emissions.aspx.

Energiesyteme der Zukunft, BDI und DENA (2019), *Expertise bündeln, Politik gestalten – Energiewende jetzt, Essenz der drei Grundsatzstudien zur Machbarkeit der Energiewende bis 2050 in Deutschland,* Berlin.

Expertenrat für Klimafragen (2021), *Bericht zur Vorjahresschätzung der deutschen Treibhausgasemissionen für das Jahr 2020,* https://expertenrat-klima.de/content/uploads/2021/04/210415_Bericht_Expertenrat_Klimafragen_2021-2.pdf.

Geden, O. and F. Schenuit (2020), "Unconventional Mitigation, Carbon Dioxide Removal as a New Approach in EU Climate Policy", *SWP Research Paper* 2020/RP 08, https://www.swp-berlin.org/publikation/eu-climate-policy-unconventional-mitigation.

Gollier, C. (2021), "The Cost-Efficiency Carbon Pricing Puzzle", *CEPR Discussion Paper* 15919.

Hagen, A. and K. Pittel (2021), "Chancen und Risiken klimapolitischer Langfriststrategien am Beispiel des deutschen Klimaschutzgesetzes", *Wirtschaftsdienst* 101, 334–338.

Intergovernmental Panel on Climate Change (IPCC, 2013), *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change,* Cambridge University Press, Cambridge (UK) and New York.

KSG (2019), *Bundesklimaschutzgesetz (KSG),* https://www.gesetze-im-internet.de/ksg/BJNR251310019.html.

Nordhaus, W. (2019), "Climate Change: The Ultimate Challenge for Economics", *American Economic Review* 109, 1991–2014.

Rockström, J., W. Steffen, K. Noone et al. (2009), "A Safe Operating Space for Humanity", *Nature* 461, 472–475.

Sachverständigenrat für Umweltfragen (SRU, 2020), *Für eine entschlossene Umweltpolitik in Deutschland und Europa,* https://www.umweltrat.de/SharedDocs/Downloads/DE/01_Umweltgutachten/2016_2020/2020_Umweltgutachten_Entschlossene_Umweltpolitik.html.

Tol, R. (2009), "The Economic Effects of Climate Change", *Journal of Economic Perspectives* 23, 29–51.

UNFCCC (2015), *The Paris Agreement,* https://unfccc.int/files/meetings/paris_nov_2015/application/pdf/paris_agreement_english_.pdf.

Wissenschaftlicher Beirat der Bundesregierung globale Umweltveränderungen (WBGU, 2020), *Landwende im Anthropozän: Von der Konkurrenz zur Integration*, Berlin.

Weiß, M. (2018), "Es ist Zeit für realistische Ziele", *Süddeutsche Zeitung,* 20 December, https://www.sueddeutsche.de/wissen/klimawandel-pariser-abkommen-treibhausgas-neutralitaet-1.5145043.

Weitzman, M. L. (2011), "Fat-Tailed Uncertainty in the Economics of Catastrophic Climate Change", *Review of Environmental Economics and Policy* 5, 275–292.

*Don Fullerton*

# Net Burdens of Carbon Policy Vary within Each Income Group — and within Each Nation*

Most studies of the distributional effects of climate policy are about the "vertical" distribution of burdens up and down the income scale, especially comparing low- and high-income households within the US or Europe. Other studies measure the likely distribution of burdens from global carbon agreements, especially comparing low- and high-income nations.

In contrast, very few studies measure "horizontal" effects within each income group. Domestic climate policy will likely impose greater burdens on families with greater need for heat and air conditioning, compared to other families at the same income level in locations with less temperature variation. For example, Cronin, Fullerton and Sexton (2019) look at costs of a carbon tax reform in the US that has a fairly proportional vertical effect—i.e., reducing real incomes by about 1 percent in all income deciles. Revenue rebates can reduce net burdens proportionally to near zero in all deciles, but revenue-neutral "carbon fee and dividend" also imposes wide disparities within each income group. Within the lowest-income decile, it reduces real net incomes of some households by 2 percent and raises real net incomes of others by 2 percent. Some fraction of low-income households live near the coasts with mild climates that require little spending on heating or air conditioning. Some have no cars and buy no gasoline, in which case, the uniform per capita dividend exceeds their carbon tax burden.

These horizontal redistributions are not a goal of carbon policy, even if they necessarily accompany a plan to discourage carbon emissions. More strongly, however, one might say that horizontal redistributions ought to be avoided. All else being equal, a redistribution that helps one poor person while taking real income away from another equally poor person might be considered unfair. Purely horizontal redistributions reduce some overall measures of social welfare.[1] Policy makers may want to avoid these redistributions, but if so, then they need to know the likely horizontal effects of each proposal at hand. In other words, this issue requires further study.

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I will review the Cronin et al. (2019) paper below in order to discuss approaches, data needs, and resulting effects of climate policy across households at the same income level. Their point is that the well-studied vertical redistributions between high- and low-income families are small compared to the under-studied horizontal redistributions. They study costs of a carbon tax, not the distribution of benefits from reduced climate damage—an additional problem that likely adds even more vertical and horizontal impact to heterogeneous households that might gain or lose property value from differential exposure to heat, floods, droughts, storms and wildfires.

Next, I will draw analogies from the large horizontal effects within each income group to discuss the likelihood of large horizontal effects within each country. Studies of redistributions between countries essentially compare effects on the average person in a poor country to the effects on the average person in a wealthy country. But these well-studied vertical effects between countries may pale in comparison to the under-studied horizontal effects across individuals within a country. A reasonable social welfare function accounts for effects on the well-being of individuals, not of institutions or other non-human entities. For these reasons, I end with the suggestion to de-emphasize redistributions between countries and instead focus on people within each country.

## THE PROBLEM OF HORIZONTAL REDISTRIBUTIONS

Any policy to reduce greenhouse gas emissions likely raises the price of electricity and gasoline and thus raises costs for those who spend more on energy. Consumer expenditure data from the US and many European countries demonstrate that the average low-income family spends a higher share of income on energy than does the average high-income family. Thus, for vertical distributional effects between high- and low-income families, the conventional view is that carbon policy is regressive.[2] As a consequence, many believe that the additional carbon fee revenue should be used to help cover those extra costs for

* The author is grateful for the contributions of Julie Anne Cronin and Steven Sexton, and for comments and suggestions from Lutz Sager and Hauke Ward.

[1] See Pizer and Sexton (2019), Fischer and Pizer (2019), or Hänsel et al. (2021).

[2] Regarding expenditure data, see Flues and Thomas (2015), and Pizer and Sexton (2019). Distributional effects are "proportional" if burdens as a fraction of income are the same for all groups, "regressive" if that fraction is falling with income, and "progressive" if it rises with income.

low-income families.[3] For example, a policy might use carbon fee revenue for equal per capita dividends to all citizens.

Yet, new research in Cronin et al. (2019) disputes this conventional view about vertical distributional effects while bringing new attention to problems from horizontal distributional effects.[4] First, they argue that annual income is not the best way to categorize families from low- to high-incomes. As explained below, they use total annual consumption as a proxy for permanent income, which makes a carbon tax or other policy much less regressive. Second, many countries like the US have automatic indexing (cost-of-living adjustments) for social security benefits and other social transfers to low-income families. When a climate policy raises energy prices, many low-income families then automatically receive higher levels of those public transfers. Tax brackets also are indexed to that price level. Indexing reduces the net revenue from a carbon tax, and it reduces measured regressivity.[5] In fact, they find that the remaining carbon tax burden is overall progressive. Third, households who rely on public transfers that are indexed to the price level do not need as much additional dividend to protect them from harm. Fourth, even if the average carbon tax burden within any income group is offset by this indexing, the burdens within each income group are very heterogeneous.

Heterogeneity of burdens arises both because of different income sources and different expenditure patterns. Within the lowest-income group, for example, burdens are higher for those with large fractions of income from un-indexed wages and those with heavy needs for spending on energy. Indexing of public transfers are based on nationwide average weights for spending categories, so a carbon tax can lead to large net *gains* for other low-income households whose primary income is from indexed social security benefits, whose commutes do not require gasoline, and whose homes are well-insulated. Thus, any package of reforms will create winners and losers within each income group (Sallee 2019).

For a large sample of households, the US Consumer Expenditure Survey (CEX) provides sufficient detail on purchases of various commodities whose prices are differentially affected by a carbon tax. However, it includes neither verified nor detailed information about income sources, taxes paid or transfers received. But Cronin et al. (2019) use the US Treasury Distribution Model (TDM), which includes extensive imputations for constructing a dataset with the necessary heterogeneity across a large, representative sample of families with differing expenditures, sources of income, taxes paid and transfers received.

The TDM starts with a merged file of 300,000 US tax returns plus 22,000 non-filer "information returns" to capture a representative number of those whose income is below the tax filing threshold. It uses only non-dependent returns and weights them, so the final weighted dataset represents 172 million US families. It uses an exact match of the social security number on each return to verify details about social security benefits received and payroll taxes paid. For each tax family, total consumption is computed as taxable income plus fringe benefits minus tax paid and savings. Each return is also matched to a similar family in the CEX whose expenditure shares for 33 consumption categories are applied to total expenditures of the tax family. The TDM makes further imputations for participation in each transfer program and receipts from each program such as Temporary Assistance for Needy Families (TANF), Supplemental Nutrition Assistance Program (SNAP) and the Earned Income Tax Credit (EITC).

Cronin et al. (2019) use the TDM to calculate the effects of a carbon tax with $100 billion of annual revenue, and they employ four alternative assumptions about rebate of revenues: (1) no rebate, but 23 percent of revenue must be used under existing law to index transfers and tax brackets for consumer prices increases; (2) net carbon tax revenue is used for a uniform $229 per capita rebate; (3) net revenue is used for a 5.9 percent increase in all existing transfers; and (4) half of net revenue is used to reduce payroll taxes, and half is used to increase social security benefits.

Burdens are determined for each family by using an input-output model to calculate the direct and indirect impacts of this carbon tax on prices for each of 389 consumer goods. Thus, the tax impacts the price of fuels and intermediate goods according to their carbon intensities, and these changes impact the market price of each commodity.[6] The overall consumer price index rises about 1 percent, but the price increase for electricity is 9.0 percent, natural gas is 14.8 percent and gasoline is 14.8 percent. The price hike for mass transit is 4.6 percent and airline tickets is 5.5 percent.

Their paper also discusses various limitations. First, they do not measure the efficiency effects of a carbon tax but instead calculate detailed distributional effects, assuming no changes in behavior. Second, they ignore possible changes in factor prices. They focus on diverse patterns of spending on energy-intensive goods and of transfers received. Third, they have one year's cross-section of data on consumer spending and transfer receipts, not a panel to construct a long-term measure of well-being. Annual income is a poor measure of well-being, because

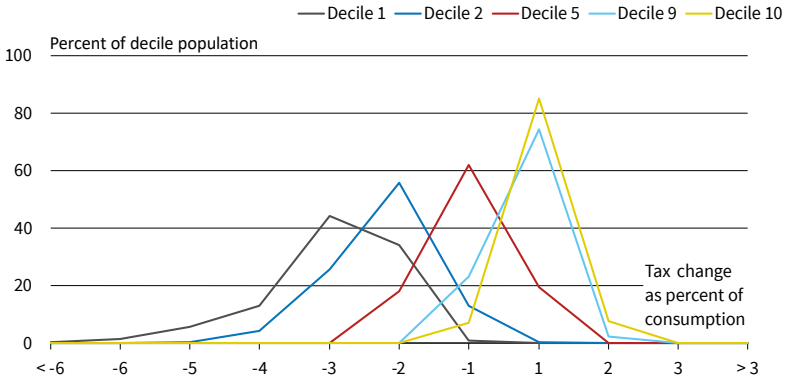
[3] Papers that find the carbon tax to be regressive and that suggest rebates to help low-income families include Blonz et al. (2011), Dinan (2012), Grainger and Kolstad (2010), Hassett et al. (2009), and Mathur and Morris (2014).

[4] Following Cronin et al. (2019), similar studies of horizontal effects are in Douenne (2020) for France and in Hänsel et al. (2021) for Germany.

[5] Dinan (2012) and Fullerton et al. (2012) account for indexing of transfers but not for income tax brackets.

[6] Each family's added burden is calculated as their observed expenditure on each consumption good times the price increase for that good, so quantities are fixed. Similar methods are employed in Metcalf (2009), Grainger and Kolstad (2010), or Mathur and Morris (2014).

Figure 1
**Net Tax Changes by Decile for Carbon Tax with Per Capita Rebate**




Source: Cronin et al. (2019). © ifo Institute

the low-annual-income group includes not only the perennially poor but also the young who earn more later, the elderly who earned more earlier, and those with volatile income observed in a bad year. Instead, they use annual spending to account for consumption smoothing.[7] Annual consumption is not a perfect measure of permanent income, because of borrowing constraints and information problems, but it is better than annual income as a measure of family well-being. Fourth, the merged dataset excludes information on each family's geographic location, house characteristics, appliance energy efficiency, or commuting distances—all of which affect exposure to carbon tax burdens. It does capture the variation of actual energy spending across households.

## RESULTS FOR US HOUSEHOLDS

Cronin et al. (2019) show the sensitivity of results based on different assumptions. As with prior studies, the use of annual income with no indexing means the carbon tax is regressive. When they instead use annual consumption to classify families, the carbon tax is roughly proportional. Then, when they account for indexing, they find that the carbon tax is progressive. The burden rises from 0.45 percent of consumption for the lowest consumption decile to 0.80 percent of consumption for the highest decile. Some families have little need for energy and thus have a very small carbon tax burden but still receive increased transfers that reflect the nationwide average increase in costs of consumer goods. Within the first decile, even with no dividend, this carbon tax leads to a net gain for 13.6 percent of families.

When carbon tax revenues are refunded by a lump-sum per capita dividend, the net additional burden as a percent of consumption is even more clearly progressive. The poorest ten percent of families gains 2.6 percent of consumption on average, and each of the first seven deciles receives a net gain, but the richest decile faces a net tax burden equal to 0.58 percent of consumption. This progressivity appears in Figure 1, where the gray line shows that burdens within the poorest group are negative, while the yellow line shows that the distribution of burdens for the richest group is mostly positive.[8]

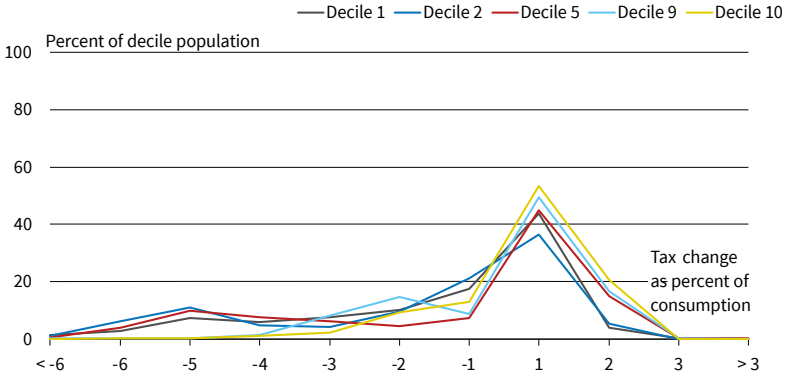
The three mechanisms for rebate revenues cause larger horizontal redistributions than those imposed by the carbon tax itself. Figure 1 shows effects of the per capita rebate. Family size varies within each decile, and so per capita rebates vary as a percent of income. Within the poorest decile, 7 percent receive net tax cuts of more than 4 percent of consumption, while 0.01 percent bear a positive net burden. In the highest decile, 85 percent get a positive net burden up to 1 percent of consumption. While the average burden in the richest decile is 0.58 percent of consumption, 8 percent of them face extra burdens up to 2 percent of consumption, and 7 percent *gain* up to 1 percent of consumption.

Next, consider the case of a uniform 5.9 percent increases in all public transfers to return all net carbon tax revenue (above and beyond the automatic indexing of transfers). This reform also results in a progressive distribution of average burdens across the ten deciles (but it is less progressive than with the per capita rebate). The poorest group gains 0.96 percent of consumption on average, and all of the first eight deciles gain, but the top decile loses 0.50 percent of consumption.

Again, however, focusing on vertical distributions by looking at the average family in each decile completely misses the bigger story. Within the poorest decile, the average gain is 0.96 percent of consumption, but 47 percent of families get a net tax increase. Complicated rules for public transfers deny eligibility to some people, and even those who are eligible often do not participate. Only 32 percent of families in the

[7] See Poterba (1989), or the permanent income hypothesis of Friedman (1957). Declining marginal utility of consumption within a year means that households wish to smooth consumption over time to reflect their permanent income. Thus, carbon tax regressivity is exaggerated when using annual income to classify households.

Figure 2
**Net Tax Changes by Decile for Carbon Tax with 5.9% More Transfers**




Source: Cronin et al. (2019). © ifo Institute

[8] Figure 1 here is taken from Figure 1A in Cronin et al. (2019), while Figure 2 below is taken from their Figure 1B. Each curve represents a selected decile (lowest, second, fifth, ninth, and tenth). The height of each curve shows the percent of that selected decile facing the net burden (as a percent of consumption) on the horizontal axis.

lowest decile receive EITC benefits, only 19 percent receive SNAP benefits, and only 16 percent receive social security income. Thus, a proportional increase in such transfers adds more horizontal variation than does the carbon tax itself. Within each of the deciles shown in Figure 2, even where the *average* family gains up to 1 percent of consumption, net losses are experienced by 42 percent to 66 percent of families. Some of those losses exceed 2 percent or 3 percent of consumption. The figure shows more variation in net burden under the transfer expansion than under the per capita rebate.

This disconcerting picture raises the question of whether a carbon tax reform package can be designed to reduce horizontal disparities within each income group. Available data include each family's expenditures and income sources, but not the age or insulation of their dwelling nor the energy efficiency of their appliances and vehicles. It might be hard for any policy package to account for each family's weather, commuting distance, or access to commuter rail. While carbon tax rebates based upon these characteristics could reduce horizontal variation in net burden outcomes, however, the big problem is that such rebates also affect incentives and could reduce future investments in energy efficiency or insulation. Ideally, revenue could be used for a one-time transfer to families based on age, location, home size and vehicle vintage. Such a payment would be extremely difficult to implement in practice, however, and many people may believe that heavy energy users ought to pay for it.

The main point here, however, is that this analysis of horizontal redistributions could be extended to a hundred nations participating in the Paris Agreement to reduce emissions. The US is not likely to implement carbon pricing soon, but 40 countries and 20 subnational governments already price carbon (World Bank 2016). Policymakers elsewhere need information about both vertical and horizontal redistributions from a carbon tax, and they need to recognize that heterogeneity can complicate efforts to return carbon tax revenues via existing transfers in ways that do not increase disparity of tax changes within each income group.

## REDISTRIBUTIONS BETWEEN LOW- AND HIGH-INCOME COUNTRIES

Just as studies of vertical effects from domestic carbon policy look at redistribution between high- and low-income groups, other studies of vertical effects from worldwide carbon policy look at redistribution across high- and low-income countries. This section reviews results from some of these global studies—despite their dubious equity implications. Theories of economic justice-based moral philosophy account for the welfare of human individuals, not the welfare of non-human entities such as institutions, corporations or nations. Rather, the general interest in these results is probably attributable partly to simple nationalism, partly to the belief that rich and poor countries are adequate representations of rich and poor individuals, and partly to the valid need for inputs to political economy models of diplomacy. Indeed, these results can affect international agreements on emission reductions.[9]

This section also points out global analogies to the research on horizontal redistributions described above. Just as the under-studied horizontal redistributions within each income group are shown above to swamp the vertical redistributions from a nation's domestic carbon policy, the under-studied horizontal redistributions within a country can swamp the vertical redistributions from a worldwide carbon policy.

Initially, Nordhaus and Yang (1996) study worldwide redistributions using the Regional Integrated Climate and Economy (RICE) model, dividing the world into ten regions.[10] They compare the con-cooperative solution to a cooperative solution (the efficient equilibrium path). The US and Former Soviet Union (FSU) lose from this efficient carbon policy, but the rest of the world reaps major net benefits "because the mitigation efforts are undertaken primarily in the high-income countries early in time while the major benefits in terms of damage avoided accrue to the developing countries in several decades" (Nordhaus and Yang 1996, 756).

Similarly, Mendelsohn et al. (2006) measure the damage that could be avoided by implementing global climate policy. Because *marginal* climate damage to agriculture are increasing in temperature, and because the poorest nations are located in low latitudes with already-high temperatures, they find that the "poorest half of the world's nations suffer the bulk of the damage from climate change, whereas the wealthiest quarter has almost no net impacts" (Mendelsohn et al. 2006, 161). In their recent review article, Hsiang et al. (2019) summarize many other estimates of differential climate effects across nations, not only through changes in temperatures but also through changes in rainfall, cyclones and tornadoes. They find that the distributions of these physical changes have no clear associations with current incomes, but poor nations have greater marginal damage from those same changes. In other words, similar physical changes are likely to impose greater damage on low-income nations.

The consensus from this brief review so far is that an efficient climate policy such as a uniform worldwide carbon tax would likely have progressive damage reduction effects, providing the most help to poor nations that would otherwise suffer the most damage. Cronin et al. (2019) and others focus on the distribu-

[9] For examples related to international climate negotiations, see Lange et al. (2010), and Bretschger (2013).
[10] Their ten regions are listed as: the US, Japan, China, European Union, former Soviet Union (FSU), India, plus Brazil/Indonesia, 11 other large countries, 38 medium-sized countries, and finally, 137 small countries.

tion of the burdens from a carbon tax through raised output prices (ignoring changes in factor prices). At the global level, Ward et al. (2019) undertake similar calculations of burdens by mapping international supply chains and using input-output tables to estimate the effects of a worldwide carbon tax on each country's output prices. Overall costs rise the most in countries with large sectors that are carbon-intensive, especially developing or transitioning economies such as China, India and Russia. A global carbon tax would reduce costs for industrialized countries with efficient production technologies and especially those with low-carbon energy systems, such as Brazil with hydro power or France with nuclear power.

Thus, ignoring factor price changes, a global carbon tax may have regressive effects between countries on the cost side but progressive effects across countries due to the benefits of reduced climate damage. However, the point here is that none of these studies deals with heterogeneity within countries or horizontal redistribution.

One partial exception is a new working paper by Sager (2021). He uses a trade gravity approach to estimate a single worldwide system of demands and supplies, using data on trade in final goods from 35 sectors across 40 countries in the World Input-Output Database. Estimated demands are not homothetic, so spending shares depend on income (both within each nation and across nations). Costs of a global carbon tax within each country depend on emissions intensity. He finds that effects are mildly regressive within industrialized countries, mildly progressive within developing countries, and quite regressive across countries. As in other studies, he finds that the use of carbon tax revenue within each country can swamp those effects. Thus, depending on the use of revenue, any carbon tax can have progressive or regressive burdens.

## DISCUSSION

While Sager (2021) looks both across countries and within countries, the effects he considers within each country are vertical redistributions between income groups – not horizontal redistributions. The point in Cronin et al. (2019) reviewed above is that a carbon tax can have large and capricious effects across families at the same income level, because some families need more use of carbon-intensive goods for commuting, heat, or air conditioning. Those families invested in their houses and locations long ago, so any new carbon policy could impose large losses in house values – losses that cannot be avoided by moving away or by paying to insulate their homes. Some individuals also face psychological costs of sudden job loss and the cultural shock of adjusting to new technologies.

Similarly, those families have widely differing benefits from a climate policy that reduces damage, having invested long ago in locations that have large or small benefits due to reductions in storm damage, drought, or sea-level rise. In some countries, some families may gain from global warming.

Nobody has estimated horizontal effects within each nation based on a global climate policy that yields differential costs and also differential benefits at the same income level. Such a study would be difficult, especially since each household's costs come earlier than their benefits from reduced climate damage. The damage is also random, so valuation depends on risk aversion. Those effects may or may not be deemed unfair in a social welfare function, but policymakers may value studies on those effects in order to make informed decisions about policy. Such studies would not be easy because they would require much data on many diverse families in order to capture heterogeneity by location characteristics and family characteristics.

In fact, country studies other than Sager (2021) do not really capture the intended measurement of vertical effects either, simply because high-income countries include many low-income families, and low-income countries include many high-income families. Heterogeneity within each country means that comparing high- and low-income countries misses not only horizontal redistributions within the same income group, but it also misses the actual vertical effects of a global climate policy on high-income people compared to low-income people.

Finally, this thought raises the same question about other studies that try to use aggregated data to measure distributional effects. When individual household data are not available, many researchers use average income for each postal code or each county (or each state or province). Perhaps a small neighborhood is relatively homogeneous, so that measuring gains or losses for each rich or poor neighborhood provides some information about redistributions between rich and poor households. But still, the individual household is the unit of interest. A social welfare function cares not about the gains or losses to a neighborhood per se, but to people.

This problem worsens at higher levels of aggregation. Despite substantial differences in average county incomes across counties in the US, any US county has wide internal disparities between rich and poor. So, measuring redistributions between rich and poor counties in the US might say very little about what happens to rich and poor US households. Then, on a grander scale, any measured redistribution between rich and poor nations says precious little about the change in any measure of social welfare that is a function of the diverse incomes of individual households, especially since any redistribution of funds from rich countries to poor countries is so often commandeered by the rich and powerful individuals within poor countries.

The implications of this line of reasoning are manifold. First, we need more studies on redistri-

bution among the many different households within each nation, and we need such studies for more nations. Second, we need careful consideration of the horizontal redistributions within each low-income country, and within each high-income country, what these effects imply for alternative measures of social welfare, and what it means in terms of how policymakers can change their proposal to reduce those capricious horizontal redistributions (for any given carbon reduction and for any desired vertical redistribution). Third, studies that must use county or other small jurisdictions as the unit of observation need not just be circumspect about the missing heterogeneity within each jurisdiction, but also exhibit some effort in dealing with the missing measures of horizontal redistribution.

## REFERENCES


Blonz, J., D. Burtraw and M. A. Walls (2011), "How Do the Costs of Climate Policy Affect Households? The Distribution of Impacts by Age, Income, and Region", *Resources for the Future Discussion Paper* 10–55.

Bretschger, L. (2013), "Climate Policy and Equity Principles: Fair Burden Sharing in a Dynamic World", *Environment and Development Economics* 18, 517–536.

Cronin, J. A., D. Fullerton and S. Sexton (2019), "Vertical and Horizontal Redistributions from a Carbon Tax and Rebate", *Journal of the Association of Environmental and Resource Economists* 6(S1), S169–S208.

Dinan, T. (2012), "Offsetting a Carbon Tax's Costs on Low-Income Households", *CBO Working Paper* 2012–16, Congressional Budget Office.

Douenne, T. (2020), "The Vertical and Horizontal Distributive Effects of Energy Taxes: A Case Study of a French Policy", *The Energy Journal* 41, 231–253.

Fischer, C. and W. A. Pizer (2019), "Horizontal Equity Effects in Energy Regulation", *Journal of the Association of Environmental and Resource Economists* 6(S1), S209–S237.

Flues, F. and T. Alastair (2015), "The Distributional Effects of Energy Taxes", *OECD Taxation Working Paper* 23.

Friedman, M. (1957), "The Permanent Income Hypothesis?", in M. Friedman, ed., *A Theory of the Consumption Function*, Princeton University Press, Princeton, 20-37.

Fullerton, D., G. Heutel and G. E. Metcalf (2012), "Does the Indexing of Government Transfers Make Carbon Pricing Progressive?", *American Journal of Agricultural Economics* 94, 347–353.

Grainger, C. A. and C. D. Kolstad (2010), "Who Pays a Price on Carbon?", *Environmental and Resource Economics* 46, 359–376.

Hänsel, M. C., M. Franks, M. Kalkuhl and O. Edenhofer (2021), "Optimal Carbon Taxation and Horizontal Equity: A Welfare-Theoretic Approach with Application to German Household Data", *CESifo Working Paper* 8931.

Hassett, K. A., A. Mathur and G. E. Metcalf (2009), "The Incidence of a US Carbon Pollution Tax: A Lifetime and Regional Analysis", *Energy Journal* 30, 155–178.

Hsiang, S., P. Oliva and R. Walker (2019), "The Distribution of Environmental Damage", *Review of Environmental Economics and Policy* 13, 83–103.

Lange, A., A. Löschel, C. Vogt and A. Ziegler (2010), "On the Self-Interested Use of Equity in International Climate Negotiations", *European Economic Review* 54, 359–375.

Mathur, A. and A. C. Morris (2014), "Distributional Effects of a Carbon Tax in Broader US Fiscal Reform", *Energy Policy* 66, 326–334.

Mendelsohn, R., A. Dinar and L. Williams (2006), "The Distributional Impact of Climate Change on Rich and Poor Countries", *Environment and Development Economics* 11, 159–178.

Metcalf, G. E. (2009), "Designing a Carbon Tax to Reduce US Greenhouse Gas Emissions", *Review of Environmental Economics and Policy* 3, 63–83.

Nordhaus, W. D. and Z. Yang (1996), "A Regional Dynamic General-Equilibrium Model of Alternative Climate-Change Strategies", *American Economic Review* 86, 741–765.

Pizer, W. A. and S. Sexton (2019), "The Distributional Impacts of Energy Taxes", *Review of Environmental Economics and Policy* 13, 104–123.

Poterba, J. M. (1989), "Lifetime Incidence and the Distributional Burden of Excise Taxes", *American Economic Review* 79, 325–330.

Sager, L. (2021), *The Global Consumer Incidence of Carbon Pricing: Evidence from Trade,* Georgetown University, http://docs.lutzsager.de/Sager_GlobalCarbonPrice.pdf.

Sallee, J. M. (2019), "Pigou Creates Losers: On the Implausibility of Achieving Pareto Improvements from Efficiency-Enhancing Policies", *NBER Working Paper* 25831.

Ward, H., J. C. Steckel and M. Jakob (2019), "How Global Climate Policy Could Affect Competitiveness", *Energy Economics* 84, 1–7.

World Bank (2016), *State and Trends of Carbon Pricing 2016*, Washington DC.

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# Distributional Impacts of Carbon Pricing in Low- and Middle-Income Countries

The climate targets agreed upon in the Paris Agreement will eventually need to be backed by ambitious climate policies. Putting a price on carbon and abolishing subsidies on fossil fuels is usually widely agreed upon by economists to be the economically efficient solution (High-Level Commission on Carbon Prices 2017). An increasing amount of countries, including low- and middle-income economies (LMICs), have already introduced (or plan to do so) carbon pricing schemes. Yet, the introduction of carbon pricing schemes frequently triggers concerns regarding the distributional justice of climate policy. The question of distributional effects relates closely to the political feasibility of reforms. A regressive carbon price would not only be problematic from a perspective of equity and justice, but very likely also be deemed to fail politically.

Yet, as it has usually been developed countries that discuss pricing mechanisms, not much is known regarding the particularities of carbon pricing schemes in LMICS. At the same time, the World Bank reports an increasing number of active and planned carbon pricing instruments (CPI) in LMICs (World Bank 2021). Argentina, Chile, Colombia, Mexico, and South Africa have implemented carbon pricing, although with relatively small effective prices and, with the exception of South Africa, narrow tax bases that cover only a small share of jurisdictional emissions. China, the only Asian country among the LMICs with a CPI in place, has now initiated the world's largest carbon market. Other countries such as Brazil, Indonesia, Vietnam, Thailand, Pakistan, Turkey, Senegal, and Côte d'Ivoire are currently considering the introduction of carbon taxes or emission trading schemes (ETS).

While there is limited real-world experience with the introduction of carbon prices in LMICs, those governments have made ample experiences with reducing fossil fuel subsidies, effectively abolishing (or reducing) a negative tax on carbon. Reforms were frequently followed by protests and sometimes violence, which frequently led to planned reforms being reversed (IMF 2013). Therefore, understanding the distributional consequences of carbon taxes—and how to alleviate them—is key for the societal and political acceptance of carbon pricing in LMICs.

In this article we will first synthesize the existing knowledge on distributional effects of carbon pricing reforms in LMICs. We provide exemplary analyses for nine low- and middle-income countries with differing development status at varying locations. We continue by discussing in detail how distributional effects could be addressed, given economic and administrative realities in LMICs. Finally, we discuss the benefits and challenges of carbon pricing in LMICs.

## DISTRIBUTIONAL IMPACTS OF CARBON PRICING IN LMICS

A growing number of studies deals with distributional effects of carbon prices (including fuel taxes and fossil fuel price subsidies) in LMICs. Unlike in high-income countries, the distributional effect of carbon prices in LMICs is often found to be progressive (Ohlendorf et al. 2021).

The majority of available studies focuses on impacts across the income distribution (i.e., vertical effects) using different methodological approaches. The dominating methodology in the scientific literature is to focus on short-run impacts under the assumption

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Table 1

**Overview of Key Economic Indicators for Sample of LMICs**

| | Population (Million) | GDP per capita (constant 2010 USD) | Gini coefficient | Energy use per capita (kgoe) | Share of population with access to clean cooking fuels (%) | Total $CO_2$ emissions ($MtCO_2$) |
|---|---|---|---|---|---|---|
| Argentina | 44 | 10,050 | 41.3 | 2,030 | 98 | 177 |
| Bolivia | 11 | 2,560 | 42.6 | 778 | 64 | 23 |
| Ethiopia | 109 | 571 | 35 | 493 | 4 | 16 |
| India | 1,353 | 2,090 | 35.7 | 637 | 41 | 2,435 |
| Indonesia | 268 | 4,285 | 37.8 | 884 | 58 | 583 |
| Nigeria | 196 | 2,383 | 35.1 | 764 | 5 | 131 |
| Peru | 32 | 6,453 | 42.4 | 790 | 75 | 54 |
| South Africa | 58 | 7,432 | 63 | 2,696 | 85 | 433 |
| Vietnam | 96 | 1,964 | 35.7 | 660 | 67 | 258 |

Note: This table displays aggregate statistics for the selection of LMIC in this study. Reference year is 2018. Column "Energy use per capita" displays numbers refers to 2014 (Vietnam: 2013). Column "Share of population with access to clean cooking fuels (%)" refers to 2016. Column "Gini coefficient" refers to 2018 with exception: India (2011), South Africa (2014), Ethiopia (2015).

Source: World Development Indicators (World Bank 2021).

of full price pass-through to final demand in environmentally extended input-output models. Solely focusing on energy related emissions from fossil fuels, Renner (2018, for Mexico), Saelim (2019, for Thailand) and Malerba (2021, for Peru) find slightly progressive impacts of carbon taxes. For the removal of energy subsidies, a comparable policy to fossil fuel carbon emissions, the literature also finds progressive impacts (Coady et al. 2015 and 2018; Schaffitzel 2020).

The main reason for differing distributional outcomes in LMICs compared to high-income countries (where studies usually find regressive results) are differing energy use patterns. In poor countries, the expenditure share for formal energy items increases with income, leading to progressive results of carbon pricing as long as other important consumption items are not exceptionally carbon intensive. In high-income countries, by contrast, richer households spend relatively less on energy items leading to regressive results of a carbon price. These results are confirmed empirically on a global level by Dorband et al. (2019) in an analysis covering 87 LMICs; however, using relatively coarse data. In a detailed and comparative approach for eight countries in developing Asia (Bangladesh, India, Indonesia, Pakistan, Philippines, Thailand, Turkey, and Vietnam), Steckel et al. (2021) confirm the progressive findings of single-country studies with few notable exceptions. For example, in India the fossil fuel-intensive agricultural sector (based on diesel-run water pumps) would be responsible for higher food prices and therefore result in regressive outcomes. They also highlight that the exact carbon pricing design (e.g., covering only specific sectors or the full economy) can lead to very different distributional outcomes.

There are also a few numerical simulation studies involving computable general equilibrium (CGE) models, theoretically superior to simpler IO models due to the possibility of distinguishing between income (source) and consumption (use) side impacts on household welfare (Goulder et al. 2019). Only very few CGE studies are available for LMICs that also tackle distributional questions of carbon pricing (e.g., Garaffa et al. 2021 for Brazil), given methodological and conceptual difficulties. Generally, looking into the full spectrum of the literature, Ohlendorf et al. (2021) find that CGE studies are systematically more progressive than other forms of study. Goulder et al. (2019) argue that carbon pricing reduces returns to capital more than returns to labor due to higher than average capital labor ratios in carbon intensive sectors. A carbon price would then reduce the demand for capital relative to labor and subsequently capital returns. Since in LMICs the capital income is concentrated in the very top of the income distribution, a similar tendency towards progressivity would be expected, but evidence is largely missing. Studies that focus on the short-run incidence might be perceived as an upper bound with regard to regressive outcomes of carbon pricing.

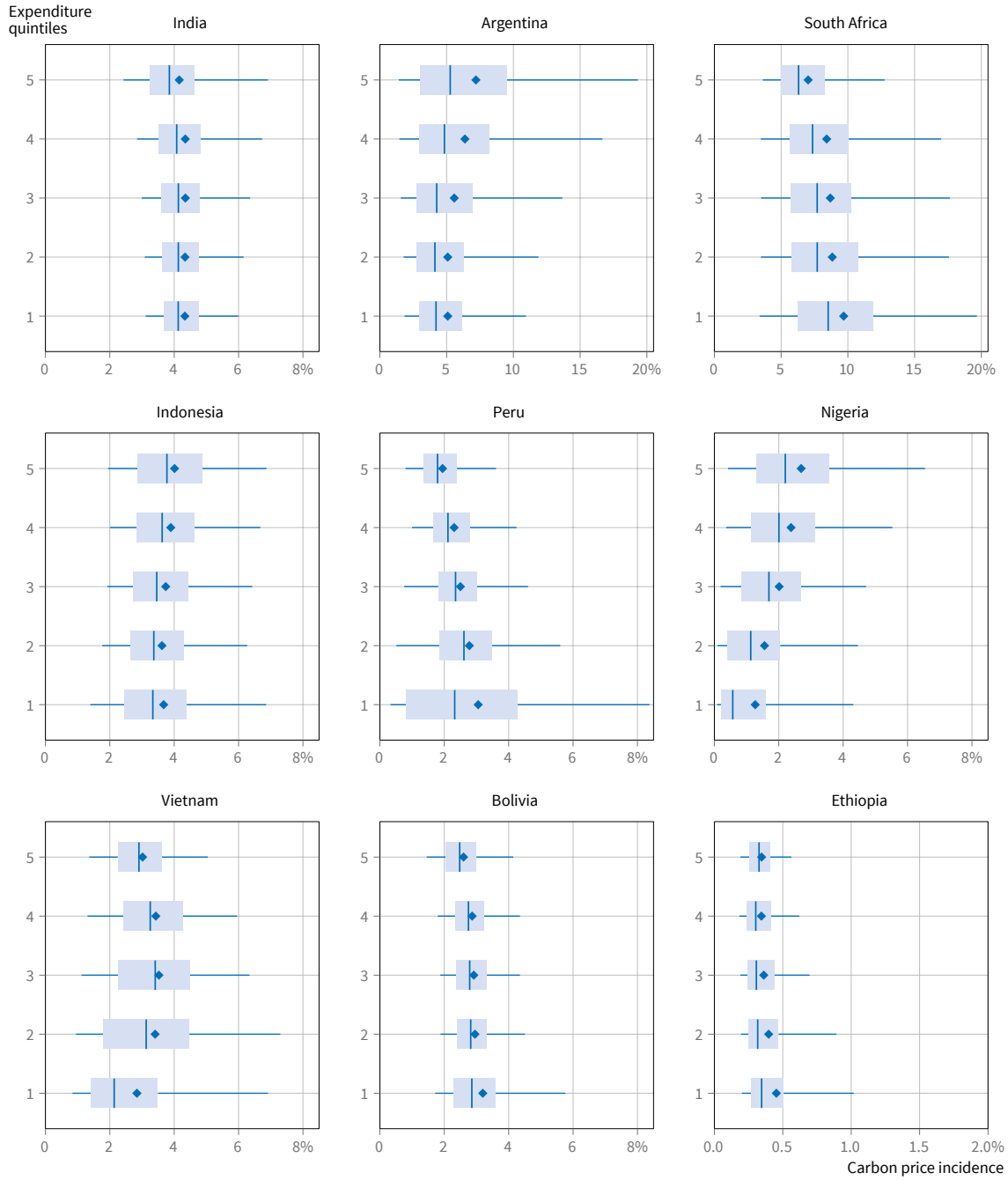
We present a more detailed analysis of short-run distributional implications of implementing a USD 40 carbon price per $tCO_2$ for a selective sample of LMICs, including three examples from Latin America (Argentina, Bolivia, Peru), Sub-Sahara Africa (Ethiopia, Nigeria, South Africa) and Asia (India, Indonesia and Vietnam), respectively. Table 1 presents an overview of key economic indicators for those countries.

Figure 1 shows both the vertical dimension of distributional incidences (i.e., inter-quintile differences of distributional incidences) as well the horizontal dimension (within-quintile differences) in percent of household income, proxied by total household expenditures.

Three basic observations emerge from this analysis: first, distributional effects are highly country-specific. While results are progressive in some countries (including Argentina, Nigeria, Indonesia, and Vietnam), they are regressive (Bolivia, Ethiopia,

Figure 1

**Carbon Pricing Incidence over Expenditure Quintiles**




Note: Additional costs to households induced by a carbon price of USD 40/t $CO_2$ as a share of total household expenditures (X-axis) for each expenditure quintile (Y-axis). Carbon price incidence of 1% indicates that a household would require an additional 1% of its expenditure budget to buy the same amount of goods and services, which they bought prior to the implementation of a carbon price, while observing price increases equivalent to carbon intensity of products. The first expenditure quintile (1) comprises those 20% of households with least total expenditures per capita. Boxes show the 25th to 75th percentile, whiskers display the 5th to 95th percentile.
Blue vertical line indicates the median. Dots represent the mean.
Source: Own microsimulation using nationally representative household survey data (see below) and an environmentally extended input-output-model based on data from Global Trade Analysis Project (GTAP) 10 (Aguiar et al. 2019) – see Steckel et al. (2021) more in detail.
Data from the national household survey include: Encuesta Nacional de Gastos de los Hogares 2017-2018 (Argentina), Encuesta de Hogares 2018 (Bolivia), Ethiopian Socio-economic Survey 2018 (Ethiopia), National Sample Survey 2012 (India), Survei Sosial Ekonomi Nasional 2018 (Indonesia), General Household Survey 2015-2016 (Nigeria), Encuesta Nacional de Hogares 2016 (Peru), Living Conditions Survey 2014-2015 (South Africa), and Vietnam Household Living Standard Survey 2012 (Vietnam).
Calculation of carbon intensities is based on the data from Global Trade Analysis Project (GTAP) 10.


South Africa) or nearly neutral (India, Peru) in others. Second, no matter the direction of the distributional impact, households suffer an effective welfare loss resulting from carbon pricing in the absence of compensatory measures that can be substantial. Among the poorest households, additional costs range from 0.5 percent in Nigeria to 8.5 percent of household expenditure in South Africa for the median household. Third, inter-quintile variation of effects is generally smaller than the within-quintile variation. That is, some households—independent of their income—are notably more affected than the median household in a specific quintile. Exemplarily, that can be well illustrated for Asian countries in the sample, where

the difference of average effects between the first and the fifth quintile range between 0.2 and 0.3 percentage points, whereas the difference between the 20th and the 80th percentile within the first quintile is 1.4 (India), 2.5 (Indonesia), and 2.8 percentage points (Vietnam), respectively.

The large variation of horizontal effects is also confirmed by the literature, e.g., for the US (Cronin et al. 2018) and France (Douenne 2020), or multiple Asian countries (Steckel et al. 2021). This yields important consequences for the political economy of carbon pricing reforms. While it is generally believed that progressive outcomes might facilitate implementation, some highly affected interest groups might—in light of high horizontal inequality—still oppose reforms.

Further, regarding LMICs it is important to understand the full spectrum of welfare effects. Carbon pricing, for example, would not include the use of traditional biomass. Yet, the relative price increase of fossil fuels compared to tradition fuels would still foster the use of firewood and charcoal, which are related to negative health implications (Cameron et al. 2016). In addition, higher prices on fossil fuels provide larger incentives to women and children to spend time collecting firewood, diverting them from participation in the paid labor market or education (Dinkelman 2011). The literature highlights potential substitution effects in various countries, including Ghana (Greve and Lay 2020 evaluating a fossil fuel subsidy reform ex-post), Tanzania (Olabisi et al. 2019), and Senegal (Yaméogo 2015). Aggarwal et al. (2021) also highlight that carbon pricing (in the case of Uganda) could additionally trigger adoptions in the food baskets, leading to lower nutrition and calorie intakes for the poorest parts of the population.

## OPTIONS FOR CARBON PRICING REVENUE RECYCLING IN LMICS

Distributional effects can theoretically be alleviated by recycling revenues from carbon pricing along different channels (Klenert et al. 2018), but the practical implementation and administrative feasibility in LMICs' institutional contexts need to be examined carefully.

When considering revenue recycling directly to households, two options are generally conceivable: cutting existing taxes and deploying transfers to households. Compensation via cuts in direct taxes, e.g., reduced income taxes, would be strongly regressive due to high income tax exemption thresholds as well as informality and misreporting (Besley and Persson 2009; Jensen 2019). Reductions in other indirect taxes such as consumption taxes might also be less promising for lower-income households due to already small tax rates for essential goods such as food and the high share of informal businesses. The latter often supply essential goods to low-income but not high-income households, resulting in effective higher consumption tax rates for richer households (Bachas et al. 2020). Overall, cutting direct and indirect taxes appear to offer little opportunities for progressive recycling of carbon pricing revenues in LMICs.

The second option is to compensate households directly, either through targeted or universal transfer schemes. Targeted transfers comprise a broad group of diverse social assistance programs such as subsidized health insurance, noncontributory pensions, or conditional and unconditional cash transfers. LMIC governments have repeatedly demonstrated the ability to redistribute resources via social assistance programs, but existing challenges require special attention in the carbon pricing debate. In LMICs, transfers are not straightforward to implement.

First, general coverages rates of social assistance are low. The share of the population covered by social transfer programs in LMICs is on average only 44 percent (World Bank 2018). Second, coverage is in particular low for poor low-income households, averaging 56 percent for the poorest 20 percent of the population (World Bank 2018). Third, adding to the general coverage issue, not all social assistance programs are suitable to compensate households for carbon-pricing-induced changes in household income and the cost of living. For such an economy-wide shock, many governments in LMICs would likely consider unconditional cash transfers as an administratively simple and suitable tool. The coverage of the poor is only reaching about 23 percent in the bottom quintile of the income distribution on average, with particularly low coverage rates of the poor in low-income countries.

Those in need are often targeted on the basis of proxy means testing (PMT), estimating household income based on assets and household characteristics collected from a short survey. The estimation procedure and subsequent ranking has been demonstrated to lead to severe targeting errors, excluding a substantial share of the population while including others who are not in need (Bah et al. 2019; Brown et al. 2018; Hanna and Olken 2018). For some well-documented cases, like the energy subsidy removal in Indonesia from 2005, targeting errors are associated with social unrest and erosion of local social capital (Cameron and Shah 2014). Such experiences should be a cautionary tale that redistribution in carbon pricing necessitates thoughtful implementation strategies to avoid politically jeopardizing reform success by creating inequality and a lack of transparency.

Administratively, the prior existence of large transfer programs is not necessarily a prerequisite for introducing carbon pricing. More important is the general ability, i.e., the institutional capacities of countries to redistribute government revenues. This can theoretically be done based on social registries, which an increasing number of middle-income countries operate, however with largely differing covering rates. Some examples include Indonesia (covering around 40 percent of the population), Colombia (73 percent),

or the Philippines (75 percent) (Leite et al. 2017). On the other end of the spectrum, low-income or lower-middle-income countries often have no social registry or a very limited coverage, which renders their use for revenue recycling of carbon pricing practically challenging. Difficulties regarding targeting also apply to social registries given the limited information in these databases. Alternatives that are applied by some countries include community-based targeting (Alatas et al. 2012), self-targeting (Alatas et al. 2016), and a mix of targeting methods. Since targeting segments of the population is most often imperfect, universal transfers to every household or citizen may also be considered. A permanent institutional solution to this, universal basic income is now also discussed in the context of LMICs (Banerjee et al. 2019), but has not been linked to carbon pricing yet.

In addition to revenue recycling at the household level, compensation schemes could also tackle firms or generally increase government spending. Compensation for firms is usually executed either through corporate tax cuts or direct compensation schemes. Corporate taxes tend to be progressive in theory, but the incidence eventually depends on the relative mobility of capital and labor (Auerbach 2006). Evidence from high-income countries suggests that a large share of the tax burden from corporate taxes falls on wages (Arulampalam et al. 2012; Fuest et al. 2018; Suárez Serrato and Zidar 2016), but there is no evidence that corporate tax cuts in LMICs would lead to higher wages. In the case of direct compensation, such as grandfathering in an emissions trading scheme, the distributional effect will also likely be regressive in LMICs. Since the capital ownership structure in LMICs is highly concentrated at the very top of the income distribution, only few individuals would benefit.

The second alternative to revenue recycling at the household level consists of the government's spending items for health, education, and infrastructure. Dorband et al. (2021) found that using revenues of a carbon price to facilitate access to key infrastructures would be more progressive than lump-sum transfers in Nigeria. Generally, for infrastructure spending the incidence measurement is complex and empirically challenging. Yet, the existing literature suggests a range from strongly (Gonzalez-Navarro and Quintana-Domeque 2016; McIntosh et al. 2018) to modestly (Asher and Novosad 2020; Lee et al. 2020) positive impacts on the welfare of poor households. Due to the wide range of different infrastructure investments, the incidence is clearly case-specific. Adding to this complexity, infrastructure investments also come with an intertemporal complication. While low-income households may benefit from the investment in the future, it does not increase current disposable income. If the goal is to compensate short-run welfare losses, then revenue recycling via infrastructure spending is harder to justify politically, even when the long-run impacts are favorable.

## DISCUSSION AND CONCLUSION

An increasing amount of LMICs discuss the possibility of implementing a carbon price. Carbon pricing indeed holds some advantages specifically for LMICs. Besides the theoretical economic argument that it is the most efficient instrument to reduce emissions, the administrative simplicity of, e.g., a $CO_2$ price for LMICs is a compelling practical argument. Administratively, a carbon price can be as easily implemented (at least when levied as a tax; an emissions trading scheme is connected to additional administrative challenges) as fuel excise taxes and therefore cost-efficiently contribute to domestic revenue mobilization. Hence, carbon pricing can be an effective means to increase the tax base in LMICs, which are usually facing difficulties to raise revenues (Besley and Persson 2014). In addition, it can also be expected that a carbon price—in contrast to many other taxes—has the potential to cover informal markets. A carbon price can further lead to incentives for informal activities to shift back to the formal sector, leading to welfare gains (Bento et al. 2018).

The barriers to introducing carbon pricing, and more importantly schemes with an effectively high incentive structure, are therefore not necessarily of administrative nature. Most often, in domestic climate and energy policy debates, equity concerns loom large and undermine public support. Policies that raise the price of fossil fuels, and thus the price of essential energy services used by households, often meet with fierce resistance from the public. Ecuador and Iran in 2019 or Nigeria in 2020 are only a few recent examples of large scale and violent protests that followed fuel price increases. Understanding which parts of the population are affected in which way is therefore not only essential from an ethical equity perspective, it is also key for the political success of carbon pricing and hence climate policy. For poor countries, understanding the distributional consequences of carbon pricing in detail is hence pivotal for their political success.

It is important to note that both distributional effects as well as absolute effects seem to be less severe when countries have not yet developed carbon-intensive energy systems (Dorband et al. 2019). Introducing carbon pricing might hence be politically easier in countries that are less developed. While countries have usually low emissions, carbon pricing could serve as an important means to ensure low-carbon development and avoiding building up emissions-intensive capital stocks. However, important caveats, e.g., how to deal with potential negative effects on other development goals, such as providing clean cooking alternatives, need to be taken very seriously. In addition, progressive results of carbon pricing in parts hinge on ignoring other greenhouse-gases but $CO_2$ emissions. Arguably, other emissions, e.g., from land use and land use changes might be relatively more important in LMICs. Extending the definition of carbon

emission to carbon equivalent emissions, including other greenhouse gases, Vogt-Schilb et al. (2019) in a comparative analysis for countries from Latin America and the Caribbean as well as Renner (2018) found regressive impacts of carbon equivalent pricing. This result mainly mirrors food price increases that result from pricing other greenhouse gases but $CO_2$. These studies, however, do not explicitly deal with the technical problem of how to administratively put a price on other GHG emissions than $CO_2$.

Progressive effects still lead to absolute welfare implications, which can be severe for some parts of the population, in particular in poor countries. In order to make carbon pricing socially and politically acceptable, the expected revenues could be used (at least partly) to alleviate negative distributional effects. Eventually, it is of utmost importance to take into account the institutional limitations of LMICs when considering revenue recycling from carbon pricing. Targeting particular segments of the population has proven to be challenging and administrative progress is needed in building social assistance programs covering the entire poor and vulnerable population. Such programs must be in place before carbon pricing is introduced, which could be a case for bilateral and multilateral development cooperation if the international community wants to include more LMICs in the worldwide effort to price carbon. On the positive end, many countries have some form of social transfer schemes in place. For example, in Ecuador (where a reform of fossil fuel subsidies without any revenue recycling ended in violent protests in 2019), Schaffitzel et al. (2020) show that extending the existing social transfer schemes could have been used to alleviate the most severe effects for most households at the bottom 40 percent of the income distribution.

Yet, political acceptance hinges on more factors but income, as is increasingly understood. Maestre-Andrés et al. (2019) highlight the important role of perceived fairness based on a review of the literature. Regarding the French Yellow Vest movement, Douenne and Fabre (2020) highlight the role of lacking trust in the government and wrong beliefs of how individuals would exactly be affected. In the German context, Sommer et al. (2020) highlight the need to take into account different fairness perceptions in the population when designing revenue recycling schemes. Yet, only limited evidence is available for LMICs. However, it can be expected that trust in governments to handle the distributional effects and recycle revenue in an acceptable way is even more limited than in developed economies. Understanding those challenges in detail for LMICs will require additional research.

## REFERENCES


Aggarwal, R., S. Ayhan, M. Jakob and J. C. Steckel (2021), "Carbon Pricing and Household Welfare: Evidence from Uganda", *SSRN Journal* 38, https://doi.org/10.2139/ssrn.3819959.

Aguiar, A., E. Corong and R. McDougall (2019), "Guide to the GTAP Data Base", in A. Aguiar, ed., *Global Trade, Assistance, and Production: The GTAP 10 Data Base,* Global Trade Analysis Project (GTAP), Department of Agricultural Economics, Purdue University, West Lafayette (IN).

Alatas, V., A. Banerjee, R. Hanna, B. A. Olken, R, Purnamasari and M. Wai-Poi (2016), "Self-Targeting: Evidence from a Field Experiment in Indonesia", *Journal of Political Economy* 124, 371–427.

Alatas, V., A. Banerjee, R. Hanna, B. A. Olken and J. Tobias (2012), "Targeting the Poor: Evidence from a Field Experiment in Indonesia", *American Economic Review* 102, 1206–1240.

Arulampalam, W., M. P. Devereux and G. Maffini (2012), "The Direct Incidence of Corporate Income Tax on Wages", *European Economic Review* 56, 1038–1054.

Asher, S. and P. Novosad (2020), "Rural Roads and Local Economic Development", *American Economic Review* 110, 797–823.

Auerbach, A. J. (2006), "Who Bears the Corporate Tax? A Review of What We Know", *Tax Policy and the Economy* 20, 1–40.

Bachas, P., L. Gadenne and A. Jensen (2020), "Informality, Consumption Taxes, and Redistribution", *NBER Working Paper* 27429.

Bah, A., S. Bazzi, S. Sumarto and J. Tobias (2019), "Finding the Poor vs. Measuring Their Poverty: Exploring the Drivers of Targeting Effectiveness in Indonesia", *World Bank Economic Review* 33, 573–597.

Banerjee, A., P. Niehaus and T. Suri (2019), "Universal Basic Income in the Developing World", *Annual Review of Economics* 11, 959–983.

Bento, A. M., M. R. Jacobsen and A. A. Liu (2018), "Environmental Policy in the Presence of an Informal Sector", *Journal of Environmental Economics and Management* 90, 61–77.

Besley, T. and T. Persson (2009), "The Origins of State Capacity: Property Rights, Taxation, and Politics", *American Economic Review* 99, 1218–1244.

Besley, T. and T. Persson (2014), "Why Do Developing Countries Tax So Little?", *Journal of Economic Perspectives* 28, 99–120.

Brown, C., M. Ravallion and D. van de Walle (2018), "A Poor Means Test? Econometric Targeting in Africa", *Journal of Development Economics* 134, 109–124.

Cameron, C., S. Pachauri, N. D. Rao, D. McCollum, J. Rogelj and K. Riahi (2016), "Policy Trade-offs between Climate Mitigation and Clean Cookstove Access in South Asia", *Nature Energy* 1, 15010.

Cameron, L. and M. Shah (2014), "Can Mistargeting Destroy Social Capital and Stimulate Crime? Evidence from a Cash Transfer Program in Indonesia", *Economic Development and Cultural Change* 62, 381–415.

Coady, D., V. Flamini and L. Sears (2015), "The Unequal Benefits of Fuel Subsidies Revisited: Evidence for Developing Countries", *IMF Working Papers* WP/15/250.

Coady, D., I. W. H. Parry and B. Shang (2018), "Energy Price Reform: Lessons for Policymakers", *Review of Environmental Economics and Policy* 12, 197–219.

Cronin, J. A., D. Fullerton and S. Sexton (2018), "Vertical and Horizontal Redistributions from a Carbon Tax and Rebate", *Journal of the Association of Environmental and Resource Economists* 6, S169–S208.

Dinkelman, T. (2011), "The Effects of Rural Electrification on Employment: New Evidence from South Africa", *American Economic Review* 101, 3078–3108.

Dorband, I. I., M. Jakob, M. Kalkuhl and J. C. Steckel (2019), "Poverty and Distributional Effects of Carbon Pricing in Low- and Middle-income Countries – A Global Comparative Analysis", *World Development* 115, 246–257.

Dorband, I. I., M. Jakob, J. C. Steckel and H. Ward (2021), *Double Progressivity of Infrastructure Financing through Carbon Pricing – Insights from Nigeria,* MCC Berlin.

Douenne, T. (2020), "The Vertical and Horizontal Distributive Effects of Energy Taxes: A Case Study of a French Policy", *Energy Journal* 41, https://doi.org/10.5547/01956574.41.3.tdou.

Douenne, T. and A. Fabre (2020), "Yellow Vests, Pessimistic Beliefs, and Carbon Tax Aversion", *PSE Working Paper.*

Fuest, C., A. Peichl and S. Siegloch (2018), "Do Higher Corporate Taxes Reduce Wages? Micro Evidence from Germany", *American Economic Review* 108, 393–418.

Garaffa, R., B. S. L. Cunha, T. Cruz, P. Bezerra, A. F. P. Lucena and A. C. Gurgel (2021), "Distributional Effects of Carbon Pricing in Brazil under the Paris Agreement", *Energy Economics* 101, 105396.

Gonzalez-Navarro, M. and C. Quintana-Domeque (2016), "Paving Streets for the Poor: Experimental Analysis of Infrastructure Effects", *The Review of Economics and Statistics* 98, 254–267.

Goulder, L. H., M. A. C. Hafstead, G. Kim and X. Long (2019), Impacts of a Carbon Tax across US Household Income Groups: What Are the Equity-efficiency Trade-offs?", *Journal of Public Economics* 175, 44–64.

Greve, H. and J. Lay (2020), *Stepping Down the Ladder: The Unintended Impacts of Fossil Fuel Subsidy Removal in a Developing Country*, Paper Presented at the 25th European Association of Environmental and Resource Economists (EAERE) Conference, Berlin.

Hanna, R. and B. A. Olken (2018), "Universal Basic Incomes versus Targeted Transfers: Anti-Poverty Programs in Developing Countries", *Journal of Economic Perspectives* 32, 201–226.

High-Level Commission on Carbon Prices (2017), *Report of the High-Level Commission on Carbon Prices,* World Bank, Washington DC.

IMF (2013), *Energy Subsidy Reform. Lessons Learnt and Implications*, International Monetary Fund, Washington DC.

Jensen, A. (2019), "Employment Structure and the Rise of the Modern Tax System", *NBER Working Paper* 25502.

Klenert, D., L. Mattauch, E. Combet, O. Edenhofer, C. Hepburn, R. Rafaty and N. Stern (2018), "Making Carbon Pricing Work for Citizens", *Nature Climate Change* 8, 669–677.

Lee, K., E. Miguel and C. Wolfram (2020), "Experimental Evidence on the Economics of Rural Electrification", *Journal of Political Economy* 128, 1523–1565.

Leite, P., T. G. Karippacheril, C. Sun, T. Jones and K. Lindert (2017), "Social Registries for Social Assistance and Beyond: A Guidance Note & Assessment Tool", *Social Protection & Labor Discussion Paper* 1704.

Maestre-Andrés, S., S. Drews and J. van den Bergh (2019), "Perceived Fairness and Public Acceptability of Carbon Pricing: A Review of the Literature", *Climate Policy* 19, 1186–1204.

Malerba, D., A. Gaentzsch and H. Ward (2021), "Mitigating Poverty: The Patterns of Multiple Carbon Tax and Recycling Regimes for Peru", *Energy Policy* 149, 111961.

McIntosh, C., T. Alegría, G. Ordóñez and R. Zenteno (2018), "The Neighborhood Impacts of Local Infrastructure Investment: Evidence from Urban Mexico", *American Economic Journal: Applied Economics* 10, 263–286.

Ohlendorf, N., M. Jakob, J. C. Minx, C. Schröder and J. C. Steckel (2021), "Distributional Impacts of Carbon Pricing: A Meta-Analysis", *Environmental and Resource Economics* 78, 1–42.

Olabisi, M., D. L. Tschirley, D. Nyange and T. Awokuse (2019), "Energy Demand Substitution from Biomass to Imported Kerosene: Evidence from Tanzania", *Energy Policy* 130, 243–252.

Renner, S. (2018), "Poverty and Distributional Effects of a Carbon Tax in Mexico", *Energy Policy* 112, 98–110.

Saelim, S. (2019), "Carbon Tax Incidence on Household Consumption: Heterogeneity across Socio-Economic Factors in Thailand", *Economic Analysis and Policy* 62, 159–174.

Schaffitzel, F., M. Jakob, R. Soria, A. Vogt-Schilb and H. Ward (2020), "Can Government Transfers Make Energy Subsidy Reform Socially Acceptable? A Case Study on Ecuador", *Energy Policy* 137, 111120.

Sommer, S., L. Mattauch and M. Pahle (2020), "Supporting Carbon Taxes: The Role of Fairness", *Ruhr Economic Papers*, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3707644.

Steckel, J. C., I. I. Dorband, L. Montrone, H. Ward, L. Missbach, F. Hafner, M. Jakob and S. Renner (2021), "Distributional Impacts of Carbon Pricing in Developing Asia", *Nature Sustainability,* https://doi.org/10.1038/s41893-021-00758-8.

Suárez Serrato, J. C. and O. Zidar (2016), "Who Benefits from State Corporate Tax Cuts? A Local Labor Markets Approach with Heterogeneous Firms", *American Economic Review* 106, 2582–2624.

Vogt-Schilb, A., B. Walsh, K. Feng, L. D. Capua, Y. Liu, D. Zuluaga, M. Robles and K. Hubaceck (2019), "Cash Transfers for Pro-Poor Carbon Taxes in Latin America and the Caribbean", *Nature Sustainability* 2, 941–948.

World Bank (2021), *State and Trends of Carbon Pricing 2021,* Washington DC.

Yaméogo, N. D. (2015), "Household Energy Demand and the Impact of Energy Prices: Evidence from Senegal", *African Development Bank Working Paper* 2156.

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# Brexit and European Finance: Prolonged Limbo


## ABSTRACT

**Following the orderly British exit from the European single market in late 2020, the full impact of Brexit on the financial sector has been delayed by risk aversion in the public and private sector alike, in part related to the Covid-19 pandemic. It will take longer than many had anticipated for the dust to settle on the post-Brexit financial landscape and its respective implications for the EU and the UK.**


It is still early to assess the impact of Brexit on the European financial sector, including both the UK and the EU. In sharp contrast to the politics of the bilateral EU-UK treaties negotiation and its aftermath, which have been and will probably remain full of sound and fury, the implementation of the British exit from the European Union and its single market has been carefully prepared and cautiously managed by regulatory authorities and market participants, with additional risk aversion in the Covid-19 pandemic phase since March 2020. While the prudent approach has successfully averted any disorderly developments so far, it also implies that the current status is far from a steady state, as many impactful decisions remain to be made. Just as the initial negotiation has taken significantly longer than initially envisaged, the transition to a truly post-Brexit financial sector in the UK and Europe more generally is turning out to be more protracted than many had anticipated.

## SUCCESSFUL TRANSITION

The period of Brexit negotiations lasted nearly four years, from the British government's formal notification of its decision to leave the Union in March 2017 to the signature of the EU-UK Trade and Cooperation Agreement on 30 December 2020. As the memories of the related twists and turns rapidly fade away, it becomes increasingly easy to forget the radical uncertainty and cliff-edges that marked the process at various junctures. At no point, however, did that result in financial turmoil. To some degree, this success has been a consequence of the very high-profile nature of Brexit, a development that captured the attention of a considerable number of participants for a long time. A critical mass of players worked hard at mapping scenarios and planning for Brexit-related contingencies, and that reduced the likelihood of market disruption.

In particular, there is every indication that the principal authorities in charge of financial stability, the European Central Bank and the Bank of England, were able to continuously maintain a high level of mutual information and cooperation throughout the period, in contrast to the toxic politics and abrupt breakdowns in the parallel relationship between the European Commission and the UK government at the same time. While personalities surely mattered, this is also to the credit of the strength and distinctiveness of the central banking community's culture and routines of cross-border coordination.

The political negotiators also deserve credit for a shrewdly designed feature of the Brexit sequence that acted as a check against instability at the point of most tangible change in the financial services sector, namely the moment of British exit from the EU single market. The Withdrawal Agreement, whose final text was published in October 2019 and ratified in January 2020, established a transition period beyond the formal point of UK exit from the EU (on 31 January 2020) during which most aspects of EU law would continue to apply and thus the UK would effectively remain in the single market (and customs union, the latter being of limited or no significance for most financial services). The transition period was set to end on 31 December 2020, but Article 132 of the Withdrawal Agreement allowed for an extension "for up to 1 or 2 years" if jointly agreed (i.e., requested by the UK—there was never much doubt about the EU's willingness to concur) before 1 July 2020. The flipside of that option was that, once the UK government decided as it did not to exercise it in June, there was no longer any uncertainty as to the date of exit from the single market—since changing it would have required amending the Withdrawal Agreement itself, an implausible prospect given the need for separate ratification before the end-2020 deadline in every EU member state. Thus, amid all the uncertainty, market participants knew one thing for certain during the second half of 2020, namely


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that Britain would indeed leave the single market on 31 December 2020, as it did. That allowed for simpler planning than if an option had been left for extension until the end.

The orderliness of the transition in the financial sphere had nothing to do with any softness of the arrangements that were made for it. Compared to the debates immediately before and after the 2016 referendum, the kind of Brexit that has applied to the financial sector has been about the hardest-possible version of "hard Brexit." Not only has Britain exited the single market as well as the EU itself—a choice that was made by the UK government after the referendum, without clear guidance on that from the referendum question itself—but it was almost granted almost no equivalence recognition for its existing financial regulatory framework, a choice made by the EU and more specifically by the European Commission. That decision of not granting any equivalence, except on a temporary basis in the stability-critical areas of securities depositories (for six months, expired since 1 July 2021) and clearing services (until mid-2022), was not to be taken for granted in the early stages of the discussion. UK treasury representatives have acknowledged publicly that it went against UK negotiating objectives.

## NEW GEOGRAPHY

Orderly as it happened, the exit from the EU single market has left London and the UK in a fundamentally different position than it had been for nearly half a century. While in the single market, the City was an onshore financial center for the EU as it was for the UK itself, and an offshore center for the rest of the world. Now, it is onshore only for the UK, and has become offshore (or in the EU parlance, a third country) for the entire EU of 27 remaining countries. Even though the share of the EU in the global economy is on a slow decline, this is a major shift.

To be sure, the onshore/offshore dichotomy is somewhat blunted by the imperfect nature of the EU single market for financial services. A number of national regulatory or tax restrictions result in effective intra-EU barriers to the provisions of cross-border services, and the European Commission has not been as proactive as it perhaps should be to fight for their elimination in compliance with European treaty provisions. One stark illustration is the extent to which European banks generally maintain fully capitalized subsidiaries in host EU countries instead of providing their services directly from their home entity or through local branches.

Even so, the UK's loss of the passport status that comes with single market membership will inevitably have structural consequences. All things equal, the single market passport is a commercial advantage: a firm that has it is in a better competitive position than a peer that lacks it. The question then becomes whether the UK's other competitive advantages can more than offset the absence of passporting rights, whereas pre-Brexit, financial firms in the UK could enjoy the passporting rights in addition to the country's other competitive advantages. Since much of UK financial regulation is currently aligned with the EU, and other drivers of national competitiveness such as tax policies are mostly determined at the national rather than EU level, the potential for the UK to be the best place for doing financial business in Europe, as it ostensibly had been from the mid-1980s to the mid-2010s, is inevitably diminished. Correspondingly, the UK will be placed in more direct competition with other offshore (or third-country) financial centers for the provision of financial services to EU-based clients, including Switzerland and, albeit farther away, the United States. Furthermore, an international center as complex as London relies on powerful clustering effects and synergies between services provided onshore and offshore. Through such linkages, the City's loss of competitiveness for services to EU clients may also have an impact, even though it is practically impossible to model and predict, on its competitiveness for services to clients in the rest of the world (and also, conceivably, in the UK itself).

The advantages of London remain considerable. It has unmatched depth and breadth of domestic and international talent that is not immediately mobile. The UK has profoundly anchored traditions of openness and outward orientation, shaped by centuries of history, that even a protracted period of populist or nativist government may be unable to change significantly. London also has excellent physical and service infrastructure for the financial community. At this point, it remains well ahead of any single other European financial center on about any criterion one can think of.

## DELAYED IMPACT

In the face of the fundamental shift that is Brexit, the structural impact that has been observed so far appears highly differentiated across market segments, and altogether limited. Even though the counterfactual will of course remain forever unknown, it is probable that the Covid-19 pandemic has been a major cause of this mild evolution so far, as it has led public authorities and market participants alike to generally minimize their short-term risk-taking and to delay long-term decisions. Since the pandemic still seems to be far from over, it is reasonable to project that the same dampening impact will be prolonged for at least several more quarters in a baseline scenario.

Since late 2014, the euro-area banking sector (which represents about nine-tenths of the entire EU or European Economic Area banking sector post-Brexit, measured by assets) has been supervised by a single authority, lodged in the European Central Bank (ECB). The ECB has repeatedly signaled that it

expected all its supervised entities to implement a suitable post-Brexit organization that would allow appropriate supervision from Frankfurt of their euro-area activities and the corresponding risks. In the years since 2016 and especially since 2020, major banks have created new legal structures and transferred significant assets from the UK to the euro area, which in April 2021 analysts Elving Friis Hamre and William Wright have estimated at more than a trillion euro (or £900 billion, nearly 10 percent of total assets in the UK banking system). As their report highlighted, however, this is not the endpoint of a process that is still unfolding (Hamre and Wright 2021). Indeed, and even though this is typically not the matter of public communication by either the ECB or the banks, the ECB appears to have allowed a number of supervised entities to delay the full implementation of their post-Brexit organization beyond the December-2020 deadline, and one suspects that several of the corresponding discussions between the ECB and the banks on target arrangements are ongoing. This obviously raises the question of the ECB's next steps: how many more assets may need to migrate, if any; what organizational consequences in terms of the banks' footprint in the euro area; and when. It is practically impossible to assess these points with any specificity from outside the supervisory community.

As for non-banks, to the extent they are publicly supervised—be it for prudential purposes, like insurers, or for conduct of business, like asset managers—the supervisory system remains essentially fragmented across individual member states, even though the European Insurance and Occupational Pensions Authority (EIOPA) and European Securities and Markets Authority (ESMA) play coordinating roles.[1] In that space, unlike in banking, there appear to exist powerful dynamics of supervisory competition, under which supervisory authorities in some member states offer significantly more flexible conditions than others in terms, for example, of how much activity needs to be located in the country as opposed to how much can remain in London. If so, one can expect most financial firms—at least those headquartered in non-EU countries—to choose to conduct their EU operations from an entity based in one of the more accommodative member states.

It remains to be seen, of course, how stable the landscape thus created will turn out to be. History suggests that regulatory and/or supervisory competition of the kind that exists in most of the EU non-bank financial sector can easily turn to a race to the bottom, eventually leading to future supervisory failures that in turn may prompt at least partial policy reform. In the EU context, such reform is likely to take the form of policy centralization as the simplest antidote against race-to-the-bottom competition. This is precisely what has happened in the past decade with banking prudential supervision, where the revelation of comprehensive undercapitalization of euro-area banks during the crisis of 2007–2017 led to the mid-2012 decision to put the ECB in charge, and with Anti-Money Laundering (AML) supervision, where a string of scandals starting in 2018 led to the 2021 proposal by the European Commission of a new EU AML Authority which appear likely to be enacted shortly. It would certainly make sense to consider such changes on a proactive basis, instead of waiting for failure before acting. Somewhat frustratingly, however, the lack of reform traction associated with the EU rhetoric on "capital markets union" since 2014, which in principle could have provided a favorable environment to integrate market supervision, for example by reforming and reinforcing the role of ESMA, has been sobering in this respect.

As Europe appears to enter a phase of post-Covid-19 recovery, even with high uncertainty about future outlook, a growing number of firms will need to make decisions on where to locate new investments—a dynamic that is likely to have larger impact eventually than any relocation of existing activity that could be directly traced to Brexit causes. It is far too early to have a sense of any corresponding geographical shifts. In a year or two, one may expect a clearer picture to emerge on whether the UK remains the best place in Europe to do financial business.

## THE FUTURE EU-UK RELATIONSHIP

In the near term, the EU-UK relationship, as far as it has impact on the financial services sector, appears set to remain at a low-trust equilibrium. No major issues call for immediate negotiation or renegotiation. A process has been set for decision on the possible extension of the clearing equivalence currently set to expire in mid-2022, which may or may not be dominated by technical considerations, with a recommendation expected from ESMA in late 2021. The Joint Financial Regulatory Forum established by memorandum of understanding in March 2021 is a coordination mechanism that can be useful but does not bind either side, little different from what has existed for years between the EU and the United States and other third-country jurisdictions. Besides the unique case of clearing, there is no indication that the EU is considering any new equivalence decision any time soon.

Meanwhile, both sides are updating their financial regulatory frameworks to adapt them to a constantly changing environment. Since there is no commitment or willingness to do so in a joined manner, regulatory divergence will slowly but surely set in. Generally speaking, the UK legislative and regulatory process is nimbler and more attuned to market realities than its EU equivalents; any resulting future differential in

[1] ESMA is also the direct supervisor for comparatively small market segments, such as credit rating agencies and trade repositories. Due disclosure: the author is an independent non-executive director of several trade repository subsidiaries of DTCC, including an EU entity supervised by ESMA and a UK entity supervised by the UK Financial Conduct Authority.

regulatory toughness and/or quality may impact the relative abilities of the EU and the UK to attract financial business. But, at least in the near term, this is unlikely to be a first-order driver of change, not least because the UK also has domestic political constraints that go against scenarios of comprehensive deregulation. The EU also has potential scope to improve its own financial rulemaking practice, for example by improving the governance and funding of EIOPA and especially ESMA to bolster their independence and effectiveness.

Of course, none of this takes place in isolation from what is happening in the wider world. By and large, London in the last two–three decades has been the central hub of financial globalization. On the face of it, the erosion of Hong Kong's position as an international center as a consequence of its growing integration into China may benefit London as a competing venue, but things are unlikely to be that simple. Chancellor Rishi Sunak recently gave a sunny view that the UK "can pursue with confidence an economic relationship with China in a safe, mutually beneficial way without compromising our values or security" (Sunak 2021). Meanwhile, analysts have debated the extent to which the EU's financial regulatory influence on a global scale, referred to as the "Brussels effect," may have been undermined as a consequence of Brexit (Rosca 2020). Unstable global geopolitics is another risk factor that could directly affect the future geography of European financial services.

## CONCLUSION

Brexit is unquestionably a tectonic shift for the European financial sector, but one that has triggered no landslide or earthquake yet. The combination of public-sector and private-sector caution in a context shaped by massive Covid-19-related uncertainty since March 2020 has resulted in an undramatic transition so far. It is not yet clear when the full fallout from the end-2020 British exit from the European single market will be observable, and what its eventual magnitude will be. The only thing that is clear is that we are not yet there.

Equally unsure is the future general direction of financial services policy, in the UK and especially in the EU. Until the Brexit referendum of 2016, the UK was disproportionately influential in shaping the EU financial services agenda and provided a policy vision, especially for anything related to wholesale markets. No alternative vision has emerged yet in the UK-less EU—not even an unambiguous intent to reduce the EU's dependence on London as a financial center, be it motivated by economically apt (financial stability-related) arguments or by less compelling (mercantilist) ones. As several member states compete to attract financial firms and activities, the EU's future policy stance need not be less conducive to a dynamic financial sector than it has been pre-Brexit. At the present juncture, however, it remains far from a point of clarity, let alone stability.

## REFERENCES

Hamre, E. F. and W. Wright (2021), "Brexit and the City: The Impact So Far", *New Financial*, April, https://newfinancial.org/brexit-the-city-the-impact-so-far/.

Rosca, M. (2020), "Brexit Has Crippled EU's Soft Power over Financial Rules", *Politico*, 23 December, https://www.politico.eu/article/uk-brexit-takes-with-it-much-of-the-eu-soft-power-in-finance/.

Sunak, R. (2021), *Mansion House Speech 2021*, 1 July, https://www.gov.uk/government/speeches/mansion-house-speech-2021-rishi-sunak.

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# Government Interventions during the Coronavirus Pandemic — A Critical Consideration


## ABSTRACT

**The coronavirus pandemic poses major challenges for governments. Especially in the beginning when news of the virus was breaking, information about the virus was limited. Many minor (e.g., facemasks) and major (e.g., curfews) restrictions were implemented to contain the virus. However, the German government failed at presenting a clear and targeted strategy, which led to confusing and overwhelmingly detailed regulations that did not entail suitable cost-benefit considerations. Many costs occurred as a consequence of the measures that were instituted (e.g., government aid for forced shop and restaurant closures). In addition, asymmetric interventions severely impacted the economic structure of and the careers, for example, those in the hospitality industry. We suggest that the government focus on more general recommendations for action based on sound information, which would then provide an appropriate framework for the markets.**


Political decision-making situations can be tackled using various strategies. Making a decision is difficult, however, if there is insufficient information about the possible outcomes. If the probabilities regarding the individual outcomes are known (i.e., uncertainty), one can at least fall back on expected values. The situation is different, however, if nothing is known at all, that is, a decision must be made without being able to factor in enough information, which limits possible strategies considerably. This is especially true when there is a high degree of risk aversion involved—something that is the case, for example, with politicians who must not only worry about the big picture but also about their chances for re-election. Politicians may well adopt the maximin strategy, which is designed to secure the least bad outcome. Furthermore, politicians rely on assistance from experts to learn about possible situations, but the experts themselves have special interests at heart. The art of politics is to deduce the "true" situation from the various interests (Grossman and Helpman 2001). The coronavirus pandemic, which posed a particularly large number of health and virological questions, confronted policymakers with precisely these issues, and they have had to find answers and implement their responses in the form of appropriate measures.

The coronavirus disease (Covid-19) is caused by the SARS-CoV-2 virus that spreads between people who are in close contact with each other and in indoor settings where people spend longer periods of time together. Touching contaminated surfaces and then touching one's mouth, nose or eyes (WHO 2021) is another way the disease is often transmitted. The disease may cause serious health issues in individuals, especially in those with compromised immune systems, and the economic costs—which can include intensive care, long-term negative health effects, and death—in terms of hospitalization are staggering. All of this is clearly undesirable from both an individual and the societal perspective.

During the coronavirus pandemic, various types of government intervention in every area of the economy and life have been omnipresent. These interventions are not only popular with politicians who can increase their power and influence considerably, but also many voters demand these interventions to be able to counter all imponderables of an increasingly complex world with a supposed bulwark. In a politico-economic analysis, Zweifel (2020) shows that citizens are willing to give politicians a larger share of GDP in order to manage risks. We assess government interventions in general and focusing on the pandemic situation from an economic point of view.

## THE NEED FOR GOVERNMENT INTERVENTIONS

On many occasions, government interventions are not only justified but also necessary to enable a coopera-

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tive and respectful living together in society. This also applies to the economy, which, as can be read in any economic textbook, requires regulation at one point or another. This particularly applies in case of market failures, which is also reflected as one the three core functions formulated by Musgrave (1959):

- macroeconomic stabilization
- income redistribution (addressing distributive market failures)
- resource allocation (addressing allocative market failures)

Consequently, governments should focus on the above core functions. However, with exception of stabilization, these goals are rather medium- to long-term oriented. Assessing the "Measures by the Federal Government to contain the spread of the Covid-19 pandemic and address its impacts" (Bundesregierung 2020), we find predominantly short-term objectives (Figure 1). The proposed and widely implemented strategy suggests a range of measures, most of them ad hoc and very specific, such as regulations payment deferrals for electricity, gas and telephone contracts, repatriation of tourists, and organizing a hackathon. Other measures have significant financial impact, e.g., short-term work arrangements. While some of the measures taken can and will certainly have lasting effects on the distribution of income and the allocation of resources, at this stage the focus of this analysis can only be on the immediate effects aimed at stabilizing the economy.

An original purpose of the government is the provision of public goods. Public goods have no rivalry in consumption (the good can be used by many consumers at the same time without any loss of utility to the individual) and no one can be excluded from use by a barrier to access, such as paying a price, which makes a provision on private markets less attractive. In this context, a robust public health system and the absence of a pandemic is a public good. Every member of society benefits from not being exposed to a potentially deadly virus and the opportunity to receive medical treatment as and when needed. As public goods imply market failure, government intervention makes sense. Of course, private enterprises care for health and safety of their stakeholders as well. However, taking care of every individual, e.g., the very poor, is beyond their objective and would also overstrain them.

Another market failure relevant for the pandemic are externalities. Externalities are the cost or benefits of an economic transaction of an individual that is not involved in this transaction and are not compensated for by price changes. While at the beginning (and still ongoing), the focus rests on the negative externalities of physical proximity (which resulted in the well-known imperative of social distancing), currently the positive externalities of being vaccinated are stressed. Nevertheless, both externalities lead to inefficient market outcomes. In the first case, people do not account for the high social costs of getting close to each other, which include, e.g., more infections and higher costs for the health system and therefore from societal perspective too much of this activity takes place.

In the second case, many do not consider that vaccination does not only protect individuals from severe consequences and thus directly lowering the costs for the health system but also, as many studies suppose, lowers the probability of spreading the virus. Therefore, from a societal perspective the benefit of one person being vaccinated is much larger than the individual one. Consequently, the percentage of a fully vaccinated population that is necessary to achieve herd immunity is unlikely to be achieved when only allowing for individual benefits of vaccination. This explains government incentives, such as fewer restrictions on vaccinated individuals or rewards like lotteries as in the United States.

Since the market thus does not have a sufficient incentive to provide public goods or has not the incentive (and perhaps information), both failures are economic justifications for why governments must intervene in the pandemic.

## EVALUATION METHOD FOR (CORONAVIRUS) POLICY MEASURES

Any policy measure generates winners and losers, thus leading to an intentional disruption of the present situation. These two interrelated effects also determine the basis on which policy measures can be evaluated. An economic welfare analysis may essentially use the very strict Pareto-criterion—no improvement of at least one party is possible without anyone else being worse off—or the more suitable "Kaldor Hicks" criterion, which points to a potential Pareto improvement—the winner(s) must at least be able to compensate the losers of a measure—for its evaluation.

The pandemic is causing almost everyone to be worse off compared to the pre-coronavirus situation. Evaluating policy measures must therefore always be made in comparison to the situation without the measure. Dorn et al. (2020) highlight that in principle, there is no trade-off between economic recovery and combating the pandemic, as significant costs would have been incurred in individual sectors of the economy even in the absence of any measures. Nevertheless, the measure must not make the situation worse. As there are still some worse off, the Pareto criterion would significantly limit the scope for action, thus paralyzing the decision-makers. Thus, in principle, one must accept welfare losses in some areas but should expect a welfare improvement overall (compared to a situation without any interventions). It is therefore necessary to examine which measures can best achieve the higher-level goal.

Generally, the measure used must first be appropriate for achieving a specific goal, and second, it must achieve this goal at the lowest possible (economic) cost. This consideration often referred to as targeting principle was formulated by Bhagwati (1971, 71): "when distortions have to be introduced into the economy, because the values of certain values have to be constrained, the optimal (or least-cost) method of doing this is to choose that policy intervention that creates the distortion affecting directly the constrained variable." However, as Rodrik (1987, 904) points out, "individual agents typically will have some influence—intentionally or not—over the nature and level of distortions that emerge in equilibrium." He highlights the importance to understand "the process by which distortions are generated" (Rodrik 1987, 910). Thus, changes in individual behavior can increase (economic) costs that imply the importance of ensuring the (right) incentives through policy measurements. This is illustrated by Siebert (2001) who describes the "cobra effect" and refers to an anecdote from India during colonial times: a British governor wanted to tackle a plague of cobras in Delhi by offering a bounty for each dead cobra. The strategy was very successful as many dead snakes were brought to him. However, at some point he received information that people had started to get into the lucrative cobra breeding business. This eventually led to the termination of the program with serious consequences: since cobras have no financial value in themselves, they were released, so by the end of the intervention, the situation was only exacerbated.

A further problem arises especially in areas where politics strongly interferes with consumer behavior. It often becomes apparent that politicians distrust the market or the economic subjects and instead want to impose their own preferences and beliefs. In the energy sector, Gayer and Viscusi (2013, 263) observe this tendency by summing up that "even if some consumers do sometimes fall short on certain dimensions of choice, the magnitude and prevalence of such a shortfall is important and is never addressed in the regulatory assessments. […] Perhaps the main failure of rationality is that of the regulators themselves. Agency officials who have been given a specific substantive mission have a tendency to focus on these concerns to the exclusion of all others."

To sum up, we evaluate main policy measurements by asking the following questions:

(1) Is the measure suitable to achieve the objective while minimizing distortions?
(2) Do the decision-makers have a sufficient information base?
(3) Are all impacts considered or are possible side effects ignored?

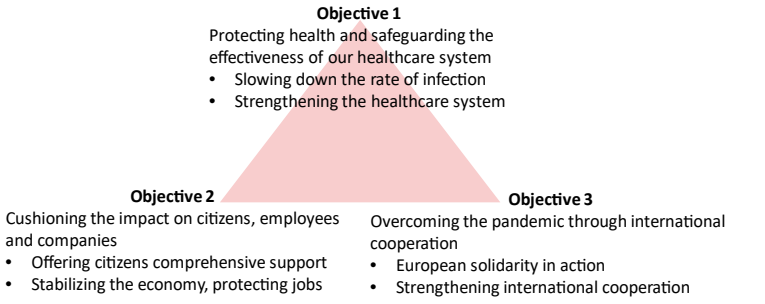
First, we do not quantify costs since we focus on distortions caused by the measures. Second, there is a multitude of measures taken on the one hand and a multitude of affected areas as well as interactions between them on the other hand. A comprehensive consideration is not possible within the scope of this outline, so that the analysis is to be regarded as very selective.

## ASSESSMENT OF CORONAVIRUS-RELATED GOVERNMENT INTERVENTIONS

To start with, regarding the information base available to policymakers, Donsimoni et al. (2020) point out the asymmetry between health and economic data: while infection and death rates are reported daily, there are no comparable daily economic indicators (see also Riphahn 2020). However, rather rough data on infections are collected (e.g., information on professions or special circumstances is missing, see RKI (2020) and §11 IfSG—German Infection Protection Act), and reported data are sometimes incomplete due to the workload of the health authorities (RKI 2021). This makes it difficult to get an accurate picture and to classify how infection figures are to be assessed in context (e.g., outbreak in a local retirement home vs. diffuse infection incidence in a large city). In addition, experts assess and process the information for decision-makers. In this context, Frey and Steiner (2021) criticize the non-representative composition of the consulting committees, which strongly biases the information, leading to decisions that focus primarily on few virological considerations without paying much attention to other opinions or effects. Thus, in general, we must deny (2) and (3), so that policy measures are fundamentally not based on an economic efficient and cost-minimizing basis.

Therefore, we will primarily focus on question (1) in the further analysis and look at the Federal Governments' objectives (Bundesregierung 2020) as a guideline for the measures and discuss the immediate impact on households, the public sector and firms. Figure 1 summarizes these objectives and also points out possible trade-offs via the chosen pres-

Figure 1
**Objectives by German Federal Government**




Source: Authors' own compilation from Bundesregierung (2020).

entation. As our analysis shows, most measures target objective 1, which jeopardizes the success of objective 2. This supports Frey and Steiner (2021)'s point. Of course, another rationale is to try to contain the virus as quickly as possible in order to keep the economic costs low (see Dorn et al. 2020), which would benefit objective 2. In the analysis, we focus on measures that can be assigned to objectives 1 or 2.

### Households

The foundation of the measures is the AHA campaign ("Abstand"—distance, "Hygiene"—hygiene, "Alltag mit Maske"—everyday life with mask), which was further extended at various stages of the pandemic (e.g., to include ventilation, "Lüften," or the use of the coronavirus warning app). In light of today's knowledge of SARS-CoV-2 transmission, reducing close physical human contact in general, particularly indoors and in combination with poor ventilation and crowds, directly affects the transmission of the virus (Eikenberry et al. 2020). Also, moderate disinfection to kill germs and viruses prevents the spread of diseases. Since the spread of the virus occurs through aerosols emitted by breathing, the wearing of face masks that obstruct this means of transmission is also very suitable. Each measurement renders any physical contact unattractive, and thus is effective for reaching objective 1.

On the individual level, contact restrictions were imposed regarding a maximum number of individuals congregating at any one time. Yet, despite adhering to the rules, the total sum of contact persons may be high if meetings occur sequentially. Therefore, although the measure is intended to be targeted and low-cost at first glance—regarding objective 1, while objective 2 is fully violated—it can only be effective if a substantial proportion of society follows the rule to the letter. In a society that highly values freedom, enforcing such rules is deemed unacceptable, thus reducing the suitability of the measure. The campaigns to encourage staying at home or foregoing unnecessary venturing outside the home has also led to significant psychological stress, e.g., the pandemic has led to both short- and long-term psychosocial and mental health implications for children and adolescents (Singh et al. 2020). There are also some behavioral changes that counteract non-coronavirus goals, such as the increase in private transport as public transport is to be avoided (Zeit 2021).

Although acceptance of wearing facemasks was low during the early stages of the pandemic in Germany (April/May 2020), Bertsch et al. (2020) find that a mandatory policy leads to sufficient compliance, is considered fair and avoids stigmatization. Face masks are available at low cost, particularly as the market quickly adapted to the demand and offers competitive products, so wearing them comes at comparatively low social cost. However, the policy change from reusable community masks to disposable medical products (surgeon's mask, FFP2) results in a serious threat to the environment (Dharmaraj et al. 2021).

### Public Services

As one of the initial measures, schools and universities were closed, again preventing people from congregating and thus targeting objective 1. However, this interrupted conventional schooling, so that pupils and students had to rely more on their own and their parents' resources to continue learning remotely, which seems to have worked better in more privileged families (Schleicher 2020). The learning losses may result in a 3 percent lower lifetime income and 1.5 percent lower annual GDP for the remainder of the century (Hanushek and Woessmann 2020). The learning losses also suggest that the resulting increase in educational and income inequality will have a lasting negative effect on society. School closures also have implications for families, as particularly younger children need to be looked after. Heggeness and Fields (2020) suggest that women in particular cut back on working hours, suffering direct economic consequences on income and pension as well as career progression. In addition, not immediately quantifiable effects on gender equality, e.g., shown by unusually lower submissions to academic journals by female academics (Flaherty 2020) may have a long-term impact. All these effects jeopardize objective 2.

To speed up the development of vaccines, the German government decided to drastically increase expenditures for research and to invest in companies that quickly developed promising vaccines. Focusing on innovative vaccines looks like a good choice. Yet, investing in research and development always involves entrepreneurial risk that governments typically do not bear because market forces are deemed much more efficient. Due to the huge costs of the pandemic, speed was essential, thus justifying potentially inefficient allocation of resources. The expenditure of considerable financial resources on research is justified, since the government in particular is supposed to support basic research. However, it becomes problematic when the government attempts to "pick the winner" (BioNTech vs. CureVac).

The government also became an entrepreneur in other areas. To save firms that have run into serious problems during the pandemic control measures, the government took (partial) ownership in Lufthansa and TUI, since the travel industry was most seriously affected. However, the issue is not the faulty business model of the firms but the demand shock. Bridge loans would therefore be much more suitable than corporate activity by the government, which in view of very different objectives does not fall within the competence of the government or its representatives.

### Business

It should always be noted, even without any measures, businesses would have been affected, e.g., by the disruption of global supply chains. Consumer behavior very likely would have changed, as some part of the population would have stopped or limited bar and restaurant visits, extensive shopping tours, participating in large-scale cultural events and traveling. Nevertheless, at various stages of the pandemic businesses were affected by many regulations: limitation of the number of customers allowed in shops, provision of hand disinfection agents, obligatory community face masks or FFP2 masks, presentation of a negative test result, and documentation of contact tracing. Despite being an obstacle for consumers to enter shops, businesses can stay operational, which implies that economic costs are comparatively low. At any rate, there was a shift in economic activity to distance solutions, which imposed an asymmetric shock. Online store business has been soaring (Ahrens 2021), for example, Amazon reported its operating cash flow increased by 72 percent in 2020 (Amazon 2021).

These asymmetries between different business models were exacerbated by the imposition of several lockdowns and also created new frontiers in physical commerce. Businesses providing essential goods or services were not subject to the lockdown measures. However, the definition of "essential" changed several times, ranging from food shops, drugstores, shoe shops, and hairdressers. Food retailers that remained open throughout the pandemic increased sales significantly, due to both price and quantity increases (Kecskes 2020). In addition, bicycle sales went up significantly while the sale of clothes and shoes decreased drastically in the first half of 2020 (Jung et al. 2020). The combination of uncertainties about the duration and scope of the measures and growth in other competing areas, caused by either induced consumer switching (e.g., delivery) or government regulations (e.g., medical test stations), leads to an adjustment in economic and employment structure. In some regions, bars and clubs are still closed, which may even be final as this endangers their concession (Dehoga 2021). As a result, the lockdowns adversely affected both businesses and their customers beyond the pure costs of the pandemic, which also caused an unintended restructuring of the economy. Together with the demographic shortage of skilled workers, this change may be sustainable or will at least entail significant costs in the future.

While the basic idea was actually to mitigate the effects caused by the pandemic, much of the government's economic aid is now instead dampening the negative effects of the pandemic response. Even at an early stage, economic consequences were sought to be relieved by means of short-time work compensation, the cost of which is borne by the taxpayer. The idea behind short-time work compensation is to prevent unemployment and keep businesses with suitable business models alive. It remains to be seen whether that shift is permanent, which would imply long-term structural changes for shops in cities and shopping centers, as well as employment. In this case, it may turn out in hindsight that doomed industries were supported financially that are not suitable. Despite compensation payments for businesses and the self-employed, some individuals still may change careers because of the pandemic and work in positions that do not adequately use their skills, thus resulting in an inefficient allocation of resources. This has been happening in hotels and restaurants, where a shortage of employees has been reported (Business Insider 2021).

## CONCLUSION

To fight the spread of the SARS-CoV-2 virus and, thus, the pandemic, the most suitable and efficient measures are comparably low cost, such as face masks and social distancing. Nevertheless, many of the measures taken are oriented toward a multitude of details (e.g., how many people from how many households are allowed to meet at one time; how many customers are allowed per square meter, depending on the size of the store) that require a great effort in terms of information and implementation on both the governmental and the individual side. In view of an only very rudimentary information base, this suggests a higher degree of controllability than is actually the case. Thus, a literal interpretation of the regulations creates a certainty that does not exist, while at the same time causing considerable costs. The creation of a fundamental awareness, whereby the government acts as an informant and supporter, and takes care of its very own tasks, such as ensuring services for the public in the form of sufficient medical facilities or the availability of medical products, and not as a detail-obsessed regulator, where one intervention always requires further interventions, should be the objective of the government. Markets are much more efficient when it comes to making detailed decisions, since they can adapt their behavior to the imposed requirements and the decentralized information that they are more familiar with.

Besides that, the success of the measures depends on their acceptance in the population. Enforcing these measures is costly (e.g., police, asking neighbors to report potentially illegal parties) and leads to people being unhappy with the government. Since compliance is closely linked to political trust (Bargain and Aminjonov 2020), politics should ensure consistent measures and communication thereof. In the current pandemic, rules have been changing from state to state and were rapidly amended over time. Therefore, improving communication and building trust in the population is key. Clear roles and responsibilities of government entities are suggested.

Finally, since the measures mainly aim at containing the virus and, at best, stabilizing the economy in the short term, the medium- and long-term consequences are tolerated. It remains to be seen whether the economic structure will be permanently transformed, whether the shortage of skilled workers in certain sectors will continue and how severely and sustainably the educational prospects of the younger generation will be impaired. Nonetheless, further substantial government intervention will be required to mitigate these consequences in terms of income distribution and allocation.

## REFERENCES


Ahrens, S. (2021), *Statistiken zu den Auswirkungen des Coronavirus auf den Einzelhandel*, https://de.statista.com/themen/6217/auswirkungen-des-coronavirusvirus-auf-den-einzelhandel/.

Amazon (2021), Amazon.com *Announces Financial Results and CEO Transition,* https://ir.aboutamazon.com/news-release/news-release-details/2021/Amazon.com-Announces-Fourth-Quarter-Results/default.aspx.

Bargain, O. and U. Aminjonov (2020), "Trust and Compliance to Public Health Policies in Times of COVID-19", *Journal of Public Economics* 192, 104316.

Bertsch, C., L. Korn, P. Sprengholz, L. Felgendreff, S. Eitze, P. Schmid and R. Böhm (2020), "Social and Behavioral Consequences of Mask Policies during the COVID-19 Pandemic", *PNAS* 117, 21851–21853.

Bhagwati, J. N. (1971), "The Generalized Theory of Distortions and Welfare", in J. N. Bhagwati, R. W. Jones, R. A. Mundell and J. Vanek, eds., *Trade, Balance of Payments and Growth, Papers in International Economics in Honor of Charles P. Kindleberger,* North-Holland, Amsterdam, 69–90.

Bundesregierung (2020), *Measures by the Federal Government to Contain the Spread of the COVID-19 Pandemic and Address Its Impacts,* https://www.bundesregierung.de/resource/blob/975226/1753912/4a0014f469023200f7cf7ba3e8ed3203/2020-05-18-massnahmen-englisch-data.pdf?download=1 7.5.2020.

Business Insider (2021), *Jobboom durch Öffnung: In Gastronomie und Hotellerie fehlen Arbeitskräfte – vor allem Kellner,* https://www.businessinsider.de/karriere/oeffnung-nach-coronavirus-in-restaurants-gastronomie-und-hotels-fehlen-jetzt-viele-arbeitskraefte/.

Dehoga (2021), *Drohender Konzessionsverlust: An Fristverlängerung bis 17.04.21 denken,* https://www.dehogabw.de/informieren/dehoga-nachrichten/2021-1q/drohender-konzessionsverlust-an-fristverlaengerung-bis-170421-denken.html.

Dharmaraj, S., V. Ashokkumar, S. Hariharan, A. Manibharathi, P. L. Show, C. T. Chong and C. Ngamcharussrivichai (2021), "The COVID-19 Pandemic Face Mask Waste: A Blooming Threat to the Marine Environment", *Chemosphere* 272, 129601.

Donsimoni, J. R., R. Glawion, T. Hartl, B. Plachter, J. Timmer, K. Wälde, E. Weber and C. Weiser (2020), "Covid-19 in Deutschland – Erklärung, Prognose und Einfluss gesundheitspolitischer Maßnahmen", *Perspektiven der Wirtschaftspolitik* 21, 250–262.

Dorn, F., C. Fuest, M. Göttert, C. Krolage, S. Lautenbacher, S. Link, A. Peichl, M. Reif, S. Sauer, S. Stöckli, K. Wohlrabe and T. Wollmershäuser (2020), "Die volkswirtschaftlichen Kosten des Coronavirus-Shutdown für Deutschland: Eine Szenarienrechnung", *ifo Schnelldienst* 4/2020, 29–35.

Eikenberry, S. E., M. Mancuso, E. Iboi, T. Phan, K. Eikenberry, Y. Kuang, E. Kostelich and A. B. Gumel (2020), "To Mask or Not to Mask: Modeling the Potential for Face Mask Use by the General Public to Curtail the COVID-19 Pandemic", *Infectious Disease Modelling* 5, 293-308.

Flaherty, C. (2020), "No Room of One's Own", *Inside HigherEd,* https://www.insidehighered.com/news/2020/04/21/early-journal-submission-data-suggest-covid-19-tanking-womens-research-productivity.

Frey, B. S. and S. Steiner (2021), "Zufallswahl der Coronavirus-Fachgremien und Ethikräte", *Ökonomenstimme*, 16 March, https://www.oekonomenstimme.org/artikel/2021/03/zufallswahl-der-coronavirus-fachgremien-und-ethikraete/.

Gayer, T. and K. Viscusi (2013), "Overriding Consumer Preferences with Energy Regulations", *Journal of Regulatory Economics* 43, 248–264.

Grossman, G. M. and E. Helpman, E. (2001), *Special Interest Politics,* MIT Press, Cambridge MA.

Hanushek, E. A. and L. Woessmann (2020), "The Economic Impacts of Learning Losses", *OECD Education Working Paper* 225.

Heggeness, M. L. and J. M. Fields (2020), *Working Moms Bear Brunt of Home Schooling While Working during COVID-19,* https://www.census.gov/library/stories/2020/08/parents-juggle-work-and-child-care-during-pandemic.html.

Jung, S., B. Rürup and A. Schrinner (2020), *Konsummonitor Coronavirus,* Handelsverband Deutschland, https://einzelhandel.de/publikationen-hde/12807-konsummonitor-coronavirus.

Kecskes, R. (2020), *Shopper und Handel auf dem Weg in eine 'neue Normalität',* https://www.gfk.com/hubfs/NCE_DE_202007_CI_06_2020.pdf?hsLang=de.

Manager Magazin (2021), "Autobranche hakt Coronaviruskrise ab - und steigert Preise", https://www.manager-magazin.de/unternehmen/autoindustrie/autobranche-hakt-coronaviruskrise-ab-muss-nun-an-lieferketten-arbeiten-laut-global-automotive-outlook-2021-a-768034cc-4ef4-4056-a38e-c36e98e3b5c6.

Musgrave, R. (1959), *The Theory of Public Finance: A Study in Public Economy,* MacGraw-Hill, New York.

Riphahn, R. (2020), "Wissenschaft braucht Daten", *Wirtschaftsdienst* 5/2020, 306–307.

Robert Koch Institute (RKI, 2020), *Epidemiologisches Bulletin* 38/2020, https://www.rki.de/DE/Content/Infekt/EpidBull/Archiv/2020/Ausgaben/38_20.pdf.

Robert Koch Institute (RKI, 2021), *Täglicher Lagebericht des RKI zur Coronavirusvirus-Krankheit-2019 (COVID-19)*, https://www.rki.de/DE/Content/InfAZ/N/Neuartiges_Coronavirusvirus/Situationsberichte/Jan_2021/2021-01-12-de.pdf.

Rodrik, D. (1987), "Policy Targeting with Endogenous Distortions: Theory of Optimum Subsidy Revisited", *The Quarterly Journal of Economics* 102, 903–911.

Schleicher, A. (2020), *The Impact of COVID-19 on Education – Insights from Education at a Glance 2020,* https://www.oecd.org/education/the-impact-of-covid-19-on-education-insights-education-at-a-glance-2020.pdf.

Siebert, H. (2001), *Der Kobra-Effekt. Wie man Irrwege der Wirtschaftspolitik vermeidet,* Deutsche Verlags-Anstalt, Stuttgart.

Singh, S., D. Roy, K. Sinha, S. Parveen, G. Sharma and G. Joshi (2020), "Impact of COVID-19 and Lockdown on Mental Health of Children and Adolescents: A Narrative Review with Recommendations", *Psychiatry Research* 293, 113429.

WHO (2021), *Coronavirus Disease (COVID-19): How Is It Transmitted?,* https://www.who.int/news-room/q-a-detail/coronavirusvirus-disease-covid-19-how-is-it-transmitted.

Zeit (2021), *Umfrage: Neue Liebe zum Auto in der Coronavirus-Krise,* https://www.zeit.de/news/2021-05/18/umfrage-neue-liebe-zum-auto-in-der-coronavirus-krise.

Zweifel, P. (2020), "Die Coronavirus-Krise: Eine politökonomische Betrachtung", *Perspektiven der Wirtschaftspolitik* 21, 200–207.

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# Refugee Education 4.0: The Potential and Pitfalls of EdTech for Refugee Education


## ABSTRACT

**The pandemic has led to a spike in implementing education technologies around the globe. Now the educational sector might finally catch up with technological advancements in other industries. Do new technologies in the area of learning have the potential to achieve a more equitable education distribution and include population groups with low access rates? Refugees are especially vulnerable with only 1 out of 4 refugee children enrolled in secondary education. Their educational paths are often disrupted and marked by a lack of systematic approaches. The potential of EdTech for refugee education is large but marked by several pitfalls. A low digital infrastructure as well as a lack of digital skills are challenges, in addition to the need for tailored educational offers and more sustainable approaches.**


While the methods of teaching have stagnated for several centuries, the pandemic has disrupted our understanding of education and led to a movement towards new ways of learning. Education has not changed much over time and there has barely been any transformation in the methods of teaching since the eighteenth century. This trend has recently been disrupted by the Covid-19 outbreak. Although the number of start-ups and companies engaged in developing innovative ways to educate has increased, the ratio of the global education market-to-market capitalization in education is 40:1 compared to 1:1 for the global market and 1:1 for most industries (Corbin Bridge 2019). This could mainly be due to the fact that the main sponsor of education is the government.

## WHAT IS EDUCATIONAL TECHNOLOGY?

Still, the pandemic has accelerated a slowly emerging trend in the educational sector and a shift toward new technologies and digitization. While traditionally, education was strongly connected with a place (as schools or universities), it is now seen as an activity. Additionally, there has been a shift from education being supply- and institution-centric to being demand- and student-centric. Knowledge is becoming more and more accessible, as people start to share it freely.[1] Investments in EdTech are spiking lately. In 2018, China invested 10.1 billion US$ in education technology, followed by the US (2.4 billion US$), India (2.3 billion US$), and Europe (0.8 billion US$) – see EdSurge (2021). The rest of the world invested 0.5 billion US$.

There are two forms of delivering new technologies to education, which are E-learning versus M-learning. E-learning refers to learning through electronic technology. It consists of the possibility of sharing and interacting with material via electronic platforms on the one hand, and to providing classes directly on the other hand through virtual rooms. It is important to study E-learning as it has changed the methodology behind teaching and learning. E-learning has several advantages and a large potential, such as its accessibility from anywhere at any time. But there are also challenges to E-learning. Instructors might lack the necessary digital teaching skills; traffic overload might arise and there might be a lack of the required IT infrastructure. It might also violate privacy regulations and expose students. Delivering education through new technologies can also occur through mobile devices with a wireless connection (often called M-learning). The difference between E-learning and M-learning is that M-learn-

[1] One example is the platform Github on which codes are shared freely and openly.

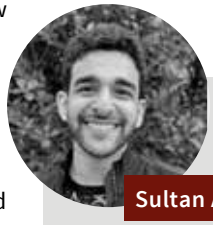


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Figure 1
**The Recent Shift in Education**

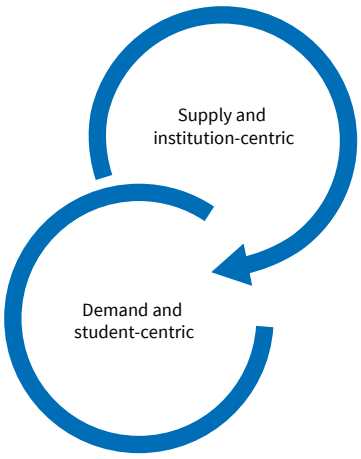


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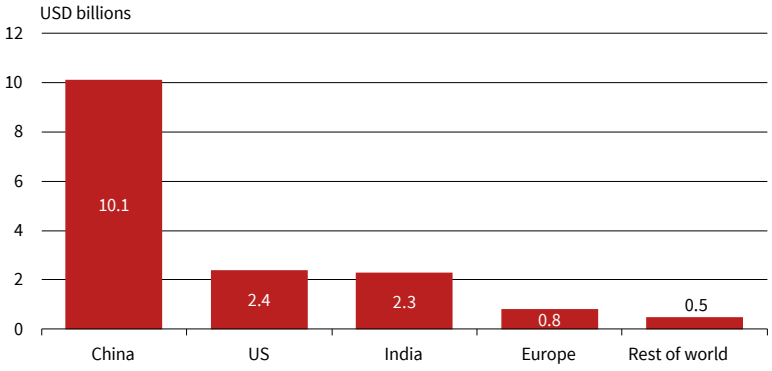
Figure 2
**Investments in EdTech Globally**



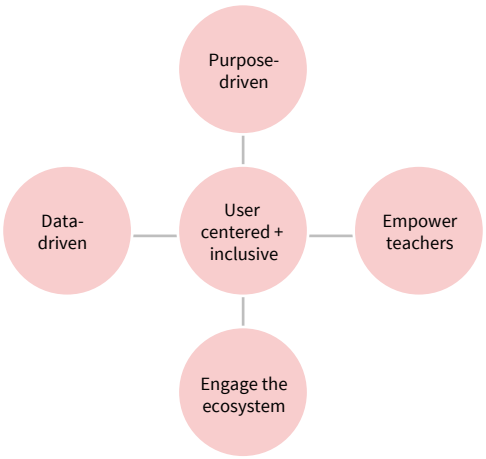

Source: EdSurge (2021). © ifo Institute

ing does not require any Internet connection nor computers.

Education technology should follow five principles. The World Bank defines Education Technology, or EdTech, as the usage of a variety of technological mechanisms, such as hardware, software, digital content, data and information systems, to support teaching and learning.[2] The potential of Educational Technology is immense and can contribute to bringing education to everybody. The pandemic has shown that education is not a place but an activity, and that technology has the potential to figure out innovative ways of teaching and learning. When engaging in EdTech, it is recommended to follow the principles outlined in Figure 1. These are that technologies interacting with education should be inclusive and user-driven, in a sense that they reach everyone and not just certain privileged groups. These principles should also center on students and their needs. Additionally, one should have a clear purpose, facilitate teacher engagement with the students, include a variety of stakeholders and be data- as well as purpose-driven.

[2] For more information, see Hawkins et al. (2020).

Figure 3
**The Five Key Principles of EdTech**




Source: The World Bank. © ifo Institute

The entry points for EdTech are manifold and there are a variety of tools and products available. EdTech can increase access to education, create important skills such as literacy and numeracy as well as digital skills, enrich and innovate the ways of teaching through online learning tools, provide new tools of learning, increase the precision and speed of assessments, provide valuable data and create networks that support learning. More concretely speaking, tools such as digital toolkits, educational games, or "edutainment," change the way we think about learning. Online learning can create a community and network of learners. There are several entry points for education technology: gamification, AR and VR, robotics, Artificial Intelligence, eSports, professional development and online testing as well as online assessments. Another evolving topic are learning management systems (LMS). Another important resource is open educational resources (OERs). Digital storytelling is another tool that can lead to identity development processes. There are also several EdTech solutions targeting teachers instead of students. These interventions are directed at training under-trained teachers and creating networks between teachers or the application of MOOCs.[3] An important caveat of EdTech is training teachers in order to secure an effective application of the learning tools created through new technologies. This means that rolling out new technologies in education should go hand in hand with an appropriate level of teacher training, giving them time to adjust.

## INNOVATION IN THE SPACE OF LEARNING AND REFUGEE EDUCATION

Education is often disrupted for refugees and refugee children are more likely not to attend school. While 91 percent of children are enrolled in primary edu-

[3] MOOC = Massive Open Online Course, usually free online classes available to a great number of people.

cation globally, only 63 percent of refugee children are. This gap is even larger for enrollment rates in secondary education, with 84 percent of secondary-school-age children enrolled globally, compared to 24 percent of refugee children (UNHCR 2019). There are several challenges related to refugee education, such as the lack of educational resources, schools, teachers, and classrooms (UNESCO 2018). Using data from the 2015-2016 school year, around 4 million of the 7.4 million school-age refugees do not attend school, which is equivalent to at least 1.75 million refugee children not attending primary school and 1.95 million refugee adolescents not attending secondary school (UNHCR 2016).

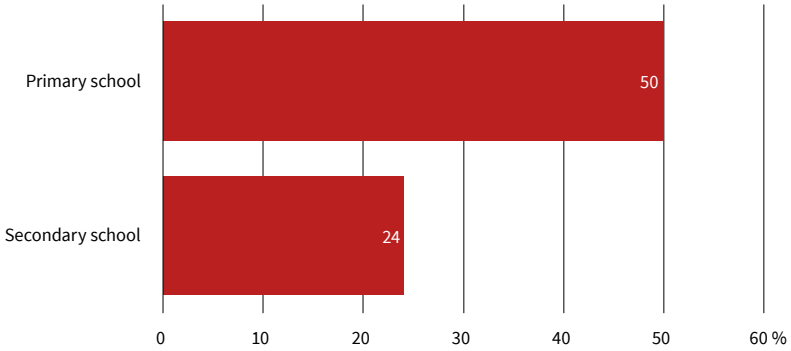
EdTech has a large potential for refugee education, but scientific evidence so far is limited. Technologies open new possibilities to bring education to displaced children independent of the availability of classrooms. Additionally, technologies can increase the social well-being of refugee children through digital games, for example, and they have the potential to support teachers engaged in refugee education. Still, there are important challenges when bringing EdTech to refugees. One is the cost of the underlying tools and the related sustainability (Ashlee et al. 2020). A recent rapid literature review found that there is limited evidence on refugee education and EdTech (Ashlee et al. 2020). There is a need for rigorous studies, impact evaluations as well as data on the perspectives and needs of refugees (Tauson and Stannard 2018). Most of the evidence so far is based on EdTech interventions for other vulnerable populations, or on qualitative research (Joynes and James 2018). In general, there are four broad fields of study within the area of EdTech and refugee education: continued access to education, modalities and pedagogies, supporting educators of refugee children as well as psycho-social support (see Figure 2).

The main limitation might be that refugees are less likely to have access to the Internet and digital tools. A recent report by UNHCR shows that refugee households are two-and-a-half times more likely to not have access to a phone, even though 93 percent of refugees live in areas that are covered by at least a 2G network (UNHCR 2016). In fact, according to the same report, 29 percent of refugee households have no mobile phone at all. The discrepancy between the lack of phone ownership among refugees while living in areas routinely serviced by network providers, highlights the potential that access to digital tools could provide refugees within the current infrastructure.

Offline solutions might solve the problem imposed by a limited access to infrastructure. First and foremost, access to mobile phones and other electronic devices is highly variable, and this difference in ownership and in the prevalent type of technology used requires EdTech to be incredibly adaptable, versatile, and compatible with as many media as possible (UNHCR 2016). Possible solutions must include off-line media resources as well, whether it is to target groups with no Internet access (using memory sticks and CDs to distribute programs, cellular networks, text message programs, etc.), and should be easy to access remotely and with minimal restrictions.

Figure 4

**Refugee Enrollment Rates in Primary and Secondary Education**

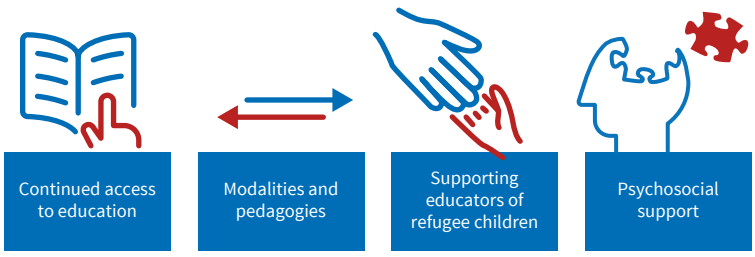



Source: UNHCR (2016). © ifo Institute

Overall, the potential for new technologies to promote social skills is large. Through technologies, it might be possible for refugees to connect and feel part of a community and a learning network (Ashlee et al. 2020). Some of the current technologies encourage social skills such as teamwork, planning and showing initiative. Online learning technologies also provide a way to engage in creative processes and deal with trauma (Lahal 2014). Several qualitative and quantitative evaluations have found that digital tools have positive effects on social skills. For example, Comings (2018) investigates the effects of literacy-teaching mobile games on the psychosocial outcomes of Syrian refugee children in camps, and finds that children who played these literacy games for around 30 hours over the period of the study experienced substantial improvement in their emotional symptoms, hyperactivity and inattention, prosocial behavior, conduct problems, as well as peer relationship problems. On the other hand, kids in the same camps who were not exposed to these mobile learning games experienced a deterioration in their psycho-social well-being. Social skills, on the other hand, can then lead to better labor market outcomes in the long-run (Aghion et al. 2019).

Figure 5

**Four Subthemes of the Literature on EdTech and Refugee Education**

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Technological tools, such as educational games, can serve as psycho-social support systems. Online educational games can provide not only skills, but also psycho-social support for those in crisis and traumatizing circumstances (UNESCO 2018). Research conducted by Stubbé (2018) underscores the power of mobile educational tools in increasing the self-esteem and self-efficacy of the engaged children and finds a positive relationship between playing a mathematics mobile game and an increase in self-esteem. This result is important in the realm of education, as Stubbé (2018) also finds that children who had higher self-esteem levels before the start of the study saw larger gains in their mathematical skills from playing the game. Furthermore, a report by UNESCO found that interactive EdTech tools might even increase refugee children's motivation to study as they engage with more interactive tools (Ashlee et al. 2020).

There are several challenges and limitations with respect to the potential of EdTech for refugee education. Technological solutions might not solve some of the quality concerns in refugee education. One question, for example, involves securing continuity in the learning curriculum and in securing a curriculum that is relevant for the local context. Consequently, it is crucial to involve local communities early on to contextualize the specific EdTech solution. Ashlee et al. (2020) has also pointed out that there are gender barriers in accessing technologies, as well as challenges imposed by community perceptions of technology.

Additionally, the lack of high-quality teachers may continue to be a hindrance for using innovative tools. Several papers have stressed the importance of involving teachers in EdTech and have highlighted the fact that technological tools alone are not sufficient. Additional challenges can arise through established beliefs regarding how learning and teaching should look (e.g., learner-centered versus teacher-centered approaches). In general, most of the literature agrees on the fact that technologies can never fully replace face-to-face interactions. Utilizing traditional teaching and learning methods as well as incorporating pedagogical principles is crucial when designing EdTech solutions (Tauson and Stannard 2018). Providing hardware is not enough to improve learning outcomes and there is no "one-fits-all" solution. It has been found that EdTech solutions that are not paired with access to a teacher or other knowledgeable mentors end up doing more harm than good, since learners end up feeling overwhelmed and lost when not provided with support (Drolia et al. 2020). This is especially relevant in terms of refugees, since they often already experience a lack of social support network, which is characterized by the loss of home ties and family members.

Furthermore, EdTech must be designed to be a real network, and not just separate nodes. Drolia et al. (2020) sketch out the main pillars of educational integration, which according to them, are composed of learning, social and emotional needs. They believe that EdTech should encompass all three of these needs, by providing freely accessible programs that teach learners in a step-by-step manner and help them develop cognitive skills, in addition to the possibility of creating social interactions. Here is where many EdTech solutions fail, as they often do not account for differences in the learning level of children or previous knowledge contexts (based on age, for example, instead of knowledge), which negatively affects learning. In addition to failing to provide material for different levels, most EdTech tools often assume that their users possess some level of digital literacy, which might not be the case for refugee children. Another important aspect of education is integration, and when not properly planned for, EdTech might increase marginalization, loneliness, and difficulty communicating and learning the social norms of the host country, since they rarely provide opportunities for cross-community dialogue (Drolia et al 2020). Therefore, EdTech solutions are often best when enhanced with opportunities for socialization between learners, teachers and even locals.

## LEARNING FROM EDTECH BEST PRACTICE FOR APPLICAION TO REFUGEE EDUCATION

The application of EdTech to refugee education could draw from best practices in the field. Programs around the world have shown ways in which innovative solutions to remote education can bridge gaps and barriers, as well as providing deeper social integration and interaction between users. Two of such best practices are the EVOKE program and the EDUCLAN program. The common factor between EVOKE and EDUCLAN is that they both strive to utilize virtual solutions that bridge private and public institutions, draw from open sources, and complement real-life circumstances.

The EVOKE program is a multi-player online educational experience that bridges aspects of game mechanics and social networks with storytelling. It is primarily centered around online collaboration to engage learners with networks of innovators, entrepreneurs and other creatives in solving problems. The program fosters skills that are meant to empower learners to create change and development in their own local communities.[4] EVOKE differs from most other programs in the sense that it creates a network among users. It creates a virtual reality in which collaboration, communication and critical thought are key. This platform has proven exceedingly popular, and its over 20,000 participants recorded an increase in both levels of future ambitions and access to social

[4] See https://www.worldbank.org/en/topic/edutech/brief/evoke-an-online-alternate-reality-game-supporting-social-innovation-among-young-people-around-the-world.

networks, both exceedingly important to the success of disadvantaged groups in terms of entrepreneurship and innovation (Hawkins et al. 2020).

EDUCLAN is another program that transforms real-life problems and situations into learning experiences—for younger children learning English. This was specifically relevant towards the start of the Covid-19 pandemic and provided learning opportunities to over 25 million users, while incorporating themes of personal hygiene and solutions for lockdown-compliant physical activity and education for children.

The literature on EdTech in the field of refugee education is scarce but one can learn from evidence presented in related fields. When looking at education in general several studies have been conducted that analyze the effect of new technologies on several outcomes. One can draw from studies analyzing the impact of EdTech on children, higher education and adult learning.

EdTech for educating children can be successful but there are several pitfalls that need to be addressed. Tunmibi et al. (2015) find positive results of the application of e-learning on a variety of student and teacher outcomes in primary and secondary school in Africa, using a sample of 40 students. This study shows that e-learning leads to an increase in the accountability of teaching and achievements, as well as efficiency in learning. Most students agreed that it helped them to increase their communication skills, critical thinking as well as engagement in learning. Lynch et al. (2021) suggest that EdTech tools can enable learners with disabilities, whether they be mental or physical. They compile research spanning different regions of the world and different disabilities, and overall find that EdTech increases the overall learning opportunities as well as the independence of children with disabilities, and can help these learners catch up if they previously had to drop-out due to a lack of support through more conventional teaching environments. Abbey et al. (2019) study how EdTech can be used to improve teaching for children in rural and remote areas and close the education gap between those areas and the cities. Using China as the focus, they demonstrate that the child users of EdTech often exhibit positive feedback. However, this study highlights uneven student participation and poor teacher training as factors that could further exacerbate the education gap between students in the same learning environments.

Several papers have studied how using e-learning tools has impacted student performance in higher education. Shah and Barkas (2018), for example, analyze the impact of Blackboard (Bb) on the attendance rate as well as "engagement"[5] of students in engineering courses. Bb is a VLE technology, which falls under the category of Internet-based learning management systems. VLEs differ from other forms of Internet-based learning systems because they are available 24 hours a day. Students can improve the time spent on a task, the quality of effort as well as student involvement. Shah and Barkas (2018) study the effect of the number of Bb clicks for one course model of Level 4 and Level 6 undergraduate engineering students, and show that student engagement via Bb hit rates significantly correlates with class attendance, engagement and performance. Alkhalaf et al. (2012) find a positive impact of e-learning on student learning in the case of university students in Saudi Arabia. Vate-U-Lan (2020) provides evidence of a positive correlation between e-learning on social network sites and life satisfaction. Bere et al. (2020) show that e-learning using LMS[6] is more effective than traditional instructional methods when looking at teaching and learning performance. In Egypt, the introduction of an open-source Moodle[7] e-learning platform has increased the motivation of undergraduate students (El-Seoud et al. 2014).

E-learning can also impact adult learning and behavior. Navimipour and Batool (2015) show that e-learning considerably affects employee satisfaction. Gaggioli et al. (2015) find that online tools provide a space for decentralizing workflows and allow users the opportunity to interact and collaborate easily with their colleagues, all of which are factors positively related to creativity and flow. Chunngam et al. (2014) find that EdTech can help to form groups and connect people with similar interests, which positively influences each group's participation and knowledge building. Tseng and Kuo (2014) study the way that virtual tools can complement more conventional forms of learning, by connecting teachers and their materials to each other.

The Covid-19 pandemic has provided an opportunity to study how virtual learning and social interactions are affected by multiple factors. Park and Kim (2020) find that having interactive tools improved adult satisfaction and social presence in the virtual sphere, which led to better results. The ease of using of these online tools has been imperative to their success, with Zheng et al. (2013) finding that users are more likely to positively contribute if they find the tools to be easy and intuitive to use. Felnhofer (2014) argues that a gender gap still exists in the benefits that EdTech learning opportunities and meetings provide, with women reportedly feeling less engaged and socially present in these virtual spaces. On the whole, most participants benefited from the flexibility that online learning and working offers in terms of creative flows, but still found themselves craving face-to-face encounters, even among those who chose to work remotely before the pandemic (Daniel 2017).

[5] See a detailed overview of the definition of "engagement" in Shah and Barkas (2018).

[6] LMS (Learning Management System) is a software application used to manage e-learning and development programs.

[7] Moodle is an open source learning platform that allows users to create online courses, collaborative online spaces, and other e-learning experiences.

## CONCLUSION

The pandemic has led to a spike in educational technologies and refugees could benefit from this innovative push in the educational sector. Refugees are among the most vulnerable populations with respect to obtaining adequate education. Their educational pathways are often disrupted, and they face high access barriers and low teacher quality. Innovative technological tools could help improve their access to education and their general wellbeing. Past evidence has shown that the potential is great but that several pitfalls persist. Tools depend on the presence of digital literacy, an adequate infrastructure, sustainable and targeted solutions to the specific needs of learners, as well as social norms. When developing and employing these solutions, tools need to be aligned with the specific learning profile of learners to ensure sustainable solutions. Governments should support systematic pilot studies that further explore the potential of EdTech for refugee education. When used properly, EdTech could revolutionize the way we learn and contribute to a more equitable education system.

## REFERENCES


Abbey, C., Y. Ma, G. Li, et al. (2019), "EdTech for Equity in China: Can Technology Improve Teaching for Millions of Rural Students?", *REAP Working Paper,* https://fsi-live.s3.us-west-1.amazonaws.com/s3fs-public/edtech_for_equity_landscape_working_paper_oct2019_0.pdf.

Aghion, P., et al. (2019), "The Innovation Premium to Soft Skills in Low-skilled Occupations", *Banque de France Working Paper* 739.

Alkhalaf, S., S. Drew and T. Alhussain (2012), "Assessing the Impact of E-Learning Systems on Learners: A Survey Study in the KSA", *Procedia-Social and Behavioral Sciences* 47, 98–104.

Ashlee, A. G. Clericetti and J. Mitchell (2020), *Refugee Education: A Rapid Evidence Review*, https://docs.edtechhub.org/lib/UUNEJ7FS/download/NBG9MLUZ/Refugee percent20Education_A percent20Rapid percent20Evidence percent20Review_FINAL.pdf.

Bere, A., H. Deng and R. Tay (2018), "Investigating the Impact of eLearning Using LMS on the Performance of Teaching and Learning in Higher Education", *2018 IEEE Conference on e-Learning, e-Management and e-Services (IC3e)*, 6–10.

Chunngam, B., S. Chanchalor and E. Murphy (2014), "Membership, Participation and Knowledge Building in Virtual Communities for Informal Learning", *British Journal of Educational Technology* 45, 863–879.

Comings, J. (2018), *Assessing the Impact of Literacy Learning Games for Syrian Refugee Children: An Executive Overview of Antura and the Letters and Feed the Monster Impact Evaluations*, World Vision and Foundation for Information Technology Education and Development, Washington DC.

Corbin Bridge (2019), *EdTech Industry: Mergers, Acquisitions & Venture Trends & Investments,* https://investmentbank.com/edtech-industry/.

Daniel, E., M. Di Domenico and D. Nunan (2018), "Virtual Mobility and the Lonely Cloud: Theorizing the Mobility-isolation Paradox for Self-employed Knowledge-workers in the Online Home-based Business Context", *Journal of Management Studies* 55, 174–203.

Drolia M, E. Sifaki, S. Papadakis and M. Kalogiannakis (2020), "An Overview of Mobile Learning for Refugee Students: Juxtaposing Refugee Needs with Mobile Applications' Characteristics", *Challenges* 11(2), 31, https://doi.org/10.3390/challe11020031.

EdSurge (2021), *Edtech Investment around the World in 2020*, https://www.edsurge.com/news/2021-03-11-edtech-investment-around-the-world-in-2020-infographic.

El-Seoud, S., et al. (2014), "The impact of E-Learning on Egyptian Higher Education and Its Effect on Learner's Motivation: A Case Study", *Computer Science and Information Technology* 2, 179–187.

Felnhofer, A., J. X. Kafka, H. Hlavacs, L. Beutl, I. Kryspin-Exner and O. D. Kothgassner (2018), "Meeting Others Virtually in a Day-to-Day Setting: Investigating Social Avoidance and Prosocial Behavior towards Avatars and Agents", *Computers in Human Behavior* 80, 399–406.

Gaggioli, A., E. Mazzoni, L. Milani and G. Riva (2015), "The Creative Link: Investigating the Relationship between Social Network Indices, Creative Performance and Flow in Blended Teams", *Computers in Human Behavior* 42, 157–166.

Hasan, N. and Y. Bao (2020), "Impact of "E-Learning Crack-Up" Perception on Psychological Distress among College Students during COVID-19 Pandemic: A Mediating Role of "Fear of Academic Year Loss"", *Children and Youth Services Review* 118, 105355.

Hawkins, R. J., M. Trucano, J. C. Cobo Romani, A. Twinomugisha and I. A. Sanchez Ciarrusta (2020), *Reimagining Human Connections: Technology and Innovation in Education at the World Bank,* http://documents.worldbank.org/curated/en/829491606860379513/Reimagining-Human-Connections-Technology-and-Innovation-in-Education-at-the-World-Bank.

Joynes, D. and Z. James (2018), *An Overview of ICT for Education of Refugees and IDPs*, K4D Helpdesk Report, 20 November, https://resourcecentre.savethechildren.net/node/15649/pdf/505_icts_for_education_of_refugees_and_idps.pdf.

Lahal, J. (2014), *The Ideas Box: Connecting and Empowering Communities in the Asia-Pacific Region,* Paper Presented at IFLA WLIC 2014 – Lyon – Libraries, Citizens, Societies: Confluence for Knowledge, http://library.ifla.org/984/1/190-lachal-en.pdf.

Lynch, P., N. Singal and G. Francis (2021), "EdTech for Learners with Disabilities in Primary School Settings in LMICs: A Systematic Literature Review", *EdTech Hub Working Paper* https://doi.org/10.5281/zenodo.4348995.

Navimipour, N. J. and B. Zareie (2015), "A Model for Assessing the Impact of E-Learning Systems on Employees' Satisfaction", *Computers in Human Behavior* 53, 475–485.

Park, C. and D. G. Kim (2020), "Exploring the Roles of Social Presence and Gender Difference in Online Learning", *Decision Sciences Journal of Innovative Education* 18, 291–312.

Pirak, S. (2021), *EdTech Investing: The Time Is Now,* https://www.linkedin.com/pulse/edtech-investing-time-now-saar-pikar/.

Shah, R. K. and L. A. Barkas (2018), "Analysing the Impact of E-Learning Technology on Students' Engagement, Attendance and Performance", *Research in Learning Technology* 26, 2070.

Soni, V. D. (2020), *Global Impact of E-learning during COVID 19,* https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3630073.

Stubbé, H. (2018), *Designing Learning Opportunities for the Hardest to Reach: Game-based Mathematics Learning for Out-of-school Children in Sudan,* https://repository.tno.nl/islandora/object/uuid percent3A406f5f5a-d859-4c22-9852-8fb55507d4b9.

Tauson, M. and L. Stannard (2018), *EdTech for Learning in Emergencies and Displaced Settings: A Rigorous Review and Narrative Synthesis*, Save the Children UK, https://resourcecentre.savethechildren.net/node/13238/pdf/edtech-learning.pdf.

Tseng, F. C. and F. Y. Kuo (2014), "A Study of Social Participation and Knowledge Sharing in the Teachers' Online Professional Community of Practice", *Computers & Education* 72, 37–47.

Tunmibi, S., et al. (2015), "Impact of E-Learning and Digitalization in Primary and Secondary Schools", *Journal of Education and Practice* 6, 53–58.

UNESCO (2018), *A Lifeline to Learning? Leveraging Technology to Support Education for Refugees,* https://en.unesco.org/icted/content/lifeline-learning-leveraging-technology-support-education-refugees.

UNHCR (2106), *Missing Out: Refugee Education in Crisis,* https://www.unhcr.org/missing-out-state-of-education-for-the-worlds-refugees.html.

UNHCR (2019), *Stepping Up: Refugee Education in Crisis*, https://www.unhcr.org/steppingup/wp-content/uploads/sites/76/2019/09/Education-Report-2019-Final-web-9.pdf.

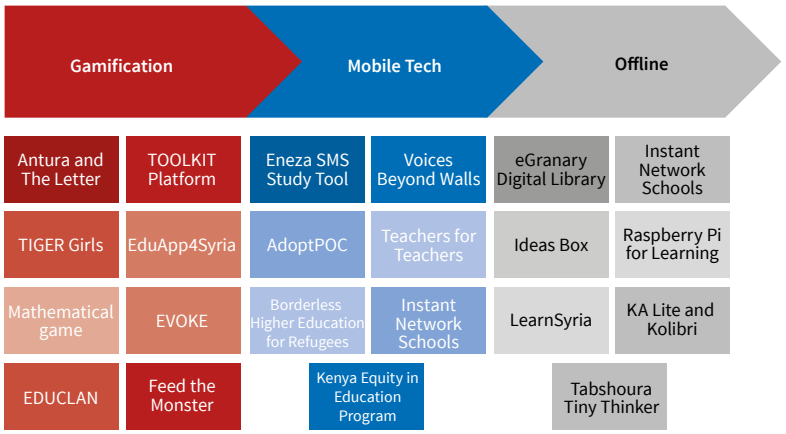
Vate-U-Lan, P. (2020), "Psychological Impact of E-Learning on Social Network Sites: Online Students' Attitudes and Their Satisfaction with Life", *Journal of Computing in Higher Education* 32, 27–40.

Zheng, Y., K. Zhao and A. Stylianou (2013), "The Impacts of Information Quality and System Quality on Users' Continuance Intention in Information-Exchange Virtual Communities: An Empirical Investigation", *Decision Support Systems* 56, 513–524.

## APPENDIX: EXAMPLE PROJECTS AND TOOLS

Figure A1

**Three Subcategories of EdTech Projects**




Source: Authors' compilation.

*Clara Albrecht*, *Victoria Endl-Geyer* and *Tanja Stitteneder**

# Covid-19: Reinforcing Gender Gaps?


## ABSTRACT

**The pandemic has had a major impact on our society and reinforces gender gaps in many areas. Looking at unemployment figures, these have been affected, but not always to the high degree one would have expected. One reason for this may have been appropriate policy measures in some countries, especially within the EU. However, women tend to work in sectors that are badly hit by the crisis, putting them at risk of job and income losses. While gender differences are rarely clearly visible in general, they become more apparent among parents. A holistic view, however, shows that the total workload of paid and unpaid work has increased significantly more for women than for men across countries. This is reflected in the fact that women are increasingly taking on care and housework tasks, making greater use of remote work options and shifting their paid working hours into the evening. The extent to which working from home and changes in availability influence career opportunities still needs to be clarified. However, other consequences can already be observed, such as higher susceptibility to psychological problems among women. Also, preliminary data show that women face more prolonged health consequences, due to missed checkups for example, and are more likely to be victims of domestic violence during a lockdown.**


The outbreak of Covid-19 brought significant changes not only to the economy, but also to social life and families. Restrictions imposed by governments were a significant disruption to everyday life. These were imposed to curb social contact and to prevent or slow the further spread of the disease. There is no doubt that this was an important step in reducing the infection and mortality rates associated with Covid-19. However, curfews and lockdowns during the Covid-19 pandemic may have imposed unintended social, health, and economic costs that did not always affect women and men equally.

In the following, we explore how the crisis has hit women particularly hard. The first section presents data on the economic impact on men and women around the globe. In addition, the pandemic-induced changes in the distribution of unpaid work and the role of remote work from a gender perspective are examined. The final section addresses the impact on mental and physical health, and domestic violence.

* ifo Institute. The authors thank Jessica Wiest for her very valuable contribution to this article.

## ECONOMIC IMPACT

The coronavirus crisis has affected the lives of many people in unprecedented ways. Apart from health-related consequences (see section below), the pandemic has also changed if and the way we work. In addition, it put an enormous strain on many people's livelihood, as hours worked decrease and the risk of job loss and care time increase.

### Hours Worked

Figure 1 shows the change in working time between the second quarter of 2019 and the second quarter of 2020. Overall, people in Europe worked fewer hours, with the impact varying by gender and country. In many countries (15 of 26), women increased their working hours in their main job slightly in the second quarter of 2020 compared with the previous year. This could indicate that some professions (such as nurses) were needed even more during the crisis. Women's working hours decreased in 9 countries (Bulgaria, Cyprus, Hungary, Italy, Luxembourg, the Netherlands, Poland, Romania, and Slovakia) and remained the same in two (Greece and Sweden). On the other hand, men's working hours decreased in most countries, except Cyprus, Denmark, France, Lithuania, and Spain. However, it should be noted that all shown changes in working time are fairly small and it cannot be observed how many hours people actually worked from home. Furthermore, it is likely that women spent more overall time working to accommodate both their job as well as increased household and childcare responsibilities (UN Women 2021).

In addition, ILOSTAT (2021) reports the percentage of hours lost to the Covid-19 crisis compared to the fourth quarter of 2019. The data confirm that the impact in the US (9.2 percent) and Canada (9.3 percent) was greater than the 8.3 percent loss in the EU and the world (8.8 percent).

### Sectoral Employment

Alon et al. (2020) state that previous crises have affected men more than women. One reason for this is the different sectoral composition of men's and women's employment. According to Coskun and Dalgic (2020), men tend to work in more volatile and procyclical sectors (e.g., transportation, construction,

manufacturing), while women are more likely to work in more stable and countercyclical sectors (e.g., health care, education, and government).

The current crisis is expected to affect women more than men for two reasons (Alon et al. 2020 and 2021): first, the pandemic has a huge impact on sectors where many women work and which were largely spared in previous downturns, such as education. Other women-dominated sectors, like tourism or hospitality, require social contact, which was not or only with limitations possible, especially during lockdowns where most of such businesses were shut down entirely. Second, the social distancing measures led to the closure of schools and childcare facilities. Both are activities that women typically engage more in than men, even in normal times (UN Women 2021).

In general, women are overrepresented in many service sectors. The sectoral employment of women as a percentage of total women's employment accounts for 54 percent in accommodation and food services, 42.1 percent in wholesale and retail trade (compared to 38.7 percent of total workers), and 61 percent in other services, which include, for example, arts and entertainment, and domestic work (households as employers) (ILO 2020). Moreover, there are significant regional differences in female employment. For example, women dominate employment in accommodation and food services in Eastern Europe, while they are overrepresented in other services in Southern Europe.

Some of these women-dominated sectors were particularly hard hit during the pandemic, resulting in a high or medium-high risk of income or job losses for workers. Figure 2 shows female employment in high or medium-high risk sectors as a percentage of total women's employment. Globally, nearly 50 percent of employed women are in sectors where the risk of income or job loss due to the pandemic is medium-high to high (ILO 2020).

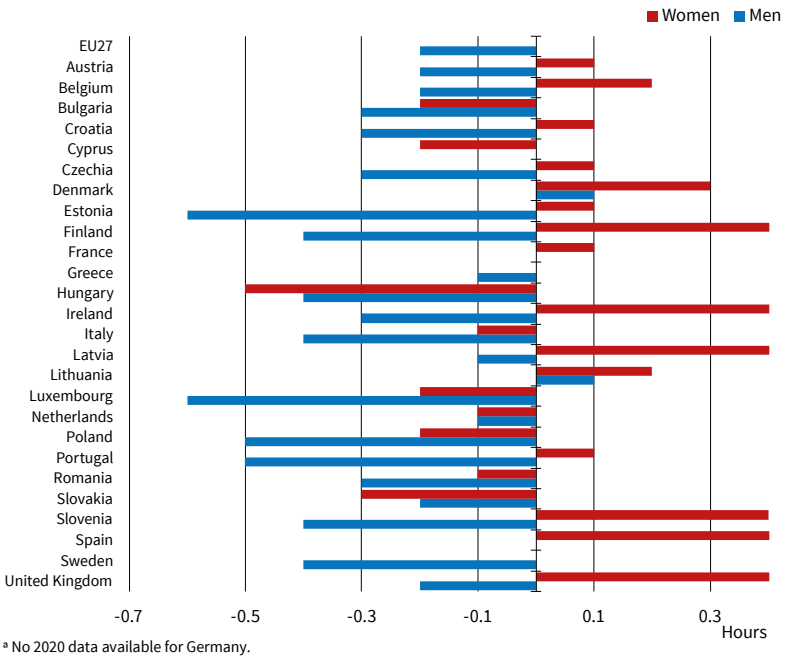
## Unemployment

Overall, the pandemic has also led to higher unemployment among women and men. According to UN Women and ILOSTAT data from 55 high- and middle-income countries, 29.4 million women aged 25 or older lost their employment between the fourth quarter of 2019 and the second quarter of 2020 (compared to 29.2 million men) (ILO 2021a). Since fewer women than men were employed to begin with, the proportionate loss is higher for women, resulting in 1.7 times as many women as men outside the labor force in these 55 countries at the end of the second quarter of 2020. Alon et al. (2020) found that two months after the start of the pandemic, the decline in employment among women without children was mild, but the employment decline among women with children was more than 5 percentage points, compared with men

Figure 1

**Change in Hours Worked between Q2 2019 and Q2 2020[a]**

Average Weekly Hours Worked in Main Job




[a] No 2020 data available for Germany.
Source: Eurostat (2021).

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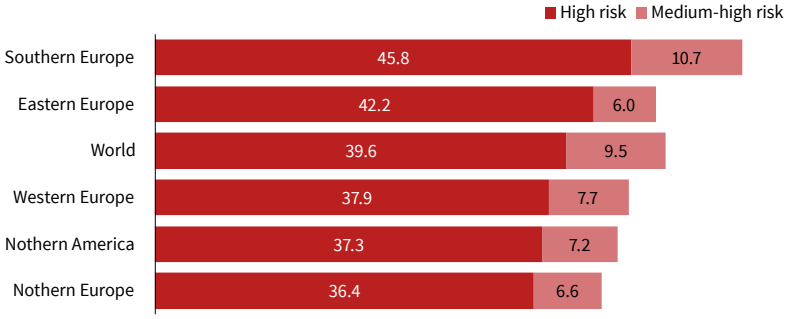
with children. Figure 3a shows that unemployment increased for both genders during the pandemic in the EU27 and the US. However, the impact varied across countries. Not only the increase but also the gender gap was much more significant in the US, while both were limited in the EU.

Figure 3b shows that the US had the strongest change in women's unemployment, peaking at 16 percent around early 2020. Although women's unemployment recovered over the course of the year, it remains at a higher level than before the crisis. In general, the female unemployment rate in the European countries increased later and more weakly than in the US. This might be an indication for the strong employee protection and well-placed policies in Europe (Alon et al. 2021). In comparison with the other countries presented, it remained relatively low and stable in Germany and the Netherlands.

Figure 2

**Share of Women Working in High Risk and Medium-High Risk Sectors[a]**

Sectoral Women's Employment/Total Women's Employment




[a] Hard-hit sectors are accommodation and food services; wholesale and retail trade; real estate, business and administrative activities; manufacturing. Medium-high risk sector is other services.
Source: ILO (2020).

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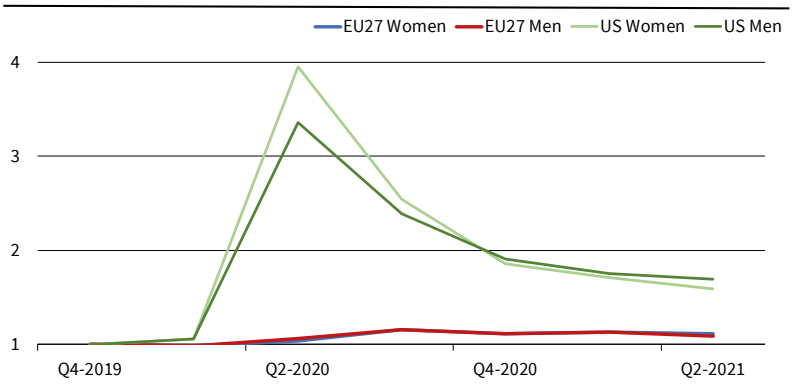
Figure 3a

**Unemployement in the EU27 and the US**

% of Labour Force; Baseline = Q4 2019

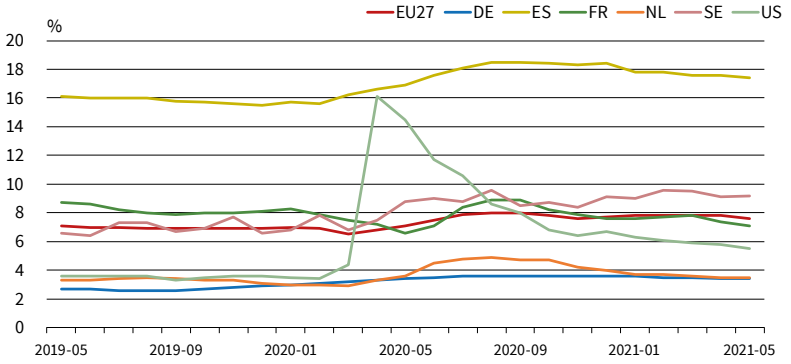



Source: OECD (2021). © ifo Institute

Figure 3b

**Unemployment Rate of Women**

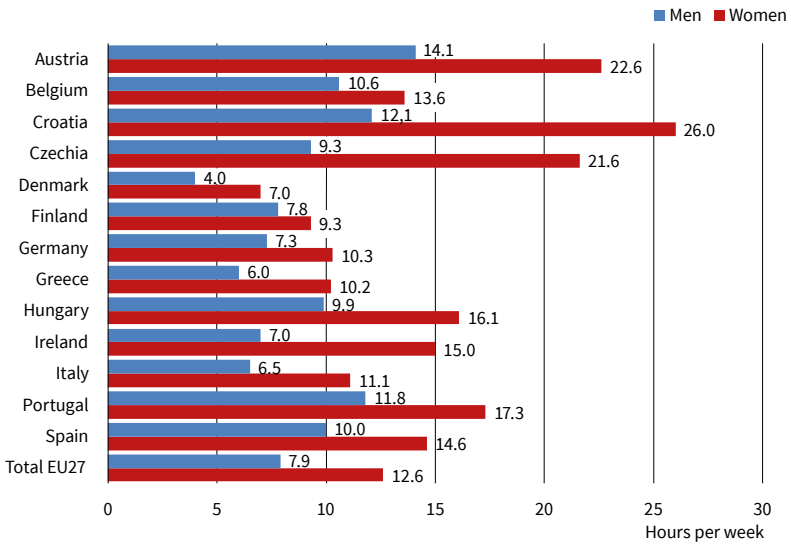
% of Population in Labor Force




Source: Eurostat (2021). © ifo Institute

Figure 4

**Caring for Children and/or Educating Children/Grandchildren in June/July 2020**




Source: Eurofound (2020). © ifo Institute

## Gendered Division of Work within the Household

It is widely known and confirmed by data that in pre-Covid-19 times women on average had spent far more time on domestic and care work than men did. The gender divide is particularly pronounced among parents. Despite progresses in the direction of a more gender equal division of unpaid work, in almost half of EU countries mothers have reported spending almost twice as much time on childcare than fathers (Blasko et al. 2020).

Policy measures to contain the spread of the virus—such as school and childcare facility closures—were implemented by governments around the globe and some of them led to an immediate and unprecedented increase of the demand for care and household related tasks. Comparative data to quantify the magnitude of the effect is scarce so far, but urgently needed. A survey conducted in October 2020 in 16 countries commissioned by UN Women reveals that both women and men have increased the time they spend on childcare activities in comparison to pre-pandemic times. Before the outbreak of the virus men on average dedicated approximately 20 hours to unpaid childcare, while it was 26 hours for women. The pandemic led to an increase of 5.2 hours for women and 3.5 hours for men, resulting in a further increase of the gender childcare gap by 1.7 hours (UN Women 2021).

Eurofound also conducted an e-survey in order to quickly gather information on people's situation during the pandemic. In terms of time spent on childcare, the survey reveals that women on average and especially mothers, bear the highest burden. With 12.6 hours per week compared to 7.9 for men, women spent 37 percent more on childcare than men.[1] The variation across European countries is as follows: women in Denmark spent 7 hours per week on childcare, whereas in Austria women invested more than three times more. Also, gender gaps in childcare time show broad differences across countries: In Croatia, Czechia, and Ireland women invested more than twice as much time for childcare than men, in Finland the gender care gap was smallest with 16 percent or 1.5 hours difference per week. In no country did men spend as much time on childcare as women did (Figure 4) (Eurofound 2020).

Research on the topic, using representative survey data collected during the pandemic, also provides evidence for this finding. Adams-Prassl et al. (2020) show for the US, the UK, and Germany that women spent about one hour per day more on childcare and home schooling than men, even among those who could work from home. Hupkau and Petrongolo (2020) found for cohabiting couples with children below the age of 15 in the UK that due to the pandemic mothers increased their time spent on childcare by 9.5 hours per week, while fathers dedicated an extra of 6.9 weekly hours to the tasks, resulting in a widened gender care gap of 11.7 hours,

[1] All women and men over the age of 18 are included, meaning also those who did not engage in childcare tasks at all. Thus, weekly hours for mothers are at higher levels.

compared to 9.1 hours in pre-pandemic times. In summary, both mothers and fathers have increased their childcare hours during the pandemic, with the increase being more pronounced for mothers.

### Telecommuting and Its Implications for Work-life-Balance and Gender Equality

Telework was implemented by policymakers and employers as an effective means to contain the spread of the coronavirus whenever possible. Before the crisis, working from home accounted for a very small proportion of paid labor in the EU and has typically been practiced in a hybrid way, part-time and as a voluntary work arrangement by both workers and employers (ILO 2021b). In 2018, only 13 percent of women and 14 percent of men were working from home at least occasionally (Eurofound 2020). In contrast, the pandemic made teleworking a mandatory and full-time arrangement in most cases and will most probably be a far more prevalent phenomenon in the future than it used to be before the crisis.

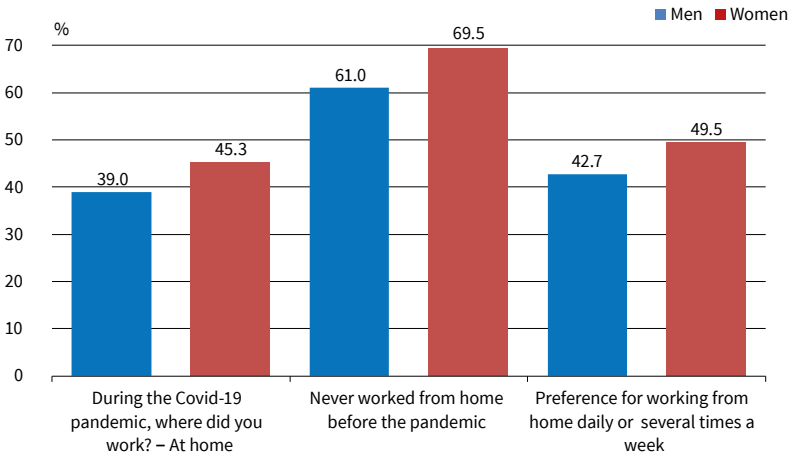
Recent e-survey data by Eurofound (2020) shows different patterns for women and men regarding home-based paid work. Men were more likely to have worked from home before the pandemic, whereas now more women than men actually do telework. Women also show a more pronounced preference for telecommuting than men for post-pandemic times (Figure 5).

Being able to do home-based paid work undoubtedly allowed many parents with childcare responsibilities to keep their jobs during lockdowns and the subsequent closure of schools and childcare institutions. The ability to telework and work flexibility in general are associated with narrowing the gender gap in the labor supply. At the same time, teleworking mothers were more likely to combine paid work with childcare, home schooling support, and household tasks. In the Netherlands, mothers with school-aged children between 6 and 14 spend 76.0 percent of their work hours simultaneously on childcare. The same is true for only 49.5 percent of fathers (Alon et al. 2021). Mothers in the UK are interrupted during 57 percent more of their hours spent on paid work than fathers. Before the pandemic no difference in the amount of interruption was observed (Andrew et al. 2020).

Unsurprisingly and supporting the findings above, mothers disproportionately report struggling with combining work and private life. The Eurofound e-survey (2020) found that 29 percent of mothers in the EU with children under 12 years find it "hard to concentrate on the job because of family," whereas the same is reported by only 11 percent of fathers. A German survey among the working population also has found that working mothers have constantly reported higher levels of perceived burden with regards to the family, work, and the general situation since the onset of the pandemic (Hövermann 2021).

Figure 5

**Remote Work Arrangements and Preferences by Gender in the EU27**




Source: Eurofound (2020). © ifo Institute

## EFFECTS ON WELLBEING

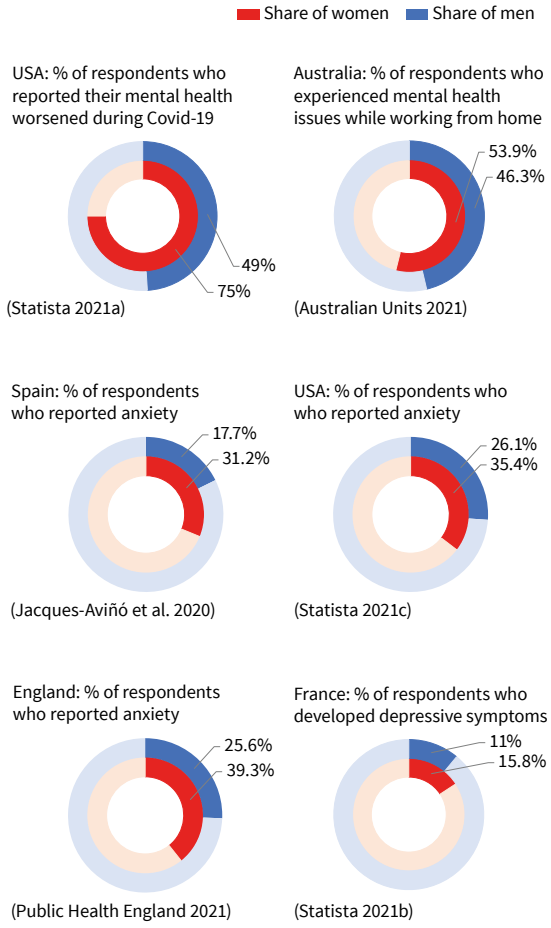
Preliminary evidence suggests that the pandemic and the associated lockdowns have led to higher rates of mental ill health, a reduced healthcare access, and an increase in incidents of intimate partner violence. The gender and health effects of the Covid-19 pandemic may be experienced quite differently by citizens across the world due to variations in national policies and the welfare systems. However, a comparison of countries shows a largely uniform picture: women are particularly affected.

### Gaps in Mental Health

The past has shown that recessions lead to increases in psychological disorders (Frasquilho et al. 2015). One reason is that unemployment increases during recessions and is strongly associated with mental health problems, such as anxiety, depression, and suicide (Cygan-Rehm et al. 2017). Financial insecurity and poverty is likely to disproportionately affect women, as they have lower incomes on average. These problems are also likely coming to the fore in the recession caused by Covid-19. However, during the pandemic, the lockdown has also proved particularly difficult for mental health due to extended isolation and lack of social contact (Gunnell et al. 2020). This is a challenge especially for citizens who already have a tendency toward mental illnesses and is also likely to be more pronounced for women, since (as described above) they seem to bear the greatest burden of caregiving work.

In the US, for example, 49 percent of men report that their mental health deteriorated during the pandemic, while 75 percent of women report the same problem. Depression and anxiety are among the most common mental health problems and are widespread across countries while being more prevalent among women (see a selective overview in Figure 6).

Figure 6
**Mental Health**




Source: Authors' compilation of different sources. © ifo Institute

## Gaps in Health Care

The pandemic has had an impact not only on the mental health of the population, but also on the—perhaps more obvious—physical health. Gender differences are also evident in this area. Decades of international research show that generally, women have longer life expectancies and lower mortality rates than men, and yet they have higher morbidity—or, put more simply, "women get sicker, men die faster" (Macintyre et al. 1996). Explanations for the "gender health paradox" are multiple but it is thought that biological, social, economic, and public policy play important—and interacting—roles. Differences in the immune systems of men and women, different responses to stress, and differences in mitochondrial fitness may contribute to the gender health paradox, but the biomedical evidence on this is controversial (Austand and Fischer 2016). Social explanations may be discrepancies in behavior between women and men. For example, men are less likely to use health services and more likely to present late with symptoms. This can contribute to men's higher mortality rates. Women, on the other hand, are more likely to have physical and mental health problems due to the dual burden of work and caregiving (van de Velde et al. 2013). Economic explanations focus on the fact that women are particularly affected by unfavorable socioeconomic factors such as higher poverty rates, lower education rates, and lower employment rates that is associated with higher rates of self-reported poor health (Bambra et al. 2021). As for public policy, women's health benefits more than men's, from government investments in childcare and active labor market programs.

Emerging data suggests that the gender health paradox also holds for the Covid-19 pandemic: women are more likely to be diagnosed with Covid-19 but the mortality rate is higher for men.[2] However, the Covid-19 pandemic and related government policies are also likely to have longer-term consequences for gender-based health inequities. With health services having to focus on pandemic response, access to health care for people with existing chronic conditions such as cancer or cardiovascular disease has also deteriorated significantly (Figueroa et al. 2021). Also, social distance regulations have resulted in people attending fewer medical appointments (Chiesa et al. 2021). Data on this phenomenon is still not available for many countries. However, existing data from countries with different social and health care systems, such as Germany and the US, can be compared to see if a consistent picture emerges. Germany has had mandatory health insurance since the World War II, whereas the US has only recently taken steps towards universal insurance coverage with the "Patient Protection and Affordable Care Act" in 2010, which has reduced the number of uninsured citizens. Currently, about 8 percent of the population in the US and 0.1 percent in Germany are uninsured,[3] while the annual health expenditure per capita in the US with approximately USD 11.500 is about double the the expenditure in Germany.[4] Figure 7 shows that in both countries, more women than men skipped preventive health services or checkups. In combination of existing evidence from before the pandemic, this indicates that the proportion among women increased significantly more than among men.[5] While for medication supply problems the data is mixed (in Germany, more men than women reported issues whereas it is the other way around in the US), the picture is consistent again

[2] The Sex, Gender and COVID-19 Project, https://globalhealth5050.org/the-sex-gender-and-covid-19-project/.
[3] United States Census Bureau, https://www.census.gov/content/dam/Census/library/publications/2020/demo/p60-271.pdf. ; Destatis, https://www.destatis.de/DE/Presse/Pressemitteilungen/2020/09/PD20_365_23.html.
[4] CMS, https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData/NationalHealthAccountsHistorical ; Destatis, https://www.destatis.de/DE/Themen/Gesellschaft-Umwelt/Gesundheit/Gesundheitsausgaben/_inhalt.html;jsessionid=DE4C6692FE97DF47601C-1676214D0A6E.live711#sprg235028..
[5] A 2019 survey shows that 9 percent of women and 13 percent of men in Germany generally do not attend screenings (Statista 2019). Even though both studies are representative surveys in Germany and therefore comparable, we caution against precisely quantifying the effect as there may have been differences in the way the studies have been conducted. Same holds for the US, where about 10 percent of women do not see a doctor regularly (KFF 2013 and 2017), compared with 22 percent of men (KFF 2013).

when looking at whether doctor appointments were not possible due to the pandemic situation. Again, more women than men report this problem in both countries. Having gone without or less health care during the pandemic could result in more citizens experiencing severe health problems after the pandemic has subsided as they present late with symptoms or skip preventive checks. This affects especially women, who are more likely than men to have not received medical care during the pandemic.

## Domestic Violence

It has generally been noted that violence increases in the context of pandemics. For example, Rose (2018) reported an erosion of social norms and an increase in violence in Bologna, Italy, in the context of plague and natural disasters. According to UNFPA (2020), pandemics often lead to the collapse of social infrastructures, reinforcing preexisting weaknesses and conflicts. Okur (2016) emphasized that victims of gender-based violence often do not receive adequate support in crisis situations due to the breakdown of laws, and sexual and gender-based violence increases. Current evidence suggests that the risk of family violence also increased substantially during the Covid-19 pandemic as a result of unintended consequences of interventions during the pandemic (Amaral et al. 2020).

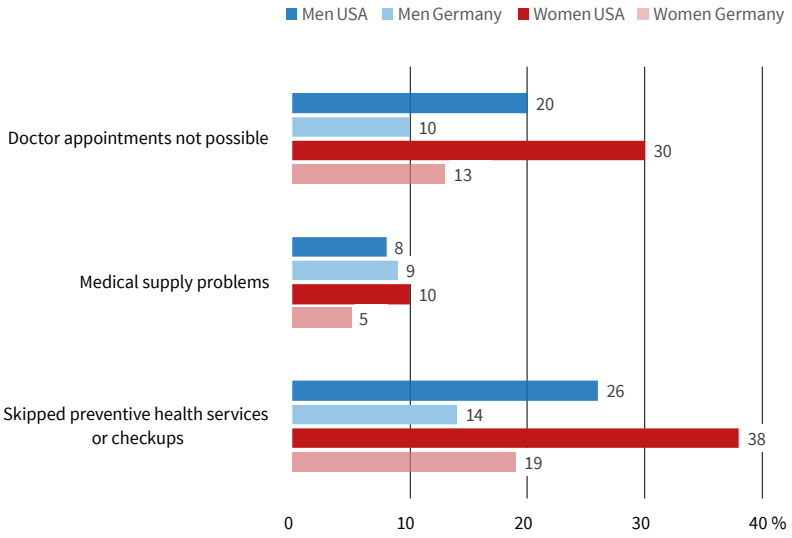
Family violence is understood to be violence that occurs between household members. This can either be perpetrated by partners or take the form of abuse or neglect of children (O'Donnell et al. 2020). Family violence is widespread worldwide and is one of the costliest forms of violence, affecting health, work performance, and increasing health care expenditures for victims (Chalfin 2015; Bindler and Ketel 2019). Women are particularly affected by intimate partner violence. According to WHO (2021), one in three women worldwide has been exposed to physical, emotional, or sexual violence by an intimate partner during her lifetime.

In the context of the Covid-19 pandemic, initial figures show that in the first months of the lockdown an increase in police emergency calls were received related to domestic violence (e.g., McCrary and Sanga 2021; Ivandic et al. 2020). Also, non-police helplines report significant increases in family violence related calls across countries (see Figure 8 for a selected overview).

There are two literature strains that can serve explanations for the described relationship. First, according to the so-called exposure theory, victims—mostly women—spend more time with violent partners, who are usually male, and the risk of abuse thus increases (Dugan et al. 2003). However, formal support that addresses domestic violence can be either overburdened or unavailable. For example, police, hospitals, or other drop-in centers are not always able to adequately serve victims of domestic violence during a pandemic. This limits options for victims seeking help (Amaral et al. 2020). In addition, victims of domestic violence have fewer opportunities to seek informal support from friends or family due to their isolation. This also increases the risk of abuse (O'Donnell et al. 2020). Second, the deterioration of economic conditions, such as unemployment and loss of income, can have an impact on violence between partners. For example, Anderberg et al. (2016) show in their study that in the UK a relative deterioration in women's labor market conditions increases family violence. This effect can be explained by women's increasing financial dependence on their partners, which can make it more difficult to end a violent relationship. Harknett et al. (2016), using a sample of mothers from the US, also found that economic dependence—as measured by unemployment—increases vulnerability to violent partner behavior. Therefore, it is crucial to facilitate the processes through which victims of domestic violence can seek help and en-

Figure 7

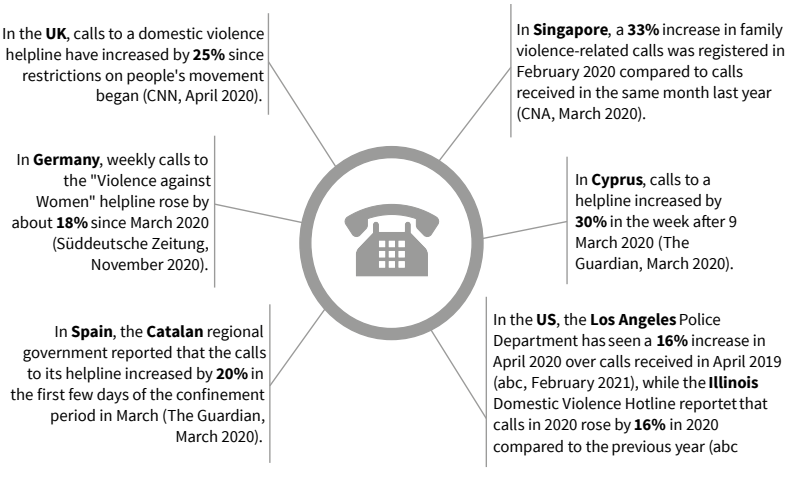
**Long-term Health Consequences of the Pandemic**




Source: Covid-19 Snapshot Monitoring; KFF Women's Health Survey. © ifo Institute

Figure 8

**Domestic Violence Helpline Calls**




Source: Authors' compilation of different sources. © ifo Institute

sure access to social services that keep the income of households of vulnerable families constant during a pandemic.

## CONCLUSION

So far and confirmed by emerging data, the coronavirus crisis has disproportionately affected women, and particularly mothers in many dimensions of their lives. Unlike previous crises, the Covid-19 pandemic impacted female dominated economic sectors more than male dominated ones: most healthcare workers are women, putting them at the forefront of fighting the pandemic and at higher risk of contagion. Women also dominate the service sector, which was strongly affected by lockdown measures, leading to disproportionate job losses for women. As women have engaged more in childcare activities than men prior to the crisis, school and childcare facility closures have further increased their time spent on unpaid work relative to men. Working from home regulations contributed to combining paid and unpaid work simultaneously, but came with the cost of higher levels of stress and increased the mental load for women, leading to more mental health related problems for women than for men. Furthermore, spending more time at home is associated with an increase in domestic violence, which again predominantly affects women.

As a consequence, a gender-sensitive approach is needed when determining appropriate policy measures to fight the pandemic and to mitigate negative effects for women, as unintended consequences pose a threat to gender equality.

## REFERENCES


abc (2021), *Calls to LA County Domestic Violence Hotline Saw Significant Increase in 2020*, 25 February, https://abc7.com/la-county-domestic-violence-statistics-hotline-calls-increase-los-angeles/10367465/.

abc Chicago (2021), *Domestic Violence Help Calls Surge during COVID-19 Pandemic*, 2 March, https://abc7chicago.com/domestic-violence-covid-statistics-2020-coronavirus/10381318/.

Adams-Prassl, A., T. Boneva, M. Golin and C. Rauh (2020), "Inequality in the Impact of the Coronavirus Shock: Evidence from Real Time Surveys", *Journal of Public Economics* 189, 104245.

Alon, T., M. Doepke, J. Olmstead-Rumsey and M. Tertilt (2020), "The Impact of COVID-19 on Gender Equality", *Covid Economics: Vetted and Real-Time Papers* 4, 62–85.

Alon, T., S. Coskun, M. Doepke, D. Koll and M. Tertilt (2021), "From Mancession to Shecession: Women's Employment in Regular and Pandemic Recessions", *NBER Working Paper* 28632.

Amaral, S., V. Endl-Geyer and H. Rainer (2020), "Domestic Violence and the Covid-19 Pandemic: An Overview of the Expected Impact and Possible Ways Out", *ifo Schnelldienst* 73(7), 52–56.

Anderberg, D., H. Rainer, J. Wadsworth and T. Wilson (2016), "Unemployment and Domestic Violence: Theory and Evidence", *The Economic Journal* 126, 1947–1979.

Andrew, A., S. Cattan, M. Costa Dias, C. Farquharson, L. Kraftman, S. Krutikova, A. Phimister and A. Sevilla (2020), "How Are Mothers and Fathers Balancing Work and Family under Lockdown?", *IFS Briefing Note BN290,* The Institute for Fiscal Studies.

Austad, S. and K. Fischer (2016), "Sex Differences in Life Span", *Cell Metab* 23, 1022.

Australian Units (2020), *Working from Home*, https://actu.org.au/media/1449319/au_workingfromhome_p1.pdf.

Bambra, C., V. Albani and P. Franklin (2021), "COVID-19 and the Gender Health Paradox", *Scandinavian Journal of Public Health* 49, 17–26.

Beckfield J., K. Morris and C. Bambra (2018), "How Social Policy Contributes to the Distribution of Population Health: The Case of Gender Health Equity", *Scandinavian Journal of Public Health* 46, 6–17.

Bindler, A. L. and N. Ketel (2019), "Scaring or Scarring? Labour Market Effects of Criminal Victimization", *CEPR Discussion Paper* 13431.

Blasko, Z., E. Papadimitriou and A. R. Manca (2020), *How Will the COVID-19 Crisis Affect Existing Gender Divides in Europe,* Publications Office of the European Union, Luxembourg.

Breast Screening Working Group (WG2) of the Covid-19 and Cancer Global Modelling Consortium, J. D. Figueroa, E. Gray, N. Pashayan, S. Deandrea, A. Karch, D. B. Vale, K. Elder, P. Procopio, N. T. van Ravesteyn, M. Mutabi, K. Canfell and C. Nickson (2021), "The Impact of the Covid-19 Pandemic on Breast Cancer Early Detection and Screening", *Preventive Medicine* 151, 106585.

Chalfin, A. (2015), "Economic Costs of Crime", in W. D. Jennings et al., eds., *The Encyclopedia of Crime and Punishment,* Wiley-Blackwell, Hoboken (NJ), 1–12.

Chiesa, V., G. Antony, M. Wismar and B. Rechel (2021), "COVID-19 Pandemic: Health Impact of Staying at Home, Social Distancing and 'Lockdown' Measures – A Systematic Review of Systematic Reviews", *Journal of Public Health*, fdab102, https://doi.org/10.1093/pubmed/fdab102.

CNA (2020), *Commentary: Isolated with Your Abuser? Why Family Violence Seems to Be on the Rise during COVID-19 Outbreak,* 26 March, https://www.channelnewsasia.com/news/commentary/coronavirus-covid-19-family-violence-abuse-women-self-isolation-12575026.

CNN (2020), *Women Are Using Code Words at Pharmacies to Escape Domestic Violence during Lockdown,* 6 April, https://edition.cnn.com/2020/04/02/europe/domestic-violence-coronavirus-lockdown-intl/index.html.

Coskun, S. and H. Dalgic (2020), "The Emergence of Procyclical Fertility: The Role of Gender Differences in Employment Risk", *CRC TR 224 Discussion Paper* 142.

COVID-19 Snapshot Monitoring (2021), https://projekte.uni-erfurt.de/cosmo2020/archiv/17-01/cosmo-analysis.html#15_medizinische_versorgung.

Cygan-Rehm, K., D. Kuehnle and M. Oberfichtner (2017), "Bounding the Causal Effect of Unemployment on Mental Health: Nonparametric Evidence from Four Countries", *Health Economics* 26, 1844–1861.

Dugan, L., D. S. Nagin and R. Rosenfeld (2003), "Exposure Reduction or Retaliation? The Effects of Domestic Violence Resources on Intimate-partner Homicide", *Law and Society Review* 37, 169–198.

Eurofound (2020), *Living, Working and COVID-19,* COVID-19 Series, Publications Office of the European Union, Luxembourg.

Eurostat (2021), *Average Number of Usual Weekly Hours of Work in Main Job, by Sex, Professional Status, Full-time/Part-time and Economic Activity (from 2008 onwards, NACE Rev. 2) – Hours,* https://ec.europa.eu/eurostat/databrowser/view/lfsq_ewhun2/default/table?lang=en; Unemployment by sex and age – monthly data, https://ec.europa.eu/eurostat/databrowser/view/une_rt_m/default/table?lang=en.

Frasquilho, D., M. G. Matos, F. Salonna, D. Guerreiro, C. C. Storti, T. Gaspar and J. M. Caldas-de-Almeida (2015), "Mental Health Outcomes in Times of Economic Recession: A Systematic Literature Review", *BMC Public Health* 16, 115.

Frodermann, C., P. Grunau, S. Wanger and S. Wolter (2021), *Nine to Five war gestern: In der Pandemie haben viele Beschäftigte ihre Arbeitszeiten verlagert, Corona-Krise: Folgen für den Arbeitsmarkt,* IAB-Forum, https://www.iab.de/897/section.aspx/Publikation/K210719KVX.

Gunnell, D., L. Appleby, E. Arensman et al. (2020), "Suicide Risk and Prevention during the COVID-19 Pandemic", *Lancet Psychiatry* 7, 468–471.

Harknett, K., S. McLanahan and D. Schneider (2016), "Intimate Partner Violence in the Great Recession", *Demography* 53, 471–505.

Hövermann, A. (2021), "Belastungswahrnehmung in der Corona-Pandemie", *WSI Policy Brief* 50, Wirtschafts- und Sozialwissenschaftliches Institut (WSI) at the Hans-Böckler-Stiftung.

Hupkau, C. and B. Petrongolo (2020), "Work, Care and Gender during the Covid-19 Crisis", *Fiscal Studies* 41, 623–651.

ILO (2020), "A Gender-Responsive Employment Recovery: Building Back Better", *Policy Brief*, July.

ILO (2021a), *Fallout of Covid-19: Working Moms Are Being Squeezed Out of the Labour Force*, https://ilostat.ilo.org/fallout-of-covid-19-working-moms-are-being-squeezed-out-of-the-labour-force/.

ILO (2021b), *Teleworking Arrangements during the COVID-19 Crisis and Beyond,* https://www.ilo.org/global/about-the-ilo/how-the-ilo-works/multilateral-system/g20/reports/WCMS_791858/lang--en/index.htm.

ILOSTAT (2021), *Working Hours Lost Due to the Covid-19 Crisis – ILO Modelled Estimates (%) – Annual,* https://www.ilo.org/shinyapps/bulkexplorer45/?lang=en&segment=indicator&id=HOW_2LSS_NOC_RT_A.

Ivandic, R., T. Kirchmaier and B. Linton (2020), "Changing Patterns of Domestic Abuse during Covid-19 Lockdown", *CEP Discussion Paper* 1729.

Jacques-Aviñó, C., T. López-Jiménez, L. Medina-Perucha et al. (2020), "Gender-based Approach on the Social Impact and Mental Health in Spain During COVID-19 Lockdown: A Cross-sectional Study", *BMJ Open*, http://dx.doi.org/10.1136/bmjopen-2020-044617.

KFF Women's Health Survey (2013), https://www.kff.org/womens-health-policy/fact-sheet/gender-differences-in-health-care-status-and-use-spotlight-on-mens-health/.

KFF Women's Health Survey (2017), https://www.kff.org/womens-health-policy/issue-brief/womens-connections-to-the-healthcare-delivery-system-key-findings-from-the-2017-kaiser-womens-health-survey/.

KFF Women's Health Survey (2021), https://www.kff.org/womens-health-policy/issue-brief/womens-experiences-with-health-care-during-the-covid-19-pandemic-findings-from-the-kff-womens-health-survey/.

Lott, Y., K. U. Müller and C. Samtleben (2020), *Auswirkungen der Ort-Zeit-Flexibilisierung von Erwerbsarbeit auf informelle Sorgearbeit im Zuge der Digitalisierung,* Expertise für den Dritten Gleichstellungsbericht der Bundesregierung, https://www.dritter-gleichstellungsbericht.de/de/article/204.auswirkungen-der-ort-zeit-flexibilisierung-von-erwerbsarbeit-auf-informelle-sorgearbeit-im-zuge-der-digitalisierung.html.

Macintyre, S., K. Hunt and H. Sweeting (1996), "Gender Differences in Health: Are Things Really as Simple as They Seem?", *Social Science and Medicine* 42, 617–624.

McCrary, J. and S. Sanga (2021), "The Impact of the Coronavirus Lockdown on Domestic Violence", *American Law and Economics Review* 23, 137–163.

Okur, P. (2016), "Sexual and Reproductive Health and Rights of People on the Move", *Bulletin of the Netherlands Society for Tropical Medicine and International Health* 54, 8–9.

O'Donnell, M., S. Oertelt-Prigione, A. Peterman, A. Potts, N. Shah, K. Thompson and N. Van Gelder (2020), "COVID-19: Reducing the Risk of Infection Might Increase the Risk of Intimate Partner Violence", EClinicalMedicine 21, DOI: 10.1016/j.eclinm.2020.100348.

OECD (2021), *Employment Rate*, https://data.oecd.org/emp/employment-rate.htm; Unemployment Rate, https://data.oecd.org/unemp/unemployment-rate.htm.

Public Health England (2021), *Wider Impacts of COVID-19 on Health (WICH) Monitoring Tool,* https://analytics.phe.gov.uk/apps/covid-19-indirect-effects/.

Rose, C. (2018), "Plague and Violence in Early Modern Italy", *Renaissance Quarterly* 71, 1000–1035.

Statista (2019), https://de.statista.com/statistik/daten/studie/661646/umfrage/inanspruchnahme-von-vorsorgeuntersuchungen-in-deutschland-nach-fachaerzten/.

Statista (2021a), *Percentage of U.S. Adults Who Reported Their Mental Health Worsened during COVID-19 vs the Last Ten Years as of March 2021, by Gender,* https://www.statista.com/statistics/1241055/us-adults-mental-health-changes-covid-vs-last-ten-years-by-gender/.

Statista (2021b), *Share of the French Population Who Developed Depressive Symptoms in May 2020, by Gender,* https://www.statista.com/statistics/1221339/depressive-symptoms-among-french-population-covid-19/.

Statista (2021c), *Percentage of Respondents in the U.S. Who Reported Symptoms of Anxiety Disorder in the Last Seven Days from April 2020 to July 2021, by Gender,* https://www.statista.com/statistics/1132661/anxiety-symptoms-us-adults-by-gender-past-week/.

Süddeutsche Zeitung (2020), "1000 Anrufe beim Hilfetelefon pro Woche", 10 November, https://www.sueddeutsche.de/panorama/corona-gewalt-in-der-partnerschaft-hilfetelefon-1.5111231.

The Guardian (2020), "Lockdowns around the World Bring Rise in Domestic Violence", 28 March, https://www.theguardian.com/society/2020/mar/28/lockdowns-world-rise-domestic-violence.

UN Women (2021), *Whose Time to Care? Unpaid Care and Domestic Work during COVID-19,* https://data.unwomen.org/sites/default/files/inline-files/Whose-time-to-care-brief_0.pdf.

UNFPA (2020), https://www.unfpa.org/news/pandemic-rages-women-and-girls-face-intensified-risks.

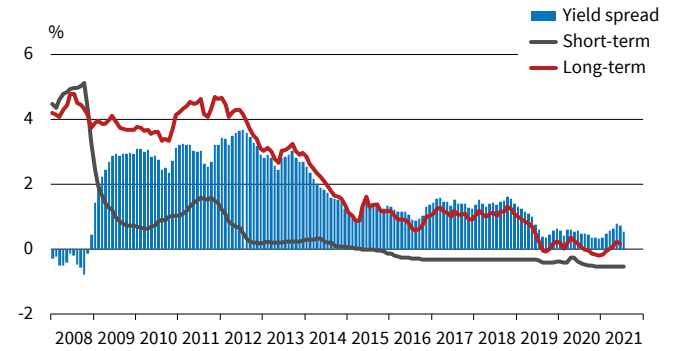
Van de Velde, S., T. Huijts, P. Bracke et al. (2013), "Gender Equity and the Gender Gap in Depression in Europe", *Sociology of Health and Illness* 35,682–698.

WHO (2021), https://www.who.int/news-room/fact-sheets/detail/violence-against-women.

# Statistics Update

## Financial Conditions in the Euro Area

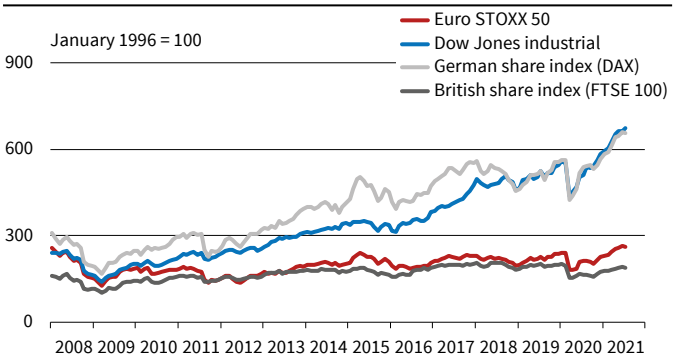
**Nominal Interest Rates** [a]




[a] Weighted average (GDP weights).
Source: European Central Bank; calculations by the ifo Institute. © ifo Institute

In the three-month period from May 2021 to July 2021 short-term interest rates remained unchanged: the three-month EURIBOR rate amounted to – 0.54% in all these months. The ten-year bond yields decreased from 0.24% in May 2021 to 0.17% in June 2021, while the yield spread also decreased from 0.78% to 0.54% between May 2021 and July 2021.

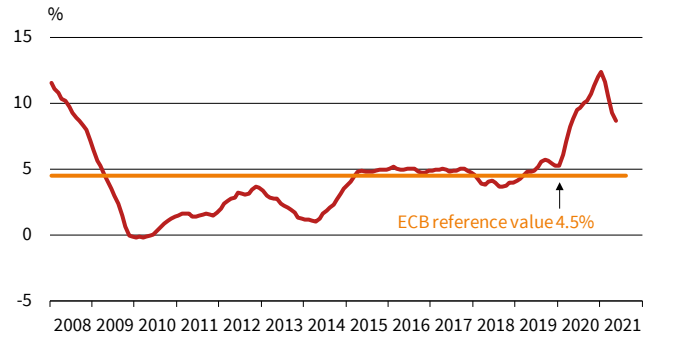
**Stock Market Indices**




Source: Deutsche Börse; Dow Jones; FTSE; STOXX. © ifo Institute

The global fears about the spread of the Coronavirus, oil price drops caused by an oil price war between Russia and the OPEC countries, and the possibility of a recession led to the stock market crash in March 2020, and global stocks saw a severe downturn in this month. The subsequent steady rise of the German stock index DAX came to a halt in July 2021, averaging 15,573 points compared to 15,619 points in June 2021, while the UK FTSE-100 also fell from 7,097 to 7,048 points over the same period. Furthermore, the Euro STOXX amounted to 4,063 in July 2021, down from 4,106 in June 2021. Yet, the Dow Jones Industrial continued to increase, averaging 34,798 points in July 2021, compared to 34,290 points in June 2021.

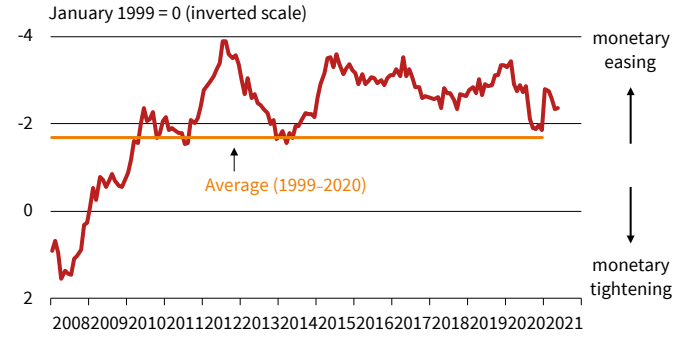
**Change in M3** [a]




[a] Annual percentage change (3-month moving average).
Source: European Central Bank. © ifo Institute

The annual growth rate of M3 decreased to 8.3% in June 2021, from 8.5% in May 2021. The three-month average of the annual growth rate of M3 over the period from April 2021 to June 2021 reached 8.7%.

**Monetary Conditions Index**

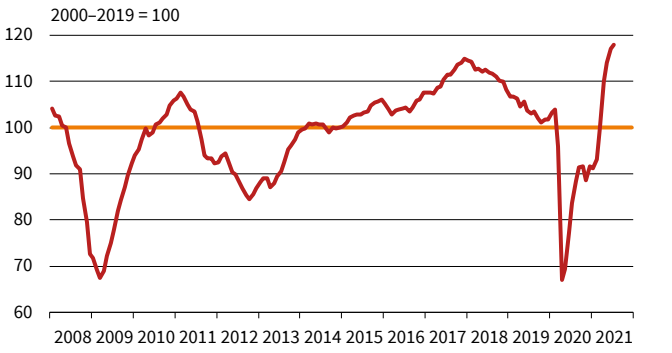



Source: European Commission. © ifo Institute

Between April 2010 and July 2011, the monetary conditions index had remained stable. Its rapid upward trend since August 2011 had led to the first peak in July 2012, signaling greater monetary easing. In particular, this was the result of decreasing real short-term interest rates. In May 2017 the index had reached one of the highest levels in the investigated period since 2007 and its slow downward trend was observed thereafter. A steady upward trend that had prevailed since October 2018 was abruptly halted in March 2020 with the onset of the Covid-19 crisis, and the index continued to decline in 2020. The rapid increase of the index in January 2021 was followed by a decline in the period February to April 2021, while a slight increase was again recorded in May 2021.

# EU Survey Results

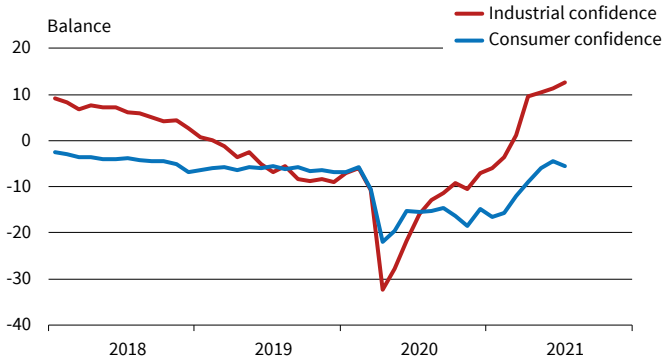
**EU27 Economic Sentiment Indicator**
Seasonally adjusted




Source: European Commission. © ifo Institute

In July 2021, the *Economic Sentiment Indicator* (ESI) increased again in both the EU (+ 0.9 points) and the euro area (+ 1.1 points). The current level (118.0 in the EU and 119.0 in the EA19) is the highest since 1985. Compared to the last months, the latest improvement was much weaker, suggesting that the indicator is approaching its peak. In the EU27, the ESI's increase in July was driven by improving confidence in industry and services, while confidence weakened in construction and among consumers, and remained virtually unchanged in retail trade.

**EU27 Industrial and Consumer Confidence Indicators**
Percentage balance, seasonally adjusted

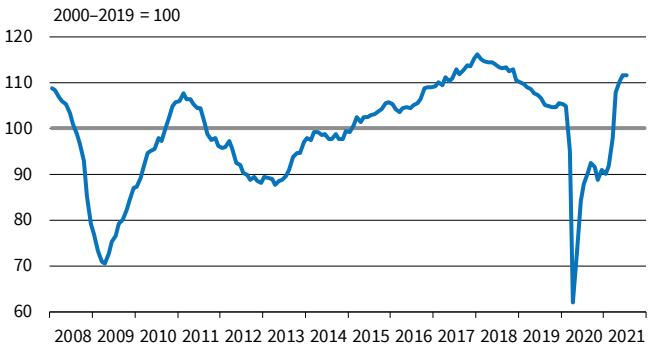



Source: European Commision. © ifo Institute

* The industrial confidence indicator is an average of responses (balances) to the questions on production expectations, order-books and stocks (the latter with inverted sign).
** New consumer confidence indicators, calculated as an arithmetic average of the following questions: financial and general economic situation (over the next 12 months), unemployment expectations (over the next 12 months) and savings (over the next 12 months). Seasonally adjusted data.

In July 2021, the *industrial confidence indicator* increased by 1.3 in the EU and by 1.8 in the euro area, compared to June 2021. However, the *consumer confidence indicator* edged down by 1.1 points in both the EU and the euro area in July 2021, compared to June 2021.

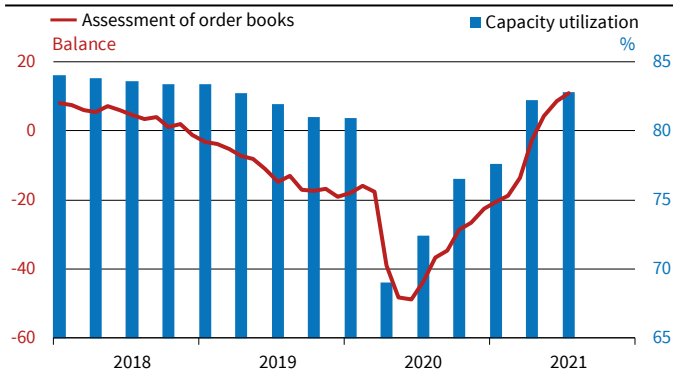
**EU27 Employment Expectations Indicator**
Seasonally adjusted




Source: European Commission. © ifo Institute

In July 2021, the Employment Expectations Indicator (EEI) stayed flat, at 111.6 points in the EU and 111.7 points in the euro area, well above its pre-pandemic level.

**EU27 Capacity Utilisation and Order Books in the Manufacturing Industry**
Seasonally adjusted

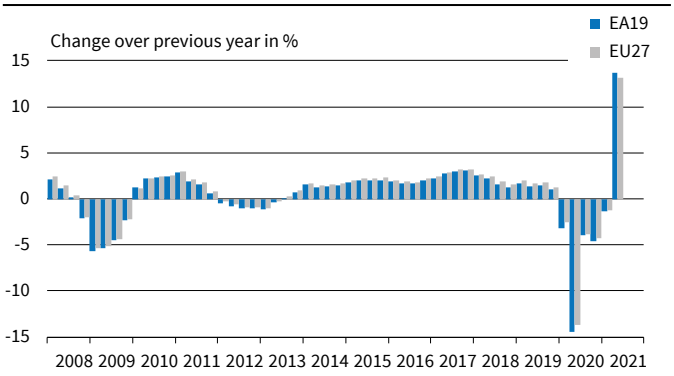



Source: European Commission. © ifo Institute

Managers' assessment of *order books* reached 10.9 in July 2021, compared to 8.6 in June 2021. In May 2021 the indicator had amounted to 4.4. *Capacity utilization* stood at 82.8 in the third quarter of 2021, up from 82.2 in the second quarter of 2021, showing the gradual improvement from the Covid-19 shock.

# Euro Area Indicators

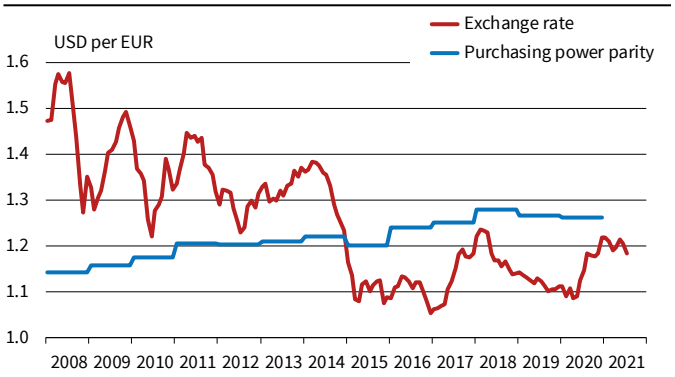
### Gross Domestic Product in Constant 2015 Prices




Source: Eurostat. © ifo Institute

According to the Eurostat estimates, seasonally adjusted GDP decreased by 0.3% in the euro area and by 0.1% in the EU during the first quarter of 2021, compared to the previous quarter. These declines follow falls in the fourth quarter of 2020 (– 0.6% in the EA19 and – 0.4% in the EU27), after a strong rebound in the third quarter of 2020 (+ 12.6% in the EA19 and + 11.7% in the EU27). Compared to the first quarter of 2020, i.e., year over year, (seasonally adjusted) GDP decreased by 1.3% in the EA19 and by 1.2% in the EU27 in the first quarter of 2021.

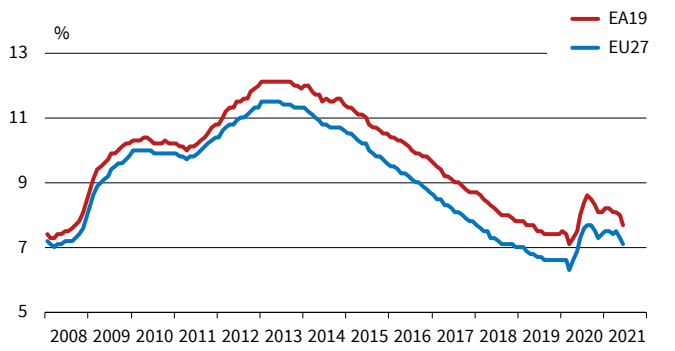
### Exchange Rate of the Euro and Purchasing Power Parity




Source: European Central Bank; OECD; calculations by the ifo Institute. © ifo Institute

The exchange rate of the euro against the US dollar averaged approximately 1.20 $/€ between March 2021 and May 2021. (In February 2021 the rate had amounted to around 1.21 $/€.)

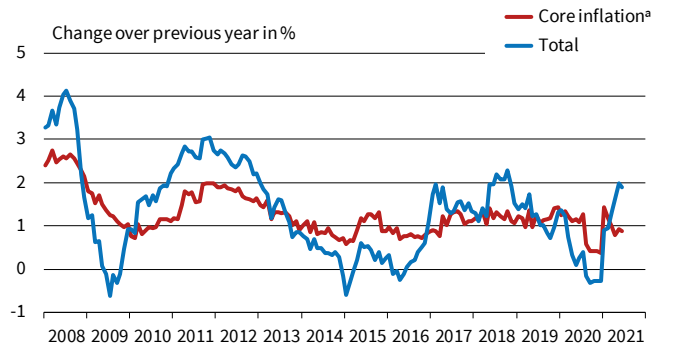
### Unemployment Rate




Source: Eurostat. © ifo Institute

Euro area unemployment (seasonally adjusted) amounted to 8.0% in April 2021, down from 8.1% in March 2021. The EU27 unemployment rate was 7.3% in April 2021, stable compared to March 2021. In April 2021 the lowest unemployment rate was recorded in Poland (3.1%), Czechia and the Netherlands (both 3.4%), while the rate was highest in Greece (15.8%) and Spain (15.4%).

### Euro Area Inflation Rate (HICP)




[a] Total excl. energy and unprocessed food.
Source: Eurostat. © ifo Institute

Euro area annual inflation (HICP) amounted to 2.0% in May 2021, up from 1.6% in April 2021. Year-on-year EA19 core inflation (excluding energy and unprocessed foods) amounted to 0.9% in May 2021, up from 0.8% in April 2021.