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Unconventionally green:
Monetary policy between engagement and conflicting goals

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Abstract

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In light of its recently completed strategy review, the ECB has presented a climate action plan, which schedules the consideration of climate criteria within the corporate sector purchase program (CSPP). We study the potential role of the ECB in supporting the transition to a low-carbon economy by decarbonizing the CSPP. We demonstrate that the carbon intensity of CSPP purchases is basically determined by three factors: First, by the CSPP-eligibility criteria as these tend to exclude bonds from low-emission sectors. Second, by the underlying structure of the bond market as this tends to be skewed towards carbon-intensive sectors. Third, among the eligible bonds, the ECB tends to select those from relatively emission-intensive sectors. Consequently, to decarbonize the CSPP, the ECB can theoretically act along these three lines. That is: Adjust the CSPP-eligibility criteria to expand the range of eligible low-carbon assets. Revise the principle of market neutrality to tilt the CSPP portfolio towards low-carbon companies. Or purchase so far neglected low-carbon bonds within the current eligibility and market neutrality framework. We analyze chances and discuss risks with regard to all three options. As we find that all approaches to decarbonize the CSPP have either very limited effects on the carbon intensity of the CSPP portfolio or are associated with significant theoretical and practical concerns, we conclude that the contributions to the success of an active green monetary policy that goes beyond the principle of market neutrality are not guaranteed, while at the same time risks arise for a monetary policy oriented towards price level stability. In contrast, by linking the CSPP to climate-related disclosures, the ECB can contribute to increased transparency and improved risk management and has an important and potentially climate-effective lever in hand that is independent of revising the principle of market neutrality.

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1 Introduction

Climate change, induced by a high concentration of greenhouse gases in the atmosphere which emerged due to human activity, is likely to bring substantial changes for societies. Signatories to the Paris Agreement pledged to reduce greenhouse gas emissions[2] in order to keep the increase in the global average temperature to well below 2°C compared to pre-industrial levels, ideally limiting the increase in temperature to no more than 1.5°C. There is broad agreement among economists that environmental externalities should be corrected primarily by increasing the price of greenhouse gas emissions, ideally by a global carbon price (Cramton et al., 2017). The transformation of economies towards significantly lower or net zero CO2-emissions is associated with high investment needs. Financial and capital markets play an important role in providing the necessary funds and to steer capital towards sustainable investments.

As monetary policy is usually mandated to conduct stabilization policy while fiscal authorities are responsible for long-term structural and redistributive policies, monetary policy has traditionally not been considered relevant for long-term climate change mitigation efforts. However, the role of central banks in fostering the transition to a low-carbon economy has been getting increased attention over the last years (Brunnermeier and Landau, 2020). ECB President Lagarde called the debate on how central banks and banking supervision might effectively contribute to climate change mitigation a “mission critical” (Arnold, 2019). Only recently, the ECB has presented the results of its 2020/21 strategy review. While the focus was on the newly defined inflation target, a plan of measures to take climate protection aspects into account in the monetary policy strategy also received a lot of attention (ECB, 2021a; ECB, 2021c). In this regard, the ECB is underscoring its endeavors to incorporate aspects of ecological sustainability more systematically into its monetary policy in the future. The proposed instruments range from disclosure obligations and a new climate-related risk assessment to the consideration of climate criteria in the corporate sector purchase program (CSPP).

The idea to incorporate climate considerations into the CSPP is subject to intense debate. The concept of ‘market neutrality’ is a core principle that is guiding the implementation of the ECB’s private sector asset purchases (Cœuré, 2015). Under the current interpretation of this principle, prevailing market structures as reflected in the issuance behavior of firms are taken as given. The main argument behind greening asset purchases has been that the central bank’s asset portfolios are skewed towards carbon-intensive sectors (Papoutsi et al., 2021; Matikainen et al., 2017; Dafermos et al., 2020). This could lead to a scenario in which monetary policy contributes to locking in investments in sectors and technologies that are more acutely exposed to the disruptive effects of the transition to a carbon-neutral economy and may therefore impede, rather than favor, an efficient allocation of resources. Various members of the executive board of the ECB have therefore repeatedly argued that within the boundaries of their mandates, the ECB should revise the market neutrality principle to prevent such biases from occurring, and instead contribute to unlocking more green investments (Schnabel, 2021a; Knot, 2021; de Galhau,

[2] We use the term greenhouse gas emissions and CO2-emissions interchangeably as the vast majority of emissions comes from carbon dioxide.

2021). However, little empirical work has been done so far on the practical implications and problems of such attempts.

The focus of our paper is to discuss the ECB's opportunities to decarbonize its purchases under the CSPP. We analyze information on the ECB's holdings of corporate bonds that have been acquired within the CSPP as of May 1, 2020. We document that the carbon intensity of the CSPP purchases is basically determined by three factors: First, by the CSPP-eligibility criteria as these criteria tend to exclude bonds from low-emission sectors, such as the financial sector. Second, by the underlying structure of the bond market as this tends to be skewed towards carbon-intensive sectors. This result is in line with earlier empirical work in the context of our research question (Papoutsi et al., 2021, Matikainen et al., 2017; Dafermos et al., 2020). Third, by the ECB's purchasing decisions. Within the universe of CSPP-eligible bonds, the ECB tends to select bonds from relatively emission-intensive sectors. Consequently, to take a more proactive approach in incorporating climate considerations into their purchase strategies under the CSPP, the ECB can theoretically act along these three lines. That is: Adjust the CSPP-eligibility criteria, abandon the principle of market neutrality to re-allocate the ECB portfolio from high- to low-carbon companies or purchase so far neglected bonds from low-emission sectors within the current eligibility and market neutrality framework.

We analyze chances and discuss risks with regard to all three options. Among the currently applied CSPP-eligibility criteria only abandoning the exclusion of bonds issued by banks and insurance companies would be associated with considerable effects on the carbon intensity of the CSPP-portfolio. However, revising this criterion raises significant concerns as it fulfills an important role in avoiding a potential conflict of interest with the ECB's role as banking supervisor. Moreover, taking the carbon intensity of bank investments into account could quickly reverse the positive effect. Adding new eligibility criteria to the current framework, e.g., linking purchases to climate-disclosures will be unlikely to reduce the carbon intensity of the CSPP-portfolio as results from the literature suggest. In contrast, revising the principle of market neutrality and recalibrating the portfolio on the basis of climate criteria with the help of a sophisticated 'tilting' approach (Schoenmaker, 2021) has a remarkable impact on the carbon intensity of the CSPP-portfolio. However, it is also associated with a significant sellout of bonds from currently carbon-intensive sectors. This, however, raises a number of theoretical and practical follow-up questions for which it remains unclear whether the ECB can and should answer them. Third, CSPP-eligible bonds with an amount of 119 billion Euro are not represented in actual purchases. On average, these bonds have a significantly lower carbon intensity than the portfolio of actual purchases. Still, we show that the scope to reduce the carbon intensity by means of the so far neglected CSPP-eligible bonds is very limited.

We conclude therefore that all three options to green the CSPP have shortcomings as they are either ineffective in terms of reducing the carbon intensity or associated with significant drawbacks. In fact, in how far reducing the current carbon intensity of the CSPP portfolio is supporting the political goal of a transformation to a low-carbon economy at all, is not obvious. Rather, companies from high-emission sectors are most in need of capital to finance the transformation to a low-carbon economy. Moreover, it

is worth noting that conventional bonds issued by companies from high-emission sectors can also be used to finance green investments. Green bonds for example are issued mainly from companies in the two most carbon-intensive sectors (Figure 1, right). Therefore, refraining from carbon-intensive sectors should automatically be associated with a decrease in the acquisition of green bonds. If anything, it is essential to design tilting approaches with a forward-looking perspective and not only to take current emissions into account, but also expected future emissions. Only then could such an approach offer companies with currently high levels of carbon emissions an incentive to reform and introduce low-carbon technologies (Schoenmaker and Schramade, 2019). In the short run, it is not likely that practical problems associated with such efforts can be solved. However, any long-term implementation strategy would stand in sharp contrast to the temporary character of the CSPP.

This paper should not be misunderstood as representing a general statement against green monetary policy. Climate change is probably the greatest challenge of our time. For the necessary comprehensive transformation to climate neutrality to succeed, all market participants and policy makers will have to examine their contribution to it - including central banks. However, there are several instruments a central bank can use to adjust operational frameworks with regard to climate considerations (NGFS, 2021; ECB, 2021c). Each measure should be carefully evaluated regarding its potential impact on various target variables and its operational feasibility. As associated improved climate outcomes are insecure and given the significant risks that we discuss with regard to price level stability, the effectiveness of monetary policy incentives as well as the politicization of monetary policy, we conclude that the benefits of going beyond the principle of market neutrality are not warranted by the costs.

In the following, chapter 2 introduces the principle of market neutrality and summarizes the ongoing debate in the literature and among (monetary) policy makers about a carbon bias in the ECB asset purchase programmes. Chapter 3 presents data and methodology. In chapter 4, we identify the key sources of carbon intensity in the ECB's corporate bonds purchases. Chapter 5 analyzes the effects on the carbon intensity with regard to the three options to decarbonize the CSPP portfolio that we identify. In chapter 6 we discuss our results and possible policy recommendations.

2 The ECB's asset purchase programmes and the concept of market neutrality

As a reaction to the 2007 financial crisis, many central banks have adopted unconventional policy measures, such as quantitative easing (QE). The large-scale purchasing of assets allowed central banks to inject large amounts of liquidity into financial systems and economies, in the hope of improving financing conditions for companies and households and stimulating aggregate demand. To this end, the ECB has launched various asset purchase programmes (APP) (Figure 1, left). The corporate sector purchase programme (CSPP) comprised 288,60 billion Euro at the beginning of August 2021 and is thus significantly smaller than the public sector purchase programme (PSPP) with a volume of 2432,56 billion Euro.

In order to be eligible for asset purchases under the APP, securities have to be listed as eligible euro-denominated collateral for refinancing operations conducted by the Eurosystem and may not resemble

a form of subordinated debt (ECB, 2019). In addition, the ECB defines several criteria for assets purchasable under the CSPP. Eligible assets must be issued by non-bank corporations which implies that neither the issuer nor its parent company may be a bank or a credit institution that is supervised in accordance with the Capital Requirements Regulation (CRR). Moreover, assets must fulfil requirements regarding the remaining maturity: given an initial maturity of 366 days or less, assets must have a minimum remaining maturity of at least 28 days, while the remaining maturity of assets with an initial maturity of 367 days or more must lie between 6 months and 30 years and 364 days. Furthermore, only assets from issuers domiciled in the euro-area are considered to be eligible, while the location of their parents' headquarters is not taken into consideration. In addition, all CSPP-eligible assets must have an investment grade rating by one of the major rating agencies. Emission, issuer and guarantor ratings might be considered in the decision process (ECB, 2020).

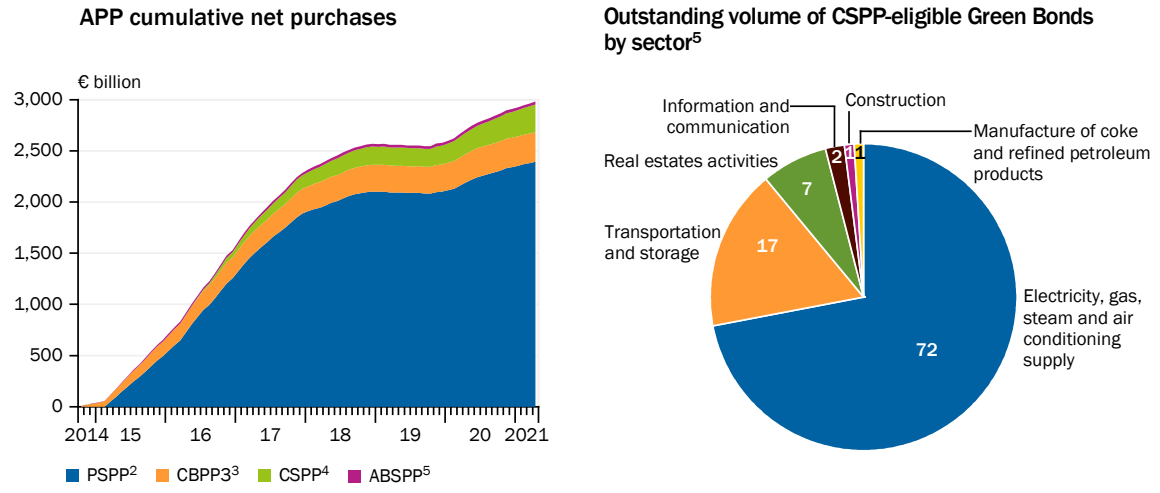
When designing the APP, the concept of 'market neutrality' was agreed upon as a core principle guiding the implementation of the ECB's private sector asset purchases.[3] By purchasing bonds in proportion to their outstanding volume in the market, relative price distortions from asset purchases should be minimized (Hammermann et al., 2019). Recently, there has been a growing debate about the role that monetary policy should play in addressing the risks of climate change. While the purpose of central banks' corporate bond purchases has usually been macroeconomic stimulus, their implementation requires selecting a bond portfolio. The question is how portfolio should be designed. Under the current interpretation of the principle of market neutrality, prevailing market structures as reflected in the issuance behavior of firms are taken as given. It has been repeatedly argued that the supposedly market-neutral interventions by central banks show an unintended structural bias towards carbon-intensive companies (Papoutsi et al., 2021, Matikainen et al., 2017; Dafermos et al., 2020). The reason is that the issuance behavior of large firms in emission-intensive sectors systematically differs from firms in other sectors. Carbon-intensive companies, such as oil and gas companies and car manufacturers, are typically also capital intensive and thus issue more corporate bonds. By purchasing assets proportional to the bond market, the ECB's asset portfolio is therefore skewed towards high-carbon companies relative to low-carbon companies. Indeed, Matikainen et al. (2017) estimate that the carbon intensity of the ECB's corporate bond portfolio is 57 percent higher than the average carbon intensity of EU companies. This carbon-intensive skew raises the concern that central banks' corporate bond purchases disproportionately increase prices, reduce financing costs and thus encourage additional debt issuance in high-carbon relative to low-carbon sectors. In this regard, the CSPP may be an implicit subsidy for fossil fuel and other 'brown' industries (Unruh, 2000). In sum, the climate change debate in monetary policy is first and foremost about the ECB's allocation of financial resources to high-carbon companies. To counteract this, the ECB would have to reduce the carbon intensity of its purchases in the CSPP. Hence, the debate revolves to a lesser extent around the decarbonization of the portfolio itself than about the aforementioned indirect effects that could be triggered on the bond market if the ECB invests more in low-emissions bonds. That is, to incentive the issuance of green financial products (Schnabel, 2021b).

[3] Other central banks, e.g. Bank of England, Bank of Japan and Bank of Canada, follow similar principles in their asset purchasing programmes to reduce price distortions.

Among economists and some central bankers, an intensive debate over this issue has emerged (see e.g., Cochrane, 2020). On the one hand, it is argued that the ECB's policy implementation needs to be in line with the principle of market neutrality to act within the boundaries of its mandate (Weidmann, 2019; Fuest et al., 2021). On the other hand, it is claimed that the ECB needs to abandon or revise its principle of market neutrality and question whether the bond market is the appropriate benchmark in the presence of environmental externalities (Schnabel, 2020; Knot, 2021; de Galhau, 2021). In this context, different approaches have been discussed by which the ECB could decarbonize its corporate bond purchases. These range from excluding the most carbon-intensive companies (Reclaim Finance, 2020) or dealing exclusively with low-carbon companies (van 't Klooster and van Tilburg, 2020) to tilting the portfolio towards low-carbon companies (Schoenmaker, 2021).

Figure 1

ECB's Asset Purchase Programmes (APP) and Green Bonds issuance per sector[1]



1 – Without regard to the Pandemic Emergency Purchase Program (PEPP). 2 – Public Sector Purchase Programme. 3 – Covered Bond Purchase Programme. 4 – Asset-Backed Securities Purchase Programme. 5 – Corporate Sector Purchase Programme. 6 – Relative share of each issuance sector by the amount of outstanding volume of all Green Bonds contained in the CSPP-eligible bonds, not depicted: wholesale and retail trade; repair of motor vehicles and motorcycles (< 1 % of amount outstanding), Green Bonds among the CSPP-eligible bonds: 85, total amount outstanding: €59.68 billion.

Sources: ECB, Refinitiv Datastream, own calculations

In the public debate it is often mistaken that decarbonizing the CSPP portfolio does not necessarily mean targeting green bonds – rather, the opposite is the case. Although green bonds' proceeds are used for environmentally sensitive purposes, their issuance does not necessarily translate into a reduction in carbon emissions at the firm level (Ehlers et al., 2020). First, the wide range of varying green bond standards allows a very broad assortment of firms to issue green bonds, each deemed to be green for different reasons (Ehlers and Packer, 2017). Second, even if bond proceeds flow into green projects (e.g., renewable energy), issuers may be heavily engaged in carbon-intensive activities elsewhere (e.g., coal power plants). Vice versa, also carbon-intensive corporate bonds could be used for the transformation to green production. For example, energy companies use conventional (and so far only in some cases green) bonds to fund their renewable energy business. Consequently, to reduce the carbon-intensity of its CSPP portfolio the ECB does not necessarily have to buy bonds labelled as 'green'. In fact, since green bonds are issued mainly from companies in carbon-intensive sectors (Figure

1, right), increased green bond purchases would initially support those sectors, thus reinforcing a bias towards carbon-intensive sectors. In addition, despite the dynamic growth seen in recent years, the market for green bonds is currently too small to allow for a exclusive focus on green bonds in the CSPP (Schnabel, 2021b).

Despite the absence of an explicit environmental target in the APP, the ECB is already now buying green bonds as part of both the CSPP and the PSPP in its attempt to establish a well-diversified portfolio. The ECB is currently holding around 20% of the eligible green corporate bonds (Schnabel, 2020a). As long as the structure of CSPP purchases is a reflection of the structure of the euro area corporate bond market, the ECB will therefore likely automatically purchase more green bonds if this market segment grows and develops (ECB, 2018; Breitenfellner et al., 2019).

3 Data and methodology

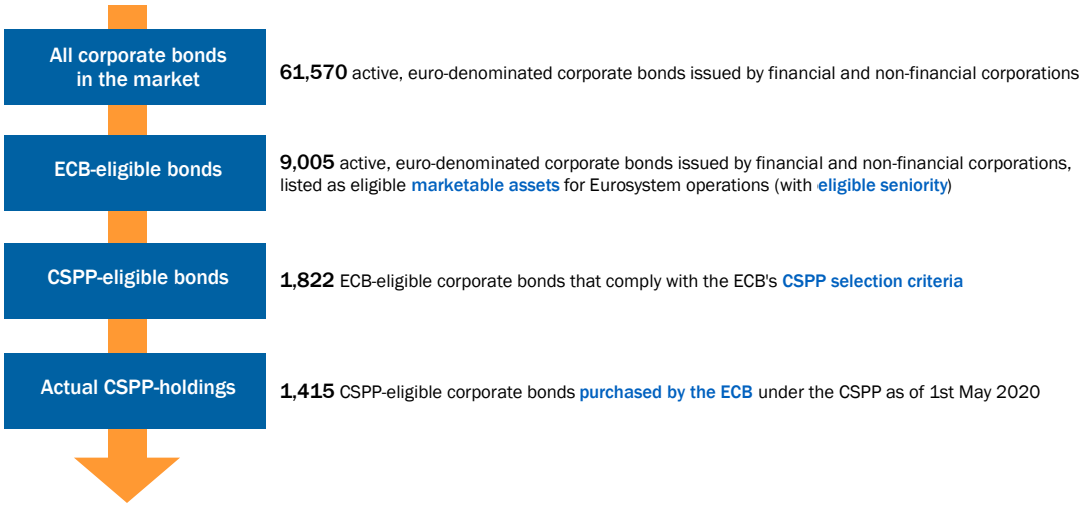
The ECB publishes a list of the ISINs of securities held under the CSPP on a weekly basis. We analyze information on the ECB's holdings of corporate bonds that have been acquired within the CSPP as of May 1, 2020. Although the ECB does not publish the amounts purchased of each security, it claims to hold 20% of the outstanding volume of CSPP-eligible bonds (ECB, 2018). In the following, we analyze CSPP-eligible bonds and actual CSPP purchases based on the total amount outstanding of each portfolio. As the ECB holds a proportional share of CSPP-eligible bonds and sticks to the principle of market neutrality, our results carry over. We perform a targeted search of potentially buyable euro-denominated corporate bonds issued by non-financial corporations that fulfil the ECB's CSPP-eligibility criteria via Refinitiv Datastream. Figure 2 summarizes our procedure of constructing the portfolio of CSPP-eligible corporate bonds. We first obtain a portfolio of 61,570 active euro-denominated corporate bonds issued by financial and non-financial corporations. For each security, we have sufficient data to clearly determine whether they meet CSPP-eligibility criteria. In a second step, we further narrow down the selection of bonds by demanding that bonds are listed as eligible marketable assets for Eurosystem operations, further excluding subordinated debt titles. Proceeding like this, we obtain 9,005 *ECB-eligible* corporate bonds. Moreover, applying the ECB's CSPP-eligibility criteria to these 9,005 ECB-eligible corporate bonds, we obtain 1,822 bonds which constitute the *CSPP-eligible* bonds (Figure 2). These bonds are issued by 337 non-financial corporations and jointly account for an outstanding volume of 1,094 billion Euro. In comparison, actual ECB holdings as of May 1st, 2020, comprise 1,415 bonds issued by 297 non-financial corporations with an outstanding volume of 974 billion Euro. Consequently, the ECB does only purchase a fraction of bonds available as CSPP-eligible.

We use the Eurostat system of classification by economic activity (NACE) to allocate our list of ISINs to economic sectors. The Greenhouse Gas Protocol (2015) distinguishes between direct emissions from sources that are owned or controlled by the reporting entity and indirect emissions embedded in intermediate products used by the entity under consideration. To examine how the choice of the emission metric influences our results, we distinguish between direct sector-specific greenhouse gas emissions (Scope 1) and an approach that takes the full corporate value chain of emissions into account

(Scope 3, carbon footprint). We estimate an economic sector's carbon footprint following Corsatea et al. (2019). We combine input-output data from the World Input Output Database (Timmer et. al, 2015) with emissions on sector-level and measure the carbon footprint as carbon dioxide embedded in sectoral imports for all EU-ETS countries in 2014. Figure 3 contrasts the average carbon intensity for both scopes and each sector measured as the sectoral CO2-emissions in tons per sectoral gross value added (GVA) in US-Dollar. As expected, the electricity and gas sector have the highest carbon intensity at 3447 t CO2/GVA in USD millions, followed by the transportation sector at 657 t CO2/GVA in USD millions, and the agriculture sector at 371 t CO2/GVA in USD millions. Financial and insurance activities have a comparable low carbon intensity at 9 t CO2/GVA in USD millions. However, assessing the carbon intensity of financial companies is associated with major challenges as the financial sectors' funded emissions from lending and investment activities should be substantially higher than those from upstream activities (CDP, 2020). Scientifically sound evaluation methods and data required to calculate the scope 3 emissions of banks' portfolios have not yet been sufficiently developed and standardized (NRI, 2021; Teubler and Kühlert, 2020). During this analysis, we therefore do not consider the carbon intensity of the financial institutions' portfolios but of the institution itself. Therefore, it is very likely that our results underestimate the actual carbon footprint of the financial sector.

Figure 2

Construction of corporate bonds portfolios

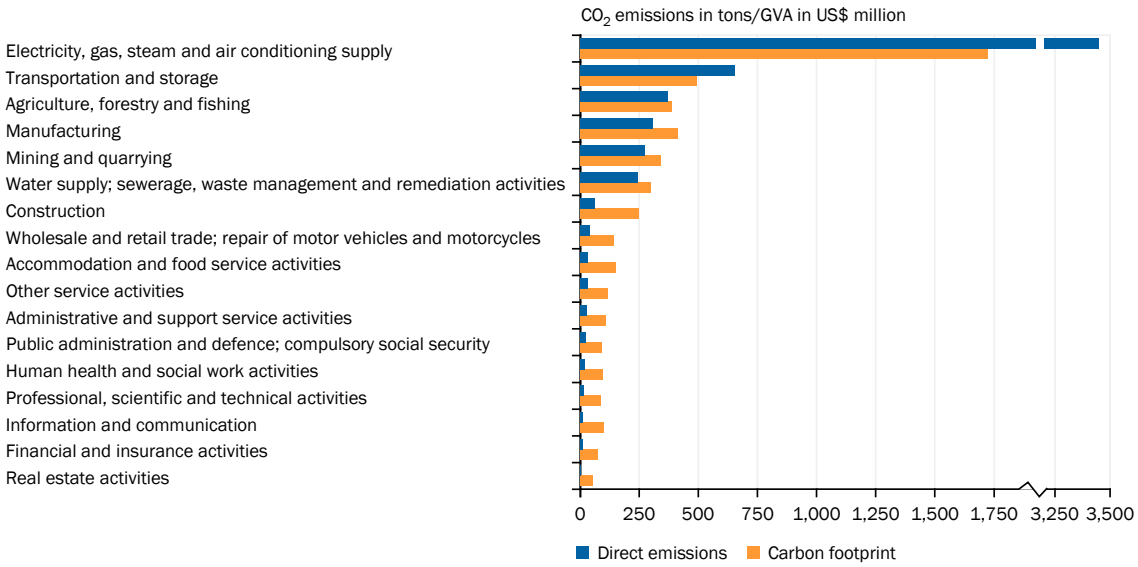


Source: ECB, own calculations

It is notable but not surprising that direct emissions are substantially higher than total embedded emissions measured by the carbon footprint in the most-carbon intensive sectors, electricity and gas as well as the transportation sector. In all other sectors in contrast, the carbon footprint exceeds direct emissions. Unless otherwise stated, we refer to the carbon intensity measured by direct emissions in the following. All our results are qualitatively similar with regard to the carbon footprint. Respective results can be found in the appendix.

Figure 3

Carbon intensity by sector[1]



1 – Direct emissions, carbon footprint and GVA (Gross Value Added) for EU-ETS countries, 2014.

Sources: Corsatea et al. (2019), ECB, Refinitiv Datastream, World Input Output Database (2014), own calculations

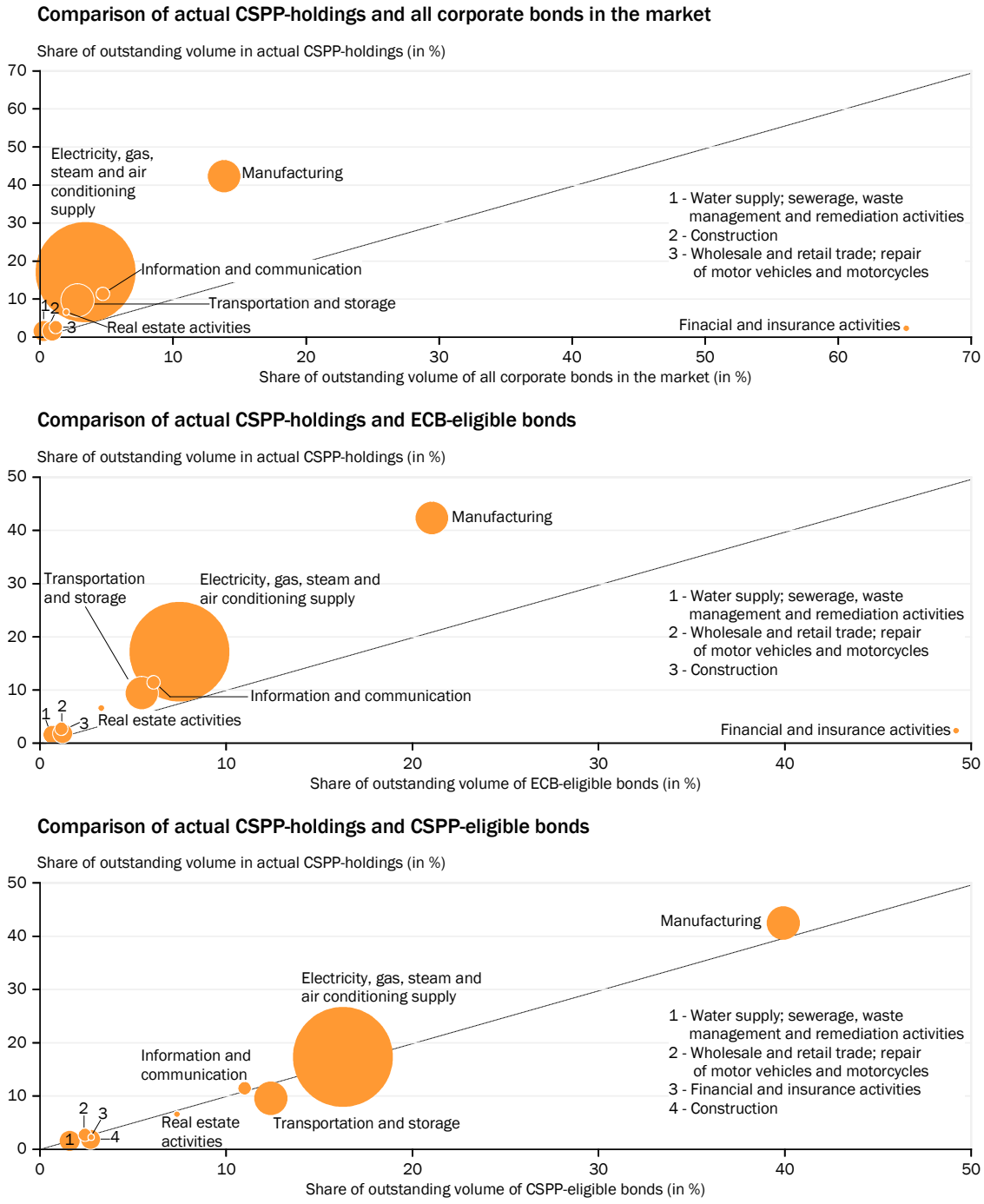
4 What determines the carbon intensity of CSPP holdings?

We aim to contribute to the current discussion by identifying the key sources of carbon intensity in the ECB's corporate bonds holdings. To do so, we compare economic sectors' share of the outstanding volume of actual CSPP-holdings as of May 2020 as well as their carbon intensity with the three corporate bonds portfolios we successively constructed to approximate the portfolio of CSPP-eligible corporate bonds.

When we compare the sectoral composition of asset purchases under the CSPP to the sectoral distribution of all outstanding bonds, we find an apparent divergence in the portfolios' sectoral distribution (Figure 4, above). Relative to all corporate bonds in the market, especially the manufacturing, the electricity and gas, the transportation as well as the information and the real estate sector are clearly overrepresented in actual CSPP holdings. Bonds issued by corporations from the manufacturing sector for example make up 42.5% of the outstanding volume of CSPP-holding, but only 13.9% of the bonds in the market. In fact, the overrepresented sectors within the ECB corporate bond purchases tend to be those from particularly emission-intensive sectors.

Figure 4

Carbon intensity of CSPP holdings (carbon footprint)[1]



1 – Only economic activities accounting for at least 1 % of the outstanding volume of actual CSPP-holdings. Carbon footprint by sector, EU-ETS area, 2014. The size of the circles represents the CO_2-intensity of the respective sector.

Sources: ECB, Refinitiv Datastream, World Input Output Database (2014), Corsatea et al. (2019), own calculations

When comparing actual CSPP-holdings with all ECB-eligible corporate bonds, there also appears to be a difference in the sectoral composition (Figure 4, middle). This divergence is particularly apparent for financial and insurance activities, as only very few bonds are purchasable under the eligibility framework. Regarding rather carbon-intensive sectors such as manufacturing, electricity and gas, as well as

transportation and storage, in all cases, the sectors' shares of outstanding volume in actual CSPP-holdings surpasses their share of ECB-eligible corporate bonds. Specifically, the manufacturing sector accounts for 42.5% of actual CSPP-holdings, while making up only 21% of all ECB-eligible corporate bonds. The most carbon-intensive sector, electricity and gas, accounts for only 7.5% of ECB-eligible corporate bonds, while it is the second largest sector by share of outstanding volume in actual CSPP-holdings (17.3%). A similar comparison holds true for other carbon-intensive economic (sub-)sectors such as transportation and storage, or manufacture of coke and refined petroleum and manufacture of chemicals and chemical products.

When comparing the sectoral composition of asset purchases under the CSPP to the sectoral distribution of CSPP-eligible corporate bonds, we find no evidence for a relevant bias in CSPP-holdings (Figure 4, below). Bonds issued by corporations from the carbon-intensive manufacturing sector make up 42.5% of the outstanding volume of the CSPP-purchases, whereas they account for a slightly smaller share of CSPP-eligible bonds (39.9%). Similarly, asset purchases from issuers of the electricity and gas sector make up 17.3% of actual CSPP-holdings, while their share among the CSPP-eligible bonds is lower by one percentage point. Although CSPP-purchases in the two most carbon-intensive sectors seem to slightly exceed the relative share of CSPP eligible bonds, actual CSPP-purchases are less concentrated in the third most carbon-intensive sector which is transportation and storage. Within this sector, the relative outstanding volume of CSPP-eligible bonds surpasses the share of actual CSPP-holdings by 2.9 percentage points, making up 12.4% of the outstanding volume.

Consequently, under the current interpretation of the principle of market neutrality the ECB does not purchase corporate bonds proportional to the share of outstanding volume of all bonds in the market, but proportional to the share of outstanding volume of CSPP-eligible bonds. This result is not driven by construction. Rather, the ECB does not purchase all bonds that are eligible under the CSPP framework (1,822 bonds), but only a fraction (1,415 bonds). Although the 407 bonds which are not purchased but CSPP-eligible, represent only about 10% of the volume of CSPP-eligible bonds, this divergence shows that the ECB makes purchasing decisions within the set of CSPP-eligible bonds. Our results are qualitatively robust to calculating an economic sector's carbon-intensity with the help of the carbon footprint instead of direct emissions (see Appendix, Figure 7).

These observations have implications regarding the question what determines the carbon intensity of CSPP purchases. As is particularly apparent from Figure 4 (below), the European bond market is dominated by bonds from the financial sector, which has the second lowest sectoral carbon intensity in our dataset (Figure 3). In order to be eligible for purchase under the CSPP, the issuer must be a non-financial corporation. Excluding this large, low-emission sector, the ECB's portfolio automatically overrepresents other, more carbon-intensive sectors. As a consequence, Figure 4 shows that actual CSPP holdings seem to match up with the sectoral distribution of CSPP-eligible bonds, though eligible bonds do not match the bond market as a whole, due in large part to the exclusion of bonds from financial institutions. With regard to the *non-financial* corporate bond market, we can confirm earlier empirical findings that the underlying structure of the market tends to be skewed towards carbon-intensive sectors (Papoutsi et al., 2021): The carbon-intensive manufacturing as well as electricity and

gas sector make up the highest share of outstanding volume in the non-financial corporate bond market. Table 1 compares the carbon intensity of the different bond portfolios that we constructed within our data and supports these views. Actual CSPP holdings (1004 t CO2/GVA in USD millions) have a higher carbon intensity than the portfolio of CSPP-eligible bonds (939 t CO2/GVA in USD millions) and that of all corporate bonds in the market (235 t CO2/GVA in USD millions). Strikingly, when we compare the carbon intensity of actual CSPP holdings to this of bonds that are CSPP-eligible but not purchased by the ECB (408 t CO2/GVA in USD millions), we find that the latter is noticeably lower.

Table 1

Carbon intensity of different ECB portfolios

	1	2	3	4	5
	All corporate bonds in the market	ECB-eligible bonds	CSPP-eligible bonds	Actual CSPP-holdings	CSPP-eligible bonds, not in ECB purchases
	Weighted average carbon intensity (in t CO2/US$ million GVA)				
Direct emissions	234.9	460.6	939.2	1,004.4	408.5
Carbon footprint	188.9	288.5	525.5	549.2	333.0

Sources: ECB, Refinitiv Datastream, own calculations

Our findings therefore document that the carbon intensity of the CSPP purchases is basically determined by three factors: First, by the CSPP-eligibility criteria as these criteria tend to exclude bonds from low-emission sectors, especially the financial service sector. Second, by the underlying structure of the bond market as this tends to be skewed towards carbon-intensive sectors. Third, by the ECB's purchasing decisions within the universe of CSPP-eligible bonds. The ECB tends to select bonds from relatively emission-intensive sectors. Consequently, to decarbonize the CSPP, the ECB can theoretically act along these three lines.

5 How to decarbonize the CSPP portfolio

5.1 Expand the range of eligible low-carbon assets

Within the current setting of the CSPP, opportunities to decarbonize are limited, as the CSPP eligibility criteria tend to exclude bonds from low-carbon sectors. Consequently, adjusting CSPP-eligibility criteria could expand the range of eligible low-carbon assets under the CSPP. A larger portfolio of CSPP-eligible bonds which is on average less carbon-intensive would then emerge. Theoretically, this would allow the ECB to continue purchasing bonds proportional to the eligible bond market and to maintain the principle of market neutrality in its current interpretation, while still reducing the carbon intensity of purchases. However, adjustments to the CSPP-eligibility criteria imply significant trade-offs. The non-bank criterion has an important role in avoiding a potential conflict of interest with the ECB's role as banking supervisor. By requiring the issuer to be incorporated in the euro area, the ECB aims to ensure that CSPP-purchases improve the financing conditions of businesses operating in the euro area and thereby

contribute to stimulating overall economic growth across the euro area. Rating requirements ensure that all CSPP-eligible bonds possess a minimum credit quality. Therefore, it seems unlikely that the ECB will make major adjustments to the current eligibility criteria or abolish any criteria in order to decarbonize the CSPP. Still, there might be scope for minor revisions under the current framework such as to only use ratings that adequately and transparently reflect climate-related financial risks or to limit the maturities of CSPP-eligible bonds (Weidmann, 2021).

To analyze whether such revisions could exert an impact on the carbon intensity of the CSPP portfolio, we consider a hypothetical case in which individual CSPP-eligibility criteria are neglected, while all other eligibility criteria are met. This allows us to calculate an upper bound of an effect on the carbon intensity that could be achieved by adjusting individual currently applied CSPP eligibility criteria. We find that CSPP-eligibility criteria vary in the extent to which they restrict the universe of potentially buyable corporate bonds. Figure 5 (left) shows how the abolishment of a single CSPP-eligibility criterion impacts the outstanding volume of CSPP-eligible bonds and their number, given that all other CSPP-eligibility criteria are fulfilled. For instance, the non-bank criterion deems 3,434 corporate bonds which otherwise would have met all other CSPP-eligibility criteria to be non-eligible under the CSPP. Applied to all CSPP-eligible corporate bonds in the market, the non-financial criterion is the most restrictive eligibility criterion, both in volume and number of excluded securities. Including all those bonds which are deemed ineligible exclusively by the non-bank criterion, would increase the outstanding volume of CSPP-eligible bonds by 693 billion Euro. This finding reflects the structure of the euro area corporate bonds market which to a large extent consists of securities issued by financial corporations.

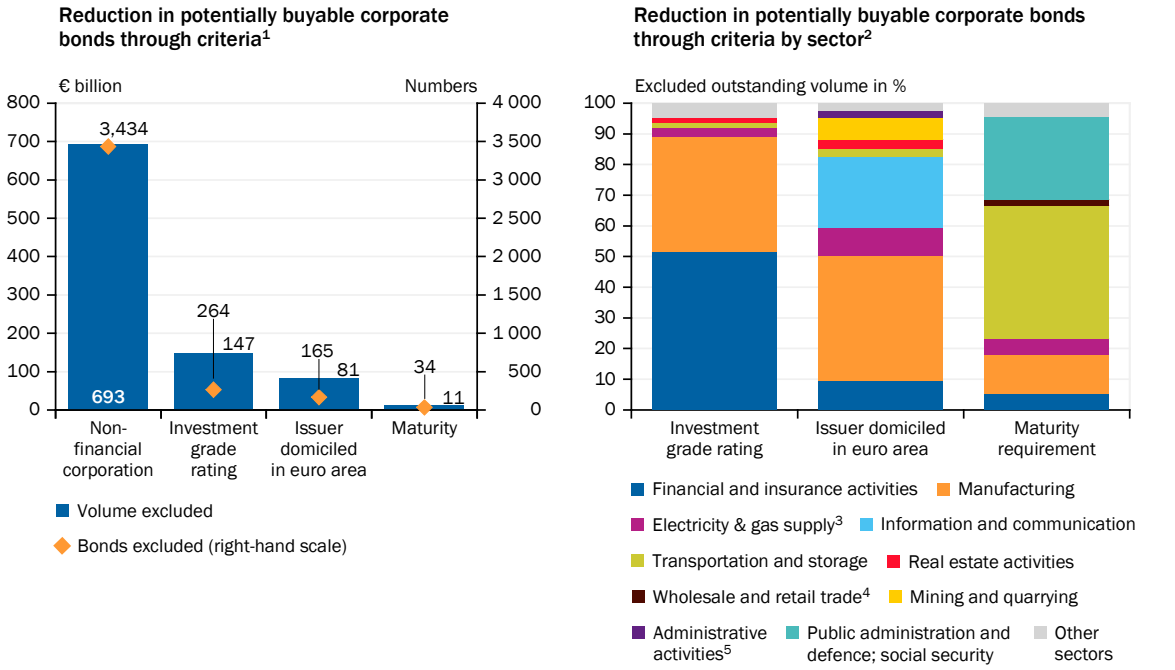
The requirement that assets must be rated investment grade in order to be CSPP-eligible has the second largest impact both by volume and number of bonds. It prohibits the purchase of 264 bonds which account for an outstanding volume of 147 billion Euro. Issue ratings have priority over issuer or guarantor ratings in the eligibility framework (ECB, 2020). Due to limited data availability, we rely on guarantor ratings (i.e., the parent company's issuer rating) in our analysis. The single exclusion of bonds which are euro-denominated but not issued by companies domiciled in the euro area limits the size of the CSPP-eligible bonds by 81 billion Euro (165 bonds). Ultimately, requirements regarding the remaining maturity of CSPP-eligible assets seem to be the least restrictive criterion, solely accounting for the exclusion of 34 bonds which have an outstanding volume of only 11 billion Euro.

How does this translate into the carbon intensity of CSPP eligibility-criteria? Figure 5 (right) suggests that the lack of an investment grade rating seems to particularly apply to bonds issued by the financial and insurance sector (51% of the excluded outstanding volume), followed by the manufacturing (37%), electricity and gas (3%), transportation (2%) and real estate sector (2%). As these sectors differ strongly in their carbon intensity, the net effect of the rating criterion for the carbon intensity of CSPP-eligible bonds initially remains unclear. More than half of the excluded outstanding volume due to the issuer-domicile criterion is issued by particularly carbon-intensive sectors such as manufacturing (26%), manufacture of coke and refined petroleum products (14%), electricity and gas (9%), mining and quarrying (7%) and transportation (2%). However, the same criterion strongly affects bonds issued by

companies from the information and communication sector (23% of excluded volume, 34.2 billion euro) which accounts for a rather low share of CO2 emissions. Among bonds that fail to meet CSPP-maturity requirements, rather carbon-intensive sectors such as transportation and storage (43% of excluded outstanding volume), manufacturing (13%) and electricity and gas (5%) stand out.

Figure 5

CSPP-eligibility and carbon intensity



1 – It is shown how an individual CSPP-selection criterion affects the outstanding volume and number of bonds excluded, given that all other elibility criteria are met. 2 – The volume excluded by a single criterion (see left side) was added to the outstanding volume of actual CSPP-holdings to simulate that this criterion was eliminated. Only economic activities accounting for more than 1 % of the excluded outstanding volume. 3 – Including steam and air conditioning supply. 4 – Including repair of motor vehicles and motorcycles. 5 – Including support services activities.

Sources: ECB, Eurostat, Refinitiv Datastream, own calculations

Table 2 provides an overview on the hypothetical carbon intensity of actual CSPP-holdings, if the volume excluded by a single criterion (given all other criteria are met) were added to the outstanding volume of CSPP-eligible bonds. We find that only the non-financial criterion has a significant impact on the carbon intensity of CSPP-eligible bonds. It reduces the carbon intensity of the CSPP-eligible bonds by 38.5%. However, it has to be noted that we do not assess the carbon intensity for financial institution securities with regard to their portfolios, which should impact our findings as we thereby underestimate the emissions induced by the financial sector. In contrast, the rating-criterion reduces the carbon intensity only by 5.8%. Consequently, even if the ECB would decide to purchase only bonds that are currently not eligible under the rating criterion, the impact on the emission intensity would be small. The issuer-domicile as well as the maturity requirement do not affect the carbon intensity of CSPP-eligible bonds. As has been discussed earlier, these numbers constitute an upper bound of an effect that would only be achieved if the ECB eliminates a certain criterion. Consequently, with the exception of the non-financial criterion, minor revisions in the eligibility criteria should not be associated with a noticeable effect on the carbon intensity of CSPP purchases.

Table 2

Options for decarbonizing CSPP portfolio

		Selection criteria				Tilting Approach (following Schoenmaker (2021))			CSPP-eligible bonds		
Weighted average carbon intensity (in t CO2/US$ millions GVA)	For comparison: CSPP-eligible bonds	Non-bank	Investment grade ranking	Issuer domicile	Maturity	Low	Medium	High	Carbon-intensity of all CSPP-eligible bonds	Carbon intensity of actual CSPP-holdings	CSPP-eligible bonds, not contained in CSPP-holdings
Direct emissions[1]	939,2	577,6	884,6	949,2	932,5	477,2	323,2	172,2	939,2	1 004,4	408,5
Δ[2]		–38,5%	– 5,8%	+ 1,1%	– 0,7%	–49,2%	–65,6%	–81,7%	–	– 6,9%	–56,5%
Carbon footprint[1]	525,5	348,3	504,7	513,3	523,0	309,8	237,8	167,0	525,5	549,2	333,0
Δ[2]		–33,7%	– 4,0%	– 2,3%	– 0,5%	–41,1%	–54,8%	–68,2%	–	+ 4,5%	–36,6%

1 – Weighted average carbon intensity (in t CO2/US$ millions GVA). 2 – Compared to the CSPP-eligible bonds.

Sources: ECB, Refinitiv Datastream, own calculations

Instead of changing the previous eligibility criteria, the ECB could also add new eligibility criteria parallel to the existing framework. In the context of the publication of its climate-related action plan, the ECB itself stated that this could mean, for example, that issuers at least need to comply with, or commit to, the EU legislation to implement the goals of the Paris Agreement (ECB, 2021c). Weidmann (2021) proposes even more specifically that certain climate-related disclosure obligations become a basis for issuers to be eligible for purchases within the framework of the CSPP. Though, in is unlikely that, at least in the short run, such new eligibility criterion would reduce the emission intensity of the CSPP. The reason is that the existing legal requirements for measuring and reporting greenhouse gas emissions are currently mainly focused on emission-intensive companies. In addition, the incentives for voluntary CO2-reporting are significantly higher for emission-intensive companies than for low-emission companies (Tang und Demeritt, 2017). In fact, a potential restriction of the CSPP to companies that disclose climate-related indicators could therefore even increase the emission intensity of the CSPP, not decrease it. HSBC (2020) moreover point to the fact that – at least on paper - the vast majority of European companies already commit to implement the goals of the Paris Agreement. Still, even if climate-related eligibility criteria do not significantly contribute to decarbonizing the CSPP, from a more future-oriented perspective a lot speaks in favor of demanding such climate-related disclosures, as they contribute to increased market transparency and improved risk management.

5.2 Tilt towards low-carbon bonds

Several ways have been discussed to reduce the over-allocation to high-carbon companies within the CSPP purchases by re-allocating the CSPP portfolio. Any such approach would move away from central banks' current interpretation of market neutrality. Proposals range from excluding the most carbon-intensive companies (Reclaim Finance, 2020) to dealing exclusively with low-carbon companies (van 't

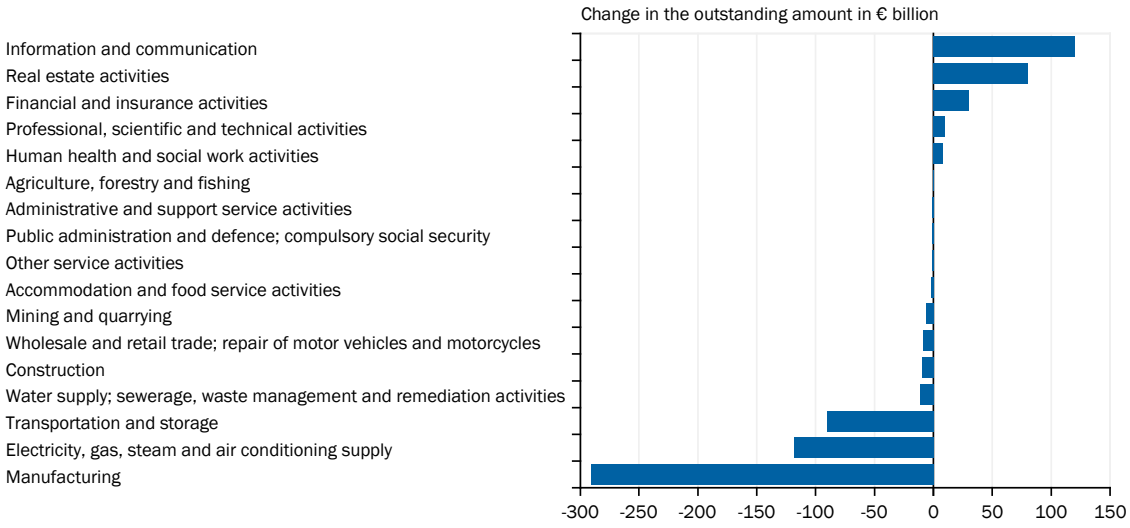
Klooster and van Tilburg, 2020). The problem with these claims is that the central bank would then not maintain a broad asset and collateral base which contributes to minimizing the impact on the functioning of markets and price formation (Bindseil et al., 2017). Thus, it is very important not to 'target' particular assets or sectors. That would impair the price stability objective of monetary policy and might erode support for central bank independence (Mishkin, 2001). Any greening of monetary policy operations should therefore follow a general approach, avoiding sector specific allocations (Smits, 1997) and make sure that the transmission mechanism of monetary policy is not unduly affected (Aksoy & Basso, 2014). Following these considerations, Schoenmaker (2021) suggests a green tilting approach that overweights low-carbon companies and underweights high-carbon companies in the ECB's portfolio. Such approach should then be less distorting in the monetary policy transmission than direct and broad exclusions of asset classes, as the ECB remains present in the whole market for eligible assets, but only adjusts the weights in the portfolio according to the carbon intensity of assets (NGFS, 2021). In the interpretation of the ECB, green tilting does not dispense with the market neutrality principle but replaces it with a more appropriate benchmark that would start to reflect the significant societal costs associated with climate change (Schnabel, 2021; ECB, 2021c).

We apply the approach that has been suggested by Schoenmaker (2021) to the CSPP and our dataset to analyze its impact on the carbon intensity of CSPP-eligible bonds. To do so, we first divide economic sectors on the level of NACE divisions, (e.g. C19: Manufacturing of coke and refined petroleum products) in tertiles and rank them by carbon intensity according to three carbon categories C^{j}: lowest tertile (C^{low} = 1), middle tertile (C^{medium}= 2) and highest tertile (C^{high} = 3). We allocate the set of tilting factors for low-, medium- and high-carbon assets proposed by Schoenmaker (2021) (medium tilting scenario: +1 for the lowest tertile, -0,33 for the middle tertile, -0,67 for the highest tertile; low tilting scenario: +0.75, −0.25 and −0.50; high tilting scenario: +1.25, −0.42 and −0.83) to these carbon categories and calculate corresponding portfolio adjustment factors. We use these portfolio adjustment factors to re-allocate our portfolio of CSPP-eligible bonds.

Our results (Table 2) reveal that in the medium tilting scenario, the carbon intensity of the ECB's corporate bond portfolio with regard to direct emissions is reduced by 66% to 323 tons per sectoral GVA in million US-Dollar compared to the portfolio of CSPP-eligible bonds at 939 t CO2/GVA in million US-Dollar. With regard to the carbon footprint, the medium tilting approach reduces the carbon intensity compared to the portfolio of CSPP-eligible bonds by 55%. The lopsided distribution of carbon emissions with very high carbon intensity in some sectors (i.e., the fossil fuel, materials and utilities sectors in Figure 1) explains this strong reduction. The low tilting scenario reduces emissions by 50%, while the high tilting scenario reduces emissions with 82%. Reductions with regard to indirect emissions are correspondingly smaller (41% and 68%, respectively). In general, our results are therefore very much in line with the numerical examples that Schoenmaker (2021) provides for the effects of a re-allocation of central banks' asset portfolios. Our results also clarify that the effects on the carbon intensity that are achievable depend very much on whether only direct emissions or also indirect emissions are taken into account.

Figure 6

Impact of the Medium Tilting Approach by Schoenmaker (2021) on the volume of CSPP-eligible bonds[1]
Direct emissions



1 – Sectors are ranked and assigned a corresponding tilting factor by their direct emissions. Direct emissions for EU-ETS countries, 2014.

Sources: Corsatea et al. (2019), ECB, Refinitiv Datastream, World Input Output Database (2014), own calculations

Figure 6 demonstrates how the CSPP-eligible bonds could be restructured on a sectoral level under a medium tilting scenario. Our results are qualitatively robust to calculating an economic sector's carbon-intensity with the help of the carbon footprint instead of direct emissions (see Appendix, Figure 8). Apparently, applying such approach is associated with a strong reduction of assets from carbon-intensive sectors, especially from the manufacturing, the electricity and gas as well as the transportation sector. The outstanding volume of CSPP-eligible bonds from the manufacturing sector alone is reduced by nearly 293 billion Euro. This equates to almost 30 percent of the total outstanding volume of CSPP-eligible bonds. In the electricity and gas as well as the transportation sector, the volume of outstanding CSPP-eligible bonds is reduced by 291 billion Euro and 118 billion Euro, respectively. In contrast, especially in the information and communication, the real estate activities and the financial sector the volume of CSPP-eligible bonds increases. For companies from the manufacturing, the electricity and gas as well as the transportation sector the cost of capital should increase relative to low-carbon companies as a result of such policy. While such approach should be associated with less distortions than any approach that excludes carbon-intensive sectors in general, our results therefore reveal that green tilting is associated with a significant divestment from carbon-intensive sectors. It will be difficult to judge how much distortion would lastly be too much.

5.3 Purchase neglected CSPP-eligible bonds

Within the portfolio of CSPP-eligible bonds, the ECB does not purchase all bonds, but only a fraction. As of May 2020, CSPP-eligible bonds which amount to 119 billion Euro were not represented in actual purchases. Studying the carbon intensity of these bonds, we find the interesting result that it is significantly lower than that of the portfolio of actual CSPP purchases as of May 2020 (Table 1). While actual CSPP holdings have a carbon intensity at 1004 t CO2/GVA in USD millions, CSPP-eligible bonds

that are not contained in ECB purchases have a significantly lower carbon intensity at 408.5 t CO2/GVA in USD millions. Consequently, the ECB could theoretically use these bonds to reduce the carbon intensity of its portfolio. This comes with the advantage that it would not require adjusting the eligibility criteria. Moreover, the ECB would maintain its principle of market neutrality.

Comparing the carbon intensity of actual purchases (1004 t CO2/GVA in million US-Dollar) with the carbon intensity of CSPP-eligible bonds that include all assets (939 t CO2/GVA in million US-Dollar) reveals, however, that the scope to reduce the carbon intensity by means of the so far neglected CSPP-eligible bonds is limited. This is not surprising as it supports our earlier finding that CSPP purchases closely mirror the portfolio of CSPP-eligible bonds. In fact, replacing individual carbon-intensive bonds that are currently included in the CSPP portfolio with less carbon-intensive bonds that are currently not included is not advisable to increase the reduction in the carbon-intensity of the CSPP. Precisely, this would imply that the ECB targets particular assets which creates major problems as we discussed earlier. Still, it is remarkable that although the ECB has traditionally claimed to operationalize the principle of market neutrality by ensuring a high degree of transparency around their interventions (Cœuré, 2015), the ECB is already now making purchasing decisions and does not disclose how it selects assets within the CSPP-eligible bond portfolio and why the selected ones are on average more carbon-intensive than the not selected.

6 Discussion: Whatever it takes for a low-carbon economy?

We discussed three practical opportunities to decarbonize the ECB's CSPP: First, adjusting the CSPP eligibility-criteria to expand the number of eligible low-carbon bonds. Second, revising the principle of market neutrality to re-allocate the ECB portfolio from mostly high to mostly low-carbon bonds. Third, purchasing so far neglected bonds from low-emission sectors within the current eligibility and market neutrality framework. Adjusting the framework for eligible assets comes with the advantage that the ECB can continue to purchase bonds proportional to their outstanding volume. However, our analysis reveals that only the non-bank criterion is associated with considerable effects on the carbon intensity of the CSPP-eligible bonds. Taking into account the carbon intensity of bank portfolios, for which no data are available, could also quickly reverse the positive effect. Furthermore, revising this criterion raises significant concerns as it fulfils an important role in avoiding a potential conflict of interest with the ECB's role as banking supervisor. Purchasing so far neglected bonds within CSPP-eligible bonds would allow the ECB to maintain the eligibility *and* market neutrality framework, but does not have a major effect on the carbon intensity of the CSPP purchases. Therefore, it seems that to decarbonize the CSPP portfolio, the ECB would lastly have to revise the principle of market neutrality and recalibrate the portfolio based on climate-related criteria.

The ECB's recently published climate-related action plan starts with two adjusting screws regarding the CSPP: On the one hand, climate criteria are to be included in the eligibility framework of the CSPP. Concrete proposals for adapting the CSPP eligibility-criteria to consider climate protection aspects are to be drawn up by the middle of next year and implemented by the end of 2022. In addition, climate-

related disclosure requirements for the CSPP are to be developed by mid-2023. On the other hand, the concept of market neutrality will be examined. By the end of 2022, the ECB wants to evaluate whether the current interpretation of the principle of market neutrality needs to be adjusted and to develop concrete proposals for alternative benchmarks, particularly with a view to the CSPP. Critics accuse the ECB of reaching the limits of its mandate with its attempt to green the CSPP (Fuest et al., 2021). Contrarily, various members of the executive board argue that it is the central banks' duty to act, given that climate change itself and the measures taken to combat it can affect the primary goal of price level stability (Schnabel, 2021; Knot, 2021; de Galhau, 2021).

The Treaty on the Functioning of the European Union (Article 127) specifies price level stability as the ECB's primary objective. Moreover, the ECB should "support the general economic policies in the Union with a view to contributing to the achievement of the objectives of the Union". To the extent that, first, the central bank's primary objective of price level stability is not affected, and second, the ECB contributes to fighting climate change as a major priority of the EU, the Treaty could be interpreted to include climate change considerations. Consequently, climate aspects can only be considered if necessary for pursuing the monetary policy target or if there is room for maneuver in monetary policy.
Whether the ECB can pursue climate policy through the bond market without compromising the goal of price level stability is not obvious. If purchases are allocated according to a climate target, instead of mirroring the prevailing market structure, the effectiveness of monetary policy is even more exposed to sector-specific fluctuations. Although it has been argued that the possible consequences of a transmission remain cross-sectional as long as the ECB does not target specific assets (Schoenmaker, 2021), green tilting is nevertheless associated with a significant re-allocation between sectors (Figure 6). The question how such dynamics impact on the transmission channel and how much distortion would be 'too much' is not easy to answer. It also requires far-reaching decisions from the ECB. It would have to decide which tilting scenario to implement, i.e., how strongly low-emission companies should be overweighted in the purchases. Correcting market disruptions often lead to complex distributional effects. Such decisions therefore require strong democratic legitimation and are a matter for governments and parliaments. Lastly, QE and thus also the CSPP, were intended to be only a temporary emergency instrument and to be reduced and terminated as soon as traditional monetary policy instruments are sufficient again (Mersch, 2018; Weidmann, 2019). Using the CSPP to support the long-term transition to a low-carbon economy might create institutional pressure to sustain it as a regular practice and creates a conflict of objectives between environmental goals and the ECB's primary mandate of price stability.

Moreover, it remains uncertain whether a deviation from the traditional principle of market neutrality can make a climate-effective contribution, thereby supporting the fight against climate change as a major priority of the EU in the sense of the ECB mandate. Although often mistakenly interpreted this way, decarbonizing the CSPP is not associated with an increased focus on green bonds. As green bonds are issued mainly by companies in carbon-intensive sectors (Figure 1, right), any re-allocation of purchases from high- to low-carbon sectors could also be associated with the ECB reducing its engagement in the market for green bonds. However, it is not obvious whether providing stronger support to green bonds

whose proceeds are used to finance green projects would not be equally or even more effective to unlock green investments and supports the long-term political climate goals even better than shifting portfolios towards currently low-emission bonds by green tilting. Moreover, as empirical evidence indicates that green bond issuance by companies may be associated with a post-issuance improvement in their environmental performance (Flammer, 2021), a de facto reduction in the number of green bonds within the CSPP could be counterproductive. While an explicit targeting of green bonds could be in conflict with the ECB's mandate (Mishkin, 2001) and might push up the prices of these assets leading to undesirable and damaging distortions (De Galhau, 2019) the ECB already purchases green bonds under the CSPP in its attempt to establish a well-diversified portfolio. The ECB is currently holding around 20% of eligible green corporate bonds (Schnabel, 2020a) and is therefore an important investor in the market. As we have argued before, the structure of CSPP purchases is currently basically a reflection of the structure of the euro area corporate bond market and the eligibility criteria formulated by the ECB. Thus, the ECB's purchases of green bonds will mechanically increase if this market segment grows and develops (ECB, 2018; Breitenfellner et al., 2019). Given the dynamic market developments in recent years such scenario seems likely. In fact, it can be observed that with the expansion of the market for green bonds, the number of green bonds that meet the purchase criteria in the CSPP has also increased (ECB, 2018; De Santis, 2018).

Besides these concerns regarding the mandate and the effectiveness of a tilting approach, the practical implementation of green tilting also faces several hurdles. A first challenge is reliable data on carbon emissions. Data on direct emissions is available under the EU's Emissions Trading System (ETS) company database for more than 1000 companies from EU countries at group level. Companies' carbon footprint, however, can substantially differ as we have also hinted at throughout this analysis. Among other things, our analysis therefore demonstrates that it is vital that the ECB makes informed choices about which emissions metrics should be used to decarbonize the CSPP portfolio. Measuring Scope 3 emissions accurately is very hard and there are many data gaps in existing Scope 3 measures (BoE, 2021). A second challenge is that tilting purchases towards low-carbon bonds can have undesired side effects. It punishes emission-intensive companies and rewards low-carbon companies. The benchmark in each case is the actual emission level. Based on that, a tilting approach can withdraw support from companies that are in transition to applying low-carbon technologies or which enable reductions towards zero emissions in other sectors (e.g., manufacturing of wind turbines). However, especially companies (sectors) with currently high emission levels need good refinancing conditions for the transition. Therefore, it is essential to design tilting measures that are forward-looking and do not only take into account current emissions but also expected future emissions (TCFD, 2017). Otherwise, such an approach will critically impair refinancing conditions for the transformation towards a low-carbon economy. However, this poses high demands on climate-related disclosure policies. To prevent the need for an independent assessment through the ECB on which assets fulfill the respective criteria, the ECB needs, to the largest extent possible, to rely on robust and commonly agreed metrics and references (taxonomies). However, existing metrics are usually backward-looking and very sensitive to assumptions, which makes it complicated to use them in operational decision making. Although methodologies are improving, a broad database on companies' future decarbonization plans is therefore

simply not available (GSFC, 2021; BoE, 2021). Hence, if the ECB decides to implement a tilting approach, it will probably need to rely mostly on backward-looking metrics (see also NGFS, 2021). However, only with a view on future emissions should such green tilting offer companies with currently high levels of carbon emissions an incentive to reform and introduce low-carbon technologies (Schoenmaker and Schramade, 2019).

Consequently, it remains that in a short-term perspective an effective tilting approach with regard to supporting the transformation to a low-carbon economy will not be implementable – at least not without large bureaucratic costs. Indeed, even the Network for Greening the Financial System (NGFS, 2021), in which the ECB is a permanent member, stated in its last report that "in the short term, this measure [the tilting approach] would principally have more of a signaling effect". To secure operational feasibility, it has been suggested to implement tilting over time which would allow for carbon criteria to be optimized with regard to future emissions and the impact on the monetary transmission mechanism (Schoenmaker, 2021; NGFS, 2021). However, such long-term implementation strategy seems to stand in sharp contrast to the temporary character of the CSPP. It appears that the ECB itself does not seriously believe in the feasibility of a tilting approach. At least, measures with regard to adjusting the market neutrality principle remain largely unconcreted in the recently published climate action plan (ECB, 2021b).
This paper should not be misunderstood to be a general statement against green monetary policy. Several lines of reasoning have been brought forward by supporters and opponents to argue how far the ECB should support the transition to a low-carbon economy. We leave it to future research to judge which arguments are more convincing. In any case, the decision to take climate considerations into account when designing and implementing monetary policy operations should not be universal but needs to be assessed on a case-by-case basis. There is a large spectrum of possible interventions how central banks could react to climate change (see e.g. NGFS, 2021) – but not all of them might be equally suitable for the intended goal. Our paper concentrates on the evaluation of incorporating climate criteria into the CSPP.

The ECB claims that the transition towards a low-carbon economy, depending on how fast and orderly it occurs, potentially poses a threat to financial stability and that the environmental externalities of economic activities are not adequately priced into financial markets (ECB, 2021c). If this is the case, then supervisory authorities need to ensure that climate-related risks are adequately incorporated into the risk management of banks. With regard to the CSPP this could mean that it could be expedient to include climate-related disclosures to the CSPP, as this should contribute to improved risk management. Moreover, while we have demonstrated throughout our analysis that adjusting the CSPP eligibility-criteria will not make a major contribution to decarbonizing the CSPP, it does have an important indirect impact on supporting the transformation to climate-neutrality: Empirical evidence shows that the disclosure of greenhouse gas emissions by companies reduces investor uncertainty, which pays off in the form of lower capital costs (Bui et al., 2020; Krueger et al., 2020). Higher transparency, on the other hand, is a crucial factor so that financial markets can channel funds into climate-friendly investments (Downer et al, 2020). This evidence demonstrates that the ECB has an important potentially climate-

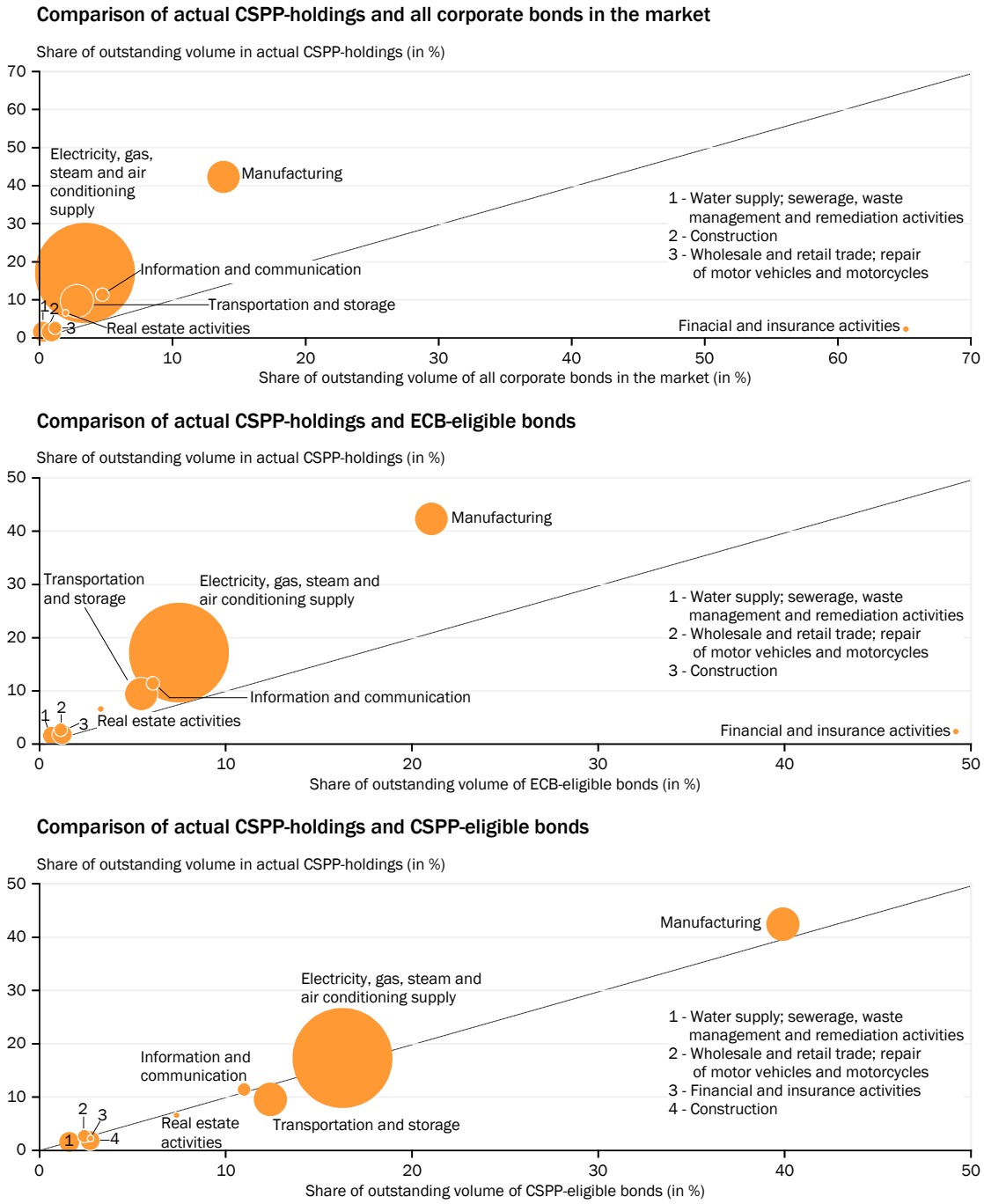
effective lever in hand that is independent of revising the principle of market neutrality.[4] Such a risk-oriented adaptation of the CSPP framework must not be confused with proposals that want to actively steer the behavior of companies for political reasons by re-allocating the CSPP portfolio. The first does not represent an explicit consideration of environmental policy goals – while the second does. Following our analysis and given the significant shortcomings that we identified when decarbonize the CSPP by deviating from the principle of market neutrality, we conclude that revising the principle of market neutrality adds additional complexity and restricts the effectiveness of monetary policy incentives, while improved climate outcomes remain insecure. Moreover, whether such action would be in line with the ECB's mandate is not obvious as it provokes a conflict with its primary goal of price level stability. We conclude therefore that from a simple cost-benefit analysis, decarbonizing the CSPP by revising the concept of market neutrality is not advisable. Indeed, the carbon-intensity of outstanding corporate bonds should (probably automatically) decrease if the stock of pollution decreases through suitable mitigation policies, most importantly through carbon pricing. This should lead to a reduction of the carbon intensity of CSPP purchases under the continuation of a market-neutral policy.

[4] One could argue that by introducing new eligibility criteria the ECB would already deviate from market neutrality as its application could change the composition of the CSPP portfolio in a way that is not necessarily proportional to market capitalization. However, as we have pointed at in our analysis, the ECB is now purchasing bonds not proportional to the bond market but proportional to the eligible bond market. Therefore, the ECB could adjust the eligibly framework and still stick to the traditional principle of market neutrality.

7 Appendix

Figure 7

Carbon intensity of CSPP holdings (carbon footprint)[1]

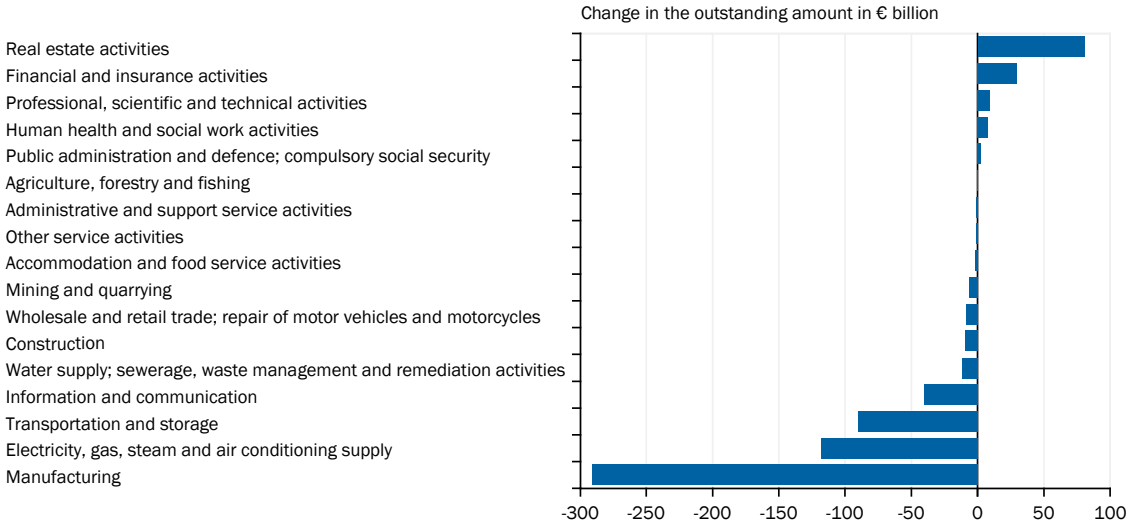


1 – Only economic activities accounting for at least 1 % of the outstanding volume of actual CSPP-holdings. Carbon footprint by sector, EU-ETS area, 2014.

Sources: ECB, Refinitiv Datastream, World Input Output Database (2014), Corsatea et al. (2019), own calculations

Figure 8

Impact of the Medium Tilting Approach by Schoenmaker (2021) on the volume of CSPP-eligibel bonds[1]
Carbon footprint



1 – Sectors are ranked by their carbon footprint. Carbon footprint for EU-ETS countries, 2014.

Sources: Corsatea et al. (2019), ECB, Refinitiv Datastream, World Input Output Database (2014), own calculations

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