

Greening the Swiss National Bank's Portfolio

Rüdiger Fahlenbrach^a and Eric Jondeau^b

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Abstract

We analyze the carbon footprint and emissions of the Swiss National Bank's (SNB) U.S. equity portfolio and compare its carbon performance to those of the world's largest asset manager, BlackRock, and to the Norwegian Government Pension Fund Global (GPF). The SNB portfolio does as well as BlackRock's but has a significantly worse carbon footprint than the portfolio of GPF. Few firms are responsible for much of the carbon emissions of the SNB portfolio so that carbon conscious investment approaches have a large impact on portfolio emissions but little impact on performance, diversification, or tracking error. We explore several avenues to reduce the carbon footprint of the SNB's portfolio, while not altering its financial performance. If the SNB excluded the firms with the highest carbon intensity representing 1% of the portfolio value and reinvested in the companies with the lowest intensity in the same sector, the total financed carbon emissions would be reduced by 22% in 2019, with no impact on the portfolio's financial performance.

Keywords: Portfolio carbon footprint, Decarbonized financial investment.

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^aSwiss Finance Institute and École Polytechnique Fédérale de Lausanne (EPFL), and Enterprise for Society (E4S) Center, 1015 Lausanne, Switzerland. E-mail: ruediger.fahlenbrach@epfl.ch.

^bUniversity of Lausanne, Faculty of Business and Economics (HEC Lausanne), Swiss Finance Institute, and Enterprise for Society (E4S) Center, 1015 Lausanne, Switzerland. E-mail: eric.jondeau@unil.ch.

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1 Introduction

The integration of environmental preferences and the practice of sustainable and responsible investing are widely discussed topics among investment professionals, academics, and policy makers. Survey results confirm that more and more institutional investors commit to the integration of principles of responsible investment in their investment process. Central banks worldwide actively take part in the policy debate. The Network of Central Banks and Supervisors for Greening the Financial System (NGFS) was launched in December 2017 and currently counts 90 central banks, including the Swiss National Bank (SNB), as members or observers. The NGFS seeks to contribute to the development of environment and climate risk management in the financial sector, and recommends its members to lead by example.¹ A working group deals with scaling up green finance, and one of its first publications was a “Sustainable and Responsible Investment Guide for Central Banks’ Portfolio Management.”²

Against this backdrop, the SNB has taken a passive, and for some observers unsatisfying, approach to investing its large foreign currency reserves. The SNB’s foreign currency reserves arose from the frequent currency interventions made to fulfill its monetary policy mandate since 2011, in particular during the period of the enforcement of a minimum exchange rate between 2011 and 2015. At the end of 2020, the SNB held foreign currency reserves in the total amount of CHF 910 billion. Equity investments represent 20% of the currency reserves and the SNB’s equity portfolio of approximately CHF 185 billion makes the SNB an important global equity investor.

According to its annual reports, the SNB manages its equity portfolio passively, based on a strategic benchmark comprising a combination of equity indexes in various markets. It does not generally overweight or underweight particular sectors, although it does not invest in systemically important banks worldwide and in companies that seriously violate fundamental human rights, systematically cause severe environmental damage, or are

¹See <https://www.ngfs.net/en>, accessed on May 6, 2021.

²See <https://www.ngfs.net/sites/default/files/medias/documents/ngfs-a-sustainable-and-responsible-investment-guide.pdf>.

involved in the production of internationally condemned weapons. Other Environmental, Social, and Governance (ESG) aspects are deliberately not taken into account, and the SNB is frequently criticized for the lack of a more active approach.³

Two arguments point in favor of a more active exclusion policy in the current mandate of the SNB. There is a broad consensus among central banks that climate change is a threat to financial stability (Bolton *et al.*, 2020). In particular, the transition to a low-carbon economy may imply that a large fraction of reserves of fossil fuel cannot be extracted. The resulting fall in the value of firms involved in fossil fuel extraction would severely impact the value of the SNB’s portfolio. Adopting a precautionary principle to the management of these climate related financial risks may imply the exclusion, or at least, the downweighting of such firms in the portfolio. Second, in its 2020 annual report, the SNB has announced that it now “excludes shares and bonds of companies primarily active in the mining of coal, as there is a broad consensus in Switzerland in favour of phasing out coal.” This decision suggests that the SNB could adopt a more proactive exclusion policy if there is a sufficient consensus on climate related issues.

In this article, we do not take a stand on whether the SNB *should* take a more active approach regarding ESG issues. Rather, our objective is two-fold. First, we describe the different paths that a large, passive asset manager such as the SNB *could* take regarding ESG issues and, more specifically, carbon emissions. Second, we quantify the impact of a more carbon conscious investment approach on the portfolio’s carbon footprint and financial performance.

Large passive asset managers can pursue two strategies to change corporate policies – voice and exit. Asset managers can voice their preferences directly in individual meetings with portfolio companies or indirectly by voting on management and shareholder proposals at the portfolio companies’ annual general meetings (AGMs). Individual meetings with companies to voice concerns about certain policies require staff and are expensive, and many passive managers therefore refrain from them. While most passive asset managers, including the SNB, vote at AGMs on proposals, the number and scope of

³For one of the most vocal critics, see: <https://www.climate-alliance.ch/swiss-national-bank>.

environmental or carbon-related proposals are still limited. Many of the proposals are restricted to improved disclosure (rather than concrete actions) of ESG policies or carbon emissions. In addition, most proposals are non-binding, i.e., management implements them at its own discretion even if the such proposals pass. Yet, a proxy fight at Exxon in May 2021, in which the environmental activist fund Engine 1 secured several board seats with the support of large passive investors, demonstrated how passive investors can team up with activists to give more bite to the “voice” channel.

The second channel available to passive asset managers is the “exit” channel. If institutional investors are dissatisfied with the ESG policies or the carbon emissions of some of their portfolio companies, they can sell their shares and reinvest the proceeds in companies that are closer to their preferences. If enough institutional investors do so, the exit channel could put pressure on the management of the respective companies, eventually increase their cost of capital, and lead to change. [Gibson *et al.* \(2020\)](#) analyze portfolio choices of institutional investors committed to the Principles for Responsible Investment (PRI) and find that more and more investors “walk the talk” and use the exit channel to rebalance their portfolios for a better environmental footprint.

Our empirical analysis focuses on the carbon footprint of the SNB’s U.S. equity portfolio, for two reasons. The SNB generally does not disclose detailed holdings data of its portfolio. The exception is the U.S. equity portfolio, because the U.S. regulator forces the SNB to disclose its holdings of all publicly listed U.S. companies. The SNB’s U.S. equity portfolio is valued at approximately CHF 100 billion at the end of 2019, which represents 65% of the total value of the global equity portfolio and 14% of the total currency reserves of the SNB. Although there are many different ESG issues, we focus on carbon emissions because of the climate emergency and media attention. In addition, the Greenhouse Gas (GHG) Protocol establishes a comprehensive global standardized framework to measure and manage emissions, and many of the publicly listed companies report their carbon emissions according to the GHG Protocol ([Greenhouse Gas Protocol, 2004](#)).

We compare the carbon footprint of the SNB’s portfolio to that of the portfolio of the world’s largest asset manager, BlackRock. Most of the assets under management of

BlackRock are in passive, index tracking portfolios and thus similarly invested to those of the SNB. We also compare the SNB’s portfolio to that of the Norwegian Government Pension Fund Global (GPF), managed by Norges Bank Investment Management. Also known as the Norwegian Oil Fund, GPF is well known for its ESG-conscious approach. Using S&P Trucost data, we attribute the Scope 1–2 carbon emissions of U.S. companies to their equity investors.⁴ We find that the SNB “owns” approximately 7.3 million tonnes (metric tons) of carbon through its U.S. equity investments in 2019.⁵

In terms of carbon footprint (carbon emissions per million U.S. dollar invested), the SNB’s portfolio does as well as BlackRock once one accounts for the fact that the SNB does not invest in large banks, which have low Scope 1–2 carbon emissions. The SNB’s portfolio has a significantly worse carbon footprint than the more actively managed portfolio of GPF.

We then examine several carbon footprint mitigation strategies, based on the carbon intensity (carbon emissions per million U.S. dollar of revenue) of portfolio companies. We first show that a small subset of portfolio companies has a particularly large environmental impact. In 2019, the 13 (89) portfolio firms with the highest carbon intensity correspond to only 1% (5%) of the market value of the SNB’s U.S. equity portfolio but cause 23% (59%) of its carbon emissions.

The first exit strategy we discuss is a global exclusion strategy, in which the SNB divests the companies with the highest carbon intensity, and over-weights companies with the lowest carbon intensity. Since many firms have a zero carbon intensity and therefore do not contribute to the carbon footprint of the portfolio, the results are quite dramatic: In 2019, the exclusion of the 13 companies mentioned above, from a portfolio of 1,991 companies, would reduce financed carbon emissions by 23%. The exclusion of the 89 companies with the worst intensity would reduce financed carbon emissions by 59%.

The SNB’s standard reply to requests for a more environmentally active approach is

⁴Scope 1 emissions are direct emissions from company-owned and controlled resources. Scope 2 emissions are indirect emissions from the generation of purchased energy. We denote by Scope 1–2 the sum of Scope 1 and Scope 2 carbon emissions.

⁵In comparison, it is estimated that Switzerland emitted 36.9 million tonnes of CO₂ in 2019. Source: Swiss Federal Office for the Environment.

that it is not its mandate – *“It should be noted that the constitutional and legislative authorities have deliberately not tasked the SNB with using its asset management activities to selectively influence the development of certain economic sectors. The SNB’s investment policy therefore cannot be geared to pursuing structural policies, i.e. advantaging or disadvantaging specific economic sectors via positive or negative selections, or promoting or inhibiting economic, political or social change.”*⁶

We therefore also examine two additional strategies that try to address this concern and would not disadvantage specific economic sectors. The first one is sectoral exclusion. With this strategy, the SNB would exclude the same proportion of firms with the highest carbon intensity in each sector, and reinvest the proceeds in the best-in-class companies in that sector. Such a strategy has relatively little impact on total emissions because the most polluting companies are concentrated in a few sectors (utilities, energy, and materials). An effective strategy requires the exclusion of a substantial fraction of firms in some sectors but limited or no exclusion in other sectors (such as financials, health care, and information technology).

The second strategy is global exclusion with sectoral reinvestment. With this strategy, the SNB would exclude firms with the highest carbon intensity overall and reinvest in companies with the lowest carbon intensity in the same sector. Such a strategy maintains the sectoral exposure of the portfolio and provides all diversification benefits. Following this strategy and excluding the same 13 most polluting firms and reinvesting the proceeds in the least polluting firms in the same sectors leads to a reduction of the total financed carbon emissions by 22% in 2019 (53% for the same 89 companies). The impact on the carbon footprint would be similar to the global exclusion strategy, while maintaining the same sectoral exposures as in the initial portfolio.

None of the strategies we analyze would have a meaningful impact on the overall performance of the SNB’s portfolio and hence would not impact the annual distributions of the SNB to its stakeholders. We find that the annual return differences arising from

⁶See the SNB 2020 annual report (p. 95), available at https://www.snb.ch/en/mmr/reference/annrep_2020_komplett/source/annrep_2020_komplett.en.pdf.

our carbon emission reduction strategies are less than 0.1%. As the list of the companies with the worst environmental footprint is also very stable across the years, and our strategies would exclude few companies, we estimate that the cost of implementation of these strategies is minimal.

Overall, exclusion strategies would be very effective at greening the SNB's portfolio and may potentially be carried out within the current mandate. However, the SNB would execute the trades to implement its exclusion strategy in secondary markets, and hence sell the shares of high carbon intensity companies to different investors, with little immediate impact on these polluting companies. If the goal of a carbon conscious investment approach was to reduce global carbon emissions and not only the carbon footprint of its portfolio, the SNB would need to focus on putting more pressure on the most carbon intensive companies to reduce their carbon emissions rather than walking away from those companies. In the last part of the paper, we briefly discuss two such strategies and provide a rough estimate of their potential impact on global carbon emissions. These more active strategies would likely require a new mandate for the SNB.

The remainder of the paper is structured as follows. Section 2 discusses the two strategies that institutional investors can implement to influence corporate decisions. Section 3 describes our data and the methodology adopted in the paper. Section 4 contains the main analysis. Section 5 discusses the main results and describes alternative strategies. Section 6 concludes.

2 Voice and Exit

Practitioners and academics argue that there are two main channels through which large institutional investors could affect corporate decisions: Voice and exit.

2.1 Voice Channel

Large investors can voice their preferences, either actively through individual meetings with a firm's management or more passively and at scale through voting on shareholder

proposals at AGMs. A subset of large shareholders, so-called activist investors, go further and attempt to replace the board or management if the company does not respond to their demands.

Using the “voice” channel can be expensive. For example, the Norwegian GPFG has since its inception in 1990 taken an ever more active approach to corporate governance and sustainable investing. As stated in their 2020 annual sustainability report, it published five position papers, voted on shareholder resolutions at all AGMs of its portfolio companies, and held 2,877 meetings with companies in 2020. Confrontational tactics are even more costly. [Gantchev \(2013\)](#) for example estimates that an activism campaign ending in a proxy fight to displace the board has average costs of \$10.71 million. It is estimated that Engine 1’s proxy fight at Exxon cost \$30 million.⁷ [Greenwood and Schor \(2009\)](#) find that activist hedge funds create value when they are able to effect a change in control. Also focusing on activism, [Dimson *et al.* \(2015\)](#) argue that active engagement from institutional investors leads to superior returns, in particular for portfolio firms with inferior governance.

Most passive institutional investors find the level of engagement of GPFG or activist hedge funds too expensive, especially low-cost and low-overhead passive index tracking institutional investors that cover thousands of stocks and compete for fund flows through fees. Such investors use the voice channel at scale, i.e., they voice general preferences for certain corporate and governance aspects in published guidelines rather than use a case-by-case approach that would require in-depth analysis of firm-specific data to engage individual firms. Researchers have shown that these guidelines can have an indirect effect on corporate governance because corporations monitor what their largest institutional investors want, and because other, more active investors can engage with companies, knowing that institutional investors will support certain of their initiatives ([Couvert, 2020](#); [Appel *et al.*, 2016](#); [Gormley *et al.*, 2021](#)). [Gormley *et al.* \(2021\)](#) describe one such initiative. In 2017, the “Big Three” institutional investors (BlackRock, State Street,

⁷See <https://www.bloomberg.com/news/articles/2021-03-18/exxon-activist-reveals-high-30-million-cost-of-boardroom-battle>.

and Vanguard) launched campaigns to increase gender diversity on corporate boards threatening to vote against directors at AGMs if the slate of director candidates was all male.

2.2 Exit Channel

Alternatively, shareholders who are dissatisfied with certain policies of a corporation can sell their shares in public markets (also known as the “Wall Street walk”). The idea is that if enough shareholders do so, the stock price will decrease, and management and the board will come under pressure to change policies. Evidence shows that institutional investors make active use of the exit channel. [McCahery *et al.* \(2016\)](#) document widespread governance-motivated exits among institutional investors. Similarly, [Aguilera *et al.* \(2016\)](#) show that GPFM significantly rebalanced its portfolio to meet its governance preferences. The main drawback of the exit channel is that it may not be available (or only available to a limited extent) to institutional investors who track indexes and are often paid by tracking error. Institutional investors also worry about losing the benefit of diversification if they exclude too many firms or entire sectors.

If the exit channel is implemented at a large scale, it should have an impact on the cost of financing of excluded firms. For instance, [Heinkel *et al.* \(2001\)](#) find in an equilibrium model with polluting firms that negative screening reduces the pool of available investors, which limits risk sharing and increases the cost of capital. In fact, [Fabozzi *et al.* \(2008\)](#) and [Hong and Kacperczyk \(2009\)](#) find a positive abnormal return for sin stocks and [Bolton and Kacperczyk \(2020\)](#) find a positive abnormal return for carbon-intensive firms. This empirical evidence seems to confirm that carbon-intensive firms should compensate investors for their exposure to carbon emission risk. Recent evidence by [Blitz and Fabozzi \(2017\)](#) however suggests that most of the difference in performance between sin and non-sin stocks can be explained by their relative risk exposures.

2.3 Environmental Corporate Decisions

In principle, institutional investors can use the same two channels – voice and exit – to communicate their preferences on ESG issues and carbon emissions. [Gibson *et al.* \(2020\)](#) report on the tools used by signatories of the PRI and indeed show that the support of shareholder campaigns and voting at AGMs (voice) as well as negative screening (exit) are two of the most commonly applied tools. They examine the ESG portfolio differences between PRI and non-PRI investors and calculate value-weighted average ESG scores for each institutional investor’s stock portfolio (called “ESG footprints”). They report that institutions that commit to responsible investing by joining the PRI network exhibit better ESG footprints than those that did not sign the PRI, suggesting that signatories rebalance their portfolios and actively use the exit channel.⁸

The last several years have also witnessed an increase in shareholder proposals regarding environmental and social issues. Shareholders of the 3,000 largest U.S. public companies filed approximately 200 such proposals per year between 2006 and 2016, but the numbers increased to more than 275 in 2017 and approximately 400 in 2018. Most of the proposals however only ask companies to disclose more information. For example, out of the 400 proposals in 2018, the most common environmental proposals were “Report on Environmental / Sustainability / Water Impact of operations” (41 proposals) or “Disclose Climate Change / Greenhouse Gas Emissions” (33 proposals). Proposals rarely ask for implementation of concrete goals related to environmental and social issues (e.g., reduce carbon emissions by 20%). One potential explanation for the lack of such proposals is that the Security and Exchange Commission (SEC) can grant management the right to exclude proposals from the annual general meeting if they relate to the company’s ordinary business operations (Rule 14a-8(i)(7)).⁹

[Dimson *et al.* \(2015\)](#) examine active engagements by a large institutional investor with a major commitment to responsible investment. It actively engages in dialogues with target companies (4,186 of them in 2014) via letters, emails, telephone conversa-

⁸For details on the methodology, please refer to [Starks *et al.* \(2017\)](#) and [Gibson *et al.* \(2020\)](#).

⁹For an example, see [Exxon Mobil Corporation; Rule 14a-8 no-action letter \(sec.gov\)](#).

tions, and direct conversations with senior management. However, only a subset of these engagements are on environmental issues and the success rate is low.

The overall conclusion from these studies seems to be that the exit channel is today still the most commonly used channel for institutional investors when it comes to environmental issues but that recent events such as the 2021 Exxon / Engine 1 proxy fight show some promise regarding the voice channel.

3 Data and Methodology

Our data sources are Standard and Poor's (S&P) Capital IQ and Trucost databases for equity portfolio holdings and carbon emissions, respectively.

3.1 Equity Portfolio Holdings

We obtain annual snapshots of the equity portfolios of the SNB, the Norwegian Oil Fund (GPF), as well as BlackRock from December 2013 to December 2019. We chose December 2013 as a start date because the SNB began to build a diversified equity portfolio in 2012 and to invest significantly in U.S. equity in 2013.

The source of the S&P Capital IQ data on the equity portfolios of the above three entities is Form 13F that they must file with the U.S. Securities and Exchange Commission (SEC). Institutional investment managers that exercise investment discretion over \$100 million or more in Section 13(f) securities must file Form 13F. The SEC specifies explicitly that governments or political subdivisions, agencies, or instrumentality of government are also considered institutional investment managers under the Securities Exchange Act and have to file. The SEC maintains an official List of Section 13(f) securities. They primarily include U.S. exchange-traded stocks, shares of closed-end investment companies, and shares of exchange-traded funds (ETFs). The SEC only requires institutional investment managers to report on their Section 13(f) securities. Importantly for us, it means that the three institutional investment managers that we consider are not required to report their holdings of non-Section 13(f) securities to the SEC. The SNB for example does not

systematically file all of its non-U.S. equity holdings.

The SNB mentions in its annual report 2019 (p. 84) that “... *at the end of 2019, the equity portfolio comprised mostly shares of mid-cap and large-cap companies in advanced economies. Shares of small-cap companies in advanced economies and shares of companies in emerging economies were also held. This resulted in a globally well-diversified equity portfolio of around 6,800 individual shares.*” The 2019 annual report further specifies that the equity portfolio represented 20% of the total foreign exchange reserves, and that the foreign exchange reserves were valued at CHF 784 billion at the end of 2019. We deduce that the value of the SNB’s equity portfolio was approximately CHF 156.8 billion at the end of 2019. Form 13F of the SNB for Q4 2019 reports holdings of 2,823 stocks with a total market value of \$105.8 billion, which at the exchange rate at the end of 2019 translates into CHF 102.3 billion. Hence, our data capture 42% of the number of stocks and 65.3% of the total equity portfolio value of the SNB.

As the SNB data available in Capital IQ only include a relatively small portion of non-U.S. firms, we exclude them from the analysis.¹⁰ Finally, we exclude firms for which carbon data are not available. Our final sample consists of 1,991 companies (29% of the total number of stocks of the SNB) and \$85.4 billion (54.5% of the total equity portfolio value) in 2019. Our analysis of global corporate carbon emissions indicates that companies in other developed countries tend to be relatively less carbon intensive than U.S. firms, while companies in emerging countries tend to be relatively more carbon intensive than U.S. firms. Hence, we expect that the portion of the SNB’s equity portfolio that is omitted from our analysis due to a lack of data does not differ too much in terms of carbon footprint.¹¹

It is important to note that the SNB implements an exclusion policy for large systemic banks. As explained in its 2019 annual report (p. 85), “*the SNB refrains from investing in shares of systemically important banks worldwide.*” As banks have relatively low Scope

¹⁰Capital IQ reports holdings for 2,263 U.S. firms (84.6% of reported market value), 314 U.K. firms (7.1%), and 96 Canadian firms (3.1%) in 2019.

¹¹We checked for GPF and BlackRock that the non-U.S. part of their portfolio has a similar carbon footprint as the U.S. part of their portfolio.

1–2 emissions, the SNB therefore has, by construction, a worse carbon profile relative to our benchmark portfolios. In addition, banks’ stocks were particularly hardly hit by the Covid-19 crisis, so a portfolio without exposure to the banking sector has been mechanically doing better in the recent past. To make the portfolios more comparable and to avoid wrongly attributing outperformance, we therefore remove banks from the benchmark portfolios as well. More precisely, we exclude firms in the “Diversified Banks,” “Investment Banking and Brokerage”, and “Multi-Sector Holdings” primary industries.

In contrast to the SNB’s holdings, Capital IQ reports more widely on the non-U.S. equity holdings by GPFPG and BlackRock. We remove non-U.S. equity securities for both entities from our analysis to facilitate comparisons. At the end of 2019, the holdings reported in Capital IQ represent 9,181 firms with a total market value of \$827.3 billion for GPFPG and 12,628 firms with a total market value of \$3,673.5 billion for BlackRock. Considering U.S. equity securities with carbon data only, our final sample contains 1,576 firms with a market value of \$289.4 billion for GPFPG and 2,211 firms with a market value of \$2,168.7 billion for BlackRock. We also use the U.S. MSCI index, which is a market-capitalization weighted portfolio of medium-size and large-size firms (1,646 U.S. firms at the end of 2019), as a benchmark in our analysis. We exclude financial institutions in the above-mentioned primary industries from GPFPG and BlackRock portfolios and from the MSCI index.

The SNB, BlackRock, and GPFPG have all made public statements about their approach to sustainable and responsible investment. Excerpts from these public statements are quoted in Appendix A. The bottom line from these statements is as follows: The SNB argues that it does not have a mandate to pursue structural policies. BlackRock emphasizes that sustainable and responsible investment is important to the fund, but does not describe concrete actions. GPFPG is most forceful and publishes a list of actions that it implements.

3.2 Carbon Emission Data

Our analysis of the portfolio carbon footprints relies on annual data from S&P Trucost. This dataset covers a large number of firms globally (from 5,628 in 2013 to 15,663 in 2019) and provides information on the three scopes of carbon emissions. Scope 1 refers to the GHG emissions generated from burning fossil fuels and production processes, which are owned or controlled by the company (direct emissions). Scope 2 relates to the GHG emissions from consumption of purchased electricity, heat or steam by the company (first-tier indirect emissions). Scope 3 relates to other (upstream and downstream) indirect greenhouse gas emissions, such as from the extraction and production of purchased materials and fuels, transport-related activities in vehicles not owned or controlled by the reporting entity, and electricity-related activities not covered in Scope 2. Data are provided in terms of emission (in tonnes of CO₂ equivalent) and intensity (in tonnes of CO₂ equivalent per million U.S. dollars of revenue).

In our analysis, we focus on the sum of Scope 1 and Scope 2 (Scope 1–2 from hereon) emissions for two reasons. First, the availability and quality of Scope 3 emissions data are not as good as for Scope 1–2 emissions. Scope 3 emissions often need to be estimated by the data provider because of the lack of information reported by firms. Usually, only Scope 3 upstream emissions are measured, while downstream emission estimates are very scarce.¹² Second, Scope 3 emissions raise the issue of double counting because Scope 1–2 emissions of some industries are often Scope 3 emissions of other industries. As a well-diversified portfolio includes firms from all industries, including Scope 3 emissions would overestimate the actual portfolio carbon footprint.

3.2.1 Total Carbon Emissions

We assign the total reported carbon emissions to the equity owners of the respective company. If a fund owns 2% of the equity of a corporation, it “owns” 2% of its emissions. The advantage of the total carbon emissions approach is that we gain an idea of the

¹²Trucost also provides information regarding Scope 3 downstream emission. This database starts in 2017, however, which does not allow for a long-term analysis.

magnitude of the financed carbon emissions, and do not report a relative number that allows for a comparison across portfolios but is otherwise difficult to interpret.

The level of carbon emissions is computed as follows. Every year, we observe the market value of the SNB’s portfolio in U.S. equity, as provided by Capital IQ. We compute the carbon emissions of the portfolio by multiplying the emissions of each firm in the portfolio by the fraction of the market capitalization of the firm held by the SNB.

The disadvantage of total carbon emissions is that the total market values of the portfolios of our benchmarks, BlackRock and GPFPG, are larger and are therefore mechanically assigned more carbon emissions. Whenever we compare the total carbon emissions of those three entities, we rescale the value of the portfolios of GPFPG and BlackRock to the size of the SNB’s portfolio, at the end of each year.

3.2.2 Carbon Intensity and Portfolio Carbon Footprint

A standard way to evaluate the impact of an asset manager’s portfolio on climate is to measure its carbon footprint. It depends on the carbon emitted by the constituents of the portfolio. We follow the recommendation of the Task Force on Climate-related Financial Disclosures to evaluate the carbon exposure of a portfolio (TCFD, 2017).¹³ The metric recommended by the TCFD is the *weighted-average carbon intensity*, which measures the portfolio’s exposure to carbon-intensive companies, expressed in tonnes of CO₂ equivalent per million U.S. dollars of revenue. It is defined as:

$$WA-CI_t^{(p)} = \sum_{i=1}^{N_t} w_{i,t} \frac{E_{i,t}}{Rev_{i,t}}, \quad (1)$$

where $E_{i,t}$ represents the carbon emitted by firm i in year t , $Rev_{i,t}$ represents the revenues generated by the firm, and $w_{i,t}$ is the weight of firm i in the portfolio. The portfolio weight is defined as $w_{i,t} = V_{i,t}/V_t$, where $V_{i,t}$ is the dollar value invested in firm i and $V_t = \sum_{i=1}^{N_t} V_{i,t}$ is the dollar value of the portfolio. N_t denotes the number of firms in the

¹³Some research suggests to go even further by assessing the alignment of a portfolio with a temperature trajectory as described by the Paris Agreement. See, among others, [Germanwatch and NewClimate Institute \(2018\)](#) and [Institut Louis Bachelier et al. \(2020\)](#).

portfolio.

As an alternative measure, the *carbon intensity* puts the total carbon emissions that can be attributed to the investor in relation to the total share of revenue attributed to this investor (carbon efficiency of the portfolio). This measure accounts for the fraction of the equity of the firm owned by the portfolio, which we denote by $o_{i,t} = V_{i,t}/Cap_{i,t}$, where $Cap_{i,t}$ represents the market capitalization of the firm. Carbon intensity is measured as:

$$CI_t^{(p)} = \frac{\sum_{i=1}^{N_t} o_{i,t} E_{i,t}}{\sum_{i=1}^{N_t} o_{i,t} Rev_{i,t}}.$$

The carbon footprint of a portfolio (also called “financed emissions”) measures the amount of annual carbon emissions that can be allocated to the investor per million U.S. dollars invested in the portfolio. It is measured as:

$$CF_t^{(p)} = \frac{1}{V_t} \sum_{i=1}^{N_t} o_{i,t} E_{i,t}. \quad (2)$$

3.3 Caveats

First, companies are financed with debt and equity, yet our main approach assigns carbon emissions to the equity owners only. A viable alternative is to distribute the carbon emissions to all financiers of the corporation, i.e., to lending banks, holders of corporate debt, and equity holders in proportions corresponding to the market value of their claims as a fraction of total firm value. These calculations would require details on the owners of corporate debt and the providers of bank financing, to which we do not have access.

Second, the Scope 2 emissions of one company may be the Scope 1 emissions of another company in a well-diversified portfolio, and our analysis double-counts them. Hence the total carbon emissions we attribute to the SNB’s portfolio may be over-estimated. Such double-counting is particularly challenging for the energy sector. For example, an industrial company may report Scope 2 emissions that are released at the facility where the electricity is generated (i.e., the power plant). The power plant itself would report these emissions as Scope 1. If the SNB owns both the industrial company that purchases

and consumes the energy and the power plant that generates it, we count the emissions caused by the energy generation twice. In a robustness test, we assess the severity of the problem, and redo all of our analysis using Scope 1 emissions only. In general, we find that Scope 1 emissions represent approximately 85% of Scope 1–2 emissions. All the main results of our analysis remain valid if we focus on Scope 1 emissions only.

4 Analysis

4.1 Evolution of Carbon Intensity and Footprint Across Time

Before we analyze the carbon intensity of the various funds, we start with the evolution of the carbon intensity and the footprint of the benchmark portfolio (U.S. MSCI index, excluding large banks). For this portfolio, the amount invested in a firm is proportional to its market capitalization. As weights in the benchmark index are proportional to the market capitalization, the carbon intensity of the benchmark simplifies to $CI_t^{(b)} = \sum_{i=1}^{N_t} E_{i,t} / \sum_{i=1}^{N_t} R_{i,t}$ and the carbon footprint to $CF_t^{(b)} = \sum_{i=1}^{N_t} E_{i,t} / \sum_{i=1}^{N_t} Cap_{i,t}$.

Figure 1 reveals that the carbon metrics of the MSCI benchmark index substantially improved over the sample period. The carbon intensity decreased from 210 tonnes of CO₂ per million U.S. dollars of revenue in 2013 to 170 tonnes in 2019, a 20% reduction. This trend reflects the improvement in the energy efficiency of production processes. The carbon footprint decreased from 128 tonnes of carbon per million U.S. dollars invested in 2013 to 73 tonnes in 2019, a 43% reduction. The fact that the carbon footprint decreased more than the carbon intensity can be explained by the larger increase in the market capitalization of U.S. firms relative to the increase in their revenues.

In Figure 2 (Panel A), we now display the carbon footprint of the portfolios of the three large investors compared to the carbon footprint of the benchmark index. As we consider entities with the same investment opportunity set (U.S. firms, excluding banks), the measures are comparable across entities. The figure reveals that the carbon footprint of the SNB’s and BlackRock’s portfolios are substantially larger than the footprint of

the GPFG’s portfolio and the MSCI index. We also observe that the footprints of all portfolios decreased almost continuously over the sample. The footprint is reduced by 49% for SNB, 45% for BlackRock, and 55% for GPFG between 2013 and 2019. This comparison suggests that the SNB and BlackRock did relatively little to improve the footprint of their portfolio over the sample period. In contrast, GPFG clearly improved its footprint relative to the MSCI benchmark, which is consistent with its mission statement.

Panel B of Figure 2 displays the level of carbon emissions that can be attributed to each of the portfolios. The total emissions of the SNB’s portfolio have considerably increased during the period, mainly driven by the increase in the size of its portfolio: The market value of the U.S. equity portfolio has increased by 347% over the sample, while carbon emissions have increased by 122%. Hence, although the carbon footprint of the portfolio improves through time, the SNB “owns” more and more carbon emissions, equal to 7.3 million tonnes in 2019. This number can be compared to the total CO₂ emissions of Switzerland in 2019 of 36.9 million tonnes.¹⁴ Therefore, the carbon emissions generated by the U.S. portion of the SNB’s equity portfolio correspond to approximately 20% of what all of Switzerland has emitted in that year.

Once rescaled to the same market value of the portfolio, total emissions by BlackRock (7.5 million tonnes in 2019) are relatively close to, or slightly above, emissions by the SNB. Numbers for GPFG are much more favorable, as its total carbon emissions are equal to 5.1 million tonnes in 2019 for the same market value of the portfolio. In other words, for the same portfolio size, the GPFG’s portfolio is responsible for 31% less carbon emissions than the SNB’s portfolio.

To evaluate the financial performance of the three portfolios during the sample period, we use the portfolio weights at the end of a given year to compute the portfolio return over the subsequent year. This approach does not provide us with the actual portfolio performance because there may be infra-annual rebalancing, which we do not observe. Instead, we obtain the performance assuming that the number of shares held are constant

¹⁴Data from the Federal Office for the Environment demonstrate that CO₂ emissions in Switzerland have decreased from 43.3 million tonnes in 2013 to 36.9 million tonnes in 2019.

during the year. Table 1 reports the financial performance of the three portfolios over the 2014–2020 period. We observe that the SNB’s portfolio performs slightly better than the other funds. Over the sample period, the average return (including dividends) is equal to 13.8% for SNB (with a Sharpe ratio of 0.83), 13.2% for BlackRock (Sharpe ratio of 0.77) and 13.2% for GPFG (Sharpe ratio of 0.76), while the MSCI index return is equal to 13.7% (Sharpe ratio of 0.81).

In summary, the carbon footprint of the SNB’s portfolio is higher than the carbon footprint of GPFG and similar to the carbon footprint of BlackRock, whereas its financial performance is slightly higher than the performance of the other portfolios. As argued by [Hong and Kacperczyk \(2009\)](#) for sin stocks and [Bolton and Kacperczyk \(2020\)](#) for carbon-intensive firms, the higher performance of the SNB’s portfolio relative to GPFG may be interpreted as the compensation for investing in carbon-intensive firms, as investors may be already demanding a premium for their exposure to carbon emission risk.

We note that the exclusion of banks is important for an accurate comparison between the SNB, GPFG, and BlackRock portfolios. Keeping banks’ stocks held by GPFG and BlackRock would change the carbon footprint and financial performance of both funds. For GPFG, the total carbon emissions would remain equal to 5.1 million tonnes in 2019 but the average return would decrease to 13% (Sharpe ratio of 0.74). For BlackRock, the total carbon emissions would improve to 7.2 million tonnes in 2019 and the average return would decrease to 13% (Sharpe ratio of 0.75).

4.2 Cross-sectional Distribution of Firm-level Carbon Intensity

Before we describe the impact of firm exclusion on portfolio’s carbon footprint, we now comment the cross-sectional distribution of the firm-level carbon intensity. As it will prove important for the subsequent analysis, the distribution of carbon intensities is extremely right-skewed. Figure 3 illustrates the empirical distribution of Scope 1–2 carbon intensity of U.S. firms in 2019. We use a log scale on the x-axis, so that we can see how right-skewed the distribution is. A few companies have particularly large carbon intensities. The top 1% (5%) of companies ranked by carbon intensity have an average intensity of

4,838 tonnes (2,732 tonnes) of CO₂ per million U.S. dollar of revenue.

Figure 4 shows that there are only three industries with particularly large carbon intensities (utilities, energy, and materials). It is also evident from the figure that there is large within-industry variation in these particularly carbon intensive industries. It matters a lot for the carbon footprint of a portfolio whether it is invested in the top or bottom quartile of firms ranked by carbon intensity in the energy sector, but it does not really matter whether it is invested in the top or bottom quartile of firms in the health care or financial sector.

The skewed distribution and large within-industry variation, which is evident from Figures 3 and 4, have important consequences for both the voice and the exit strategies. It means that even a well-diversified investor can exclude a small subset of companies and accomplish a significant reduction in the portfolio footprint. Focusing on a small subset will also reduce trading costs for the exit strategy and engagement costs for the voice strategy. It also shows that in each sector, a best-in-class approach could be implemented.

4.3 Exclusion strategies

We now consider alternative portfolio strategies that would improve the carbon footprint of the SNB by excluding subsets of firms.

4.3.1 Global Exclusion

We start with a global exclusion strategy, which consists of excluding the firms with the highest carbon intensity and reinvesting the proceeds in the firms with the lowest carbon intensity. We sort all companies in the disclosed U.S. equity portfolio of the SNB by their carbon intensity (Scope 1–2 emissions per million U.S. dollars of revenue), in descending order. Then, we identify the companies with the highest carbon intensities until the total dollar value excluded from the portfolio reaches 1%, 2.5%, or 5% of the total market value of the portfolio. These firms are excluded from the “decarbonized” portfolio. The proceeds are then reinvested in the companies with the lowest carbon intensities. We

rebalance the portfolio once a year.

In 2019, for the SNB's portfolio, the exclusion based on 1%, 2.5%, or 5% of the total market value corresponds to 13, 35, and 89 firms, respectively. If we consider the 1% exclusion strategy, the 13 excluded firms have an average carbon intensity (weighted by their weight in the SNB's portfolio) equal to 4,838 tonnes per million U.S. dollars of revenue. Their average carbon footprint is equal to 2,025 tonnes per million U.S. dollars invested. Excluding these firms would therefore reduce the carbon footprint of the portfolio by $0.01 \times 2,025 = 20.3$ tonnes per million U.S. dollars invested. As the carbon footprint of the SNB's portfolio is equal to 86 tonnes in 2019, it would be reduced to 66.4 tonnes by excluding these firms. Reinvesting the proceeds in the lowest intensity firms would contribute to increase the portfolio footprint by 0.1 tonne, for a final footprint equal to 66.5 tonnes.¹⁵

Figure 5 (Panel A) displays the carbon footprint of the SNB's portfolio based on the global exclusion strategy and compares it with the benchmarks. On average over the sample, excluding 1% of the market capitalization would allow the SNB to reduce its carbon footprint by 21%. Its carbon footprint would then be in the same ballpark as the GPF's portfolio. Excluding 2.5% and 5% of the market capitalization would reduce the footprint by 45% and 60%, respectively. In 2019, the reduction in the carbon footprint would be equal to 23%, 42%, and 59%, respectively.

Panel B displays the total carbon emissions for the same exclusion portfolios. In 2019, having excluded 1% of the market capitalization based on the most polluting firms would have reduced the total emissions of the SNB's portfolio from 7.4 million tonnes to 5.7 million tonnes. With the 5% exclusion criterion, the total emissions would have been equal to 3 million tonnes, or 59% below the actual emissions.¹⁶

¹⁵In 2019, the U.S. firm in the SNB's portfolio with the highest carbon intensity is Vistra Corp., a utility specialized in electricity power generation, with a carbon intensity of 8,957 tonnes per million U.S. dollars of revenue and a weight of 0.03% in the U.S. equity portion of the SNB's portfolio with carbon data. The firm with the largest market capitalization that would be excluded in the 1% exclusion strategy is the Southern Company, a utility specialized in natural gas power generation, with a carbon intensity of 4,435 tonnes per million U.S. dollars of revenue and a weight of 0.34%. Among the 13 firms excluded, 10 are utilities, 2 are energy firms, and 1 is in the materials sector.

¹⁶Using Scope 1 carbon data instead of Scope 1–2 data would have a limited impact on our results.

Table 2 (Panel A) reports the financial performance generated by the global exclusion strategy. The 1% and 2.5% exclusion portfolios would have had no material impact on the financial performance of the SNB's portfolio. The average return would have been equal to 13.8% and 13.9%, respectively. The 5% exclusion portfolio would have even benefited from a slightly higher average return (14.2% on average, with a Sharpe ratio of 0.84).

4.3.2 Sectoral Exclusion

When investors consider building a portfolio based on the exclusion of stocks with some specific characteristics, they face the issue of changes in risk exposures. Excluding high-carbon intensity firms might severely affect sectoral exposures. On the one hand, most of the excluded firms are from the utilities, energy, and materials sectors. On the other hand, some sectors are low carbon intensive and therefore mechanically over-weighted in the portfolio resulting from the global exclusion strategy, in particular the financial, health care, and information technology sectors. The utilities sector would be the most affected by the global exclusion strategy. In 2019, 20% of the market value of the utilities sector would be excluded from the SNB's portfolio with the 1% threshold. With the 2.5% and 5% thresholds, the excluded market value would even jump to 47% and 74%, respectively. Although such an exclusion would be desirable from a carbon footprint perspective, it may severely affect the risk exposure of the portfolio.

To address this issue, we now consider a sectoral exclusion strategy. With the 1% threshold, we exclude in a given sector all firms with the highest carbon intensity until the total dollar value excluded reaches 1% of the market value of the sector. Then, the proceeds are reinvested proportionately in firms in the same sector with the lowest carbon intensity (and representing 1% of the market value of the sector). The portfolio weights of these "green" firms with the lowest carbon intensity double.

On average over the sample, excluding 1% (5%) of the market capitalization would allow the SNB to reduce its carbon footprint by 23% (68%). The total emissions attributed to the SNB's portfolio would be reduced from 5 million tonnes to 3.8 million tonnes with the 1% exclusion and to 1.6 million tonnes with the 5% exclusion.

As Figure 6 reveals, the three sectoral exclusion portfolios, based on 1%, 2.5%, and 5% of the market capitalization in each sector, have a much more limited impact on the carbon footprint. On average over the sample period, the 1% exclusion results in a reduction of the carbon footprint of the SNB's portfolio by 4% only. Increasing the exclusion to 5% of the market value decreases the portfolio footprint by 13.1% and total emissions by 13%, i.e., to a level close to the MSCI index. The carbon footprint of the 5% portfolio is still 17% higher than the footprint of the GPF's portfolio.

Table 2 (Panel B) indicates that the impact of sectoral exclusion on the financial performance is minimal. This result is expected, as the exclusion process affects all sectors to the same extent and therefore has limited impact on risk exposures.

We conclude that excluding the same fraction of the portfolio within each sector would not be able to significantly reduce the carbon footprint of the SNB's portfolio: In some sectors, some highly polluting firms would not be excluded; in some other sectors, some very low carbon intensity firms would be excluded.

4.3.3 Global Exclusion with Sectoral Reinvestment

An alternative strategy consists of excluding firms at the portfolio level but reinvesting the proceeds at the sectoral level in order to keep the same sectoral exposure as in the initial portfolio. We proceed as follows. As before, we exclude globally the firms with the highest carbon intensities until the total dollar value excluded from the portfolio reaches 1%, 2.5%, or 5% of the total market value of the SNB's portfolio. Then, we measure how much of the market value of each sector is excluded with this process and we reinvest the proceeds in the firms with the lowest carbon intensity in this sector. For instance, assume that in the exclusion process, 20% of the market value of the utilities sector is lost by excluding high carbon-intensity firms. We identify the utilities with the lowest carbon intensities until the total dollar value reaches 20% of the market value of the utilities sector in the initial portfolio. For these low carbon-intensity firms, we double their weight, so that the energy sector represents exactly the same proportion as in the initial SNB's portfolio. By doing so, we exclude the firms with the highest carbon

intensity, while keeping the same sectoral exposures.

Figure 7 (Panel A) displays the carbon footprint of three exclusion portfolios, based on 1%, 2.5%, and 5% of the market capitalization. We find that the 1% exclusion is still sufficient to reduce the carbon footprint of the SNB’s portfolio by 20% on average over the sample period. The resulting SNB’s carbon footprint is slightly above that of the GPFG’s portfolio (8% higher on average over the sample period, 10% higher in 2019). Increasing the exclusion threshold to 5% of the market value is sufficient to decrease the portfolio footprint by 54%.¹⁷

When we consider the total emissions of the portfolios (Panel B), we note that the 1% exclusion would allow the SNB to reduce the carbon emissions of its portfolio to a level slightly above the emissions generated by the GPFG’s portfolio (with the same portfolio market value). In 2019, total emissions would have been reduced from 7.4 million tonnes to 5.8 million tonnes, i.e., 13% above the GPFG’s emissions. Increasing the exclusion to 5% of the market value would cut total emissions by 53%.

As Table 2 (Panel C) reveals, the ex-post financial performance of the portfolio would not be affected by the exclusion, as the cumulative return and the Sharpe ratio for all thresholds would remain at the same level as for the initial portfolio.

4.3.4 Implementability of the Exclusion Strategies

The global exclusion strategy leads to the largest reduction in emissions, with little impact on the realized financial performance. However, the global exclusion strategy shifts sectoral risk exposures in a way that an entity such as the SNB may not find desirable. The sectoral exclusion, which implements a “best-in-sector” approach, leads to the least deviation from the original portfolio, but it also leads to the lowest carbon reduction. The global exclusion with sectoral reinvestment strategy combines the advantages of the two other approaches. Using the global exclusion criterion excludes the companies with

¹⁷Note that the strategy that excludes 5% of the market value of the portfolio would exclude utilities (with the highest intensity) representing 74% of the market value of the utilities sector. With the sectoral reinvestment strategy, the proceeds would be reinvested in the remaining utilities (with the lowest intensity) representing 26% of the utilities sector.

the highest carbon intensity overall, while the sectoral reinvestment maintains portfolio diversification.

How expensive would it be to implement that strategy? Potential issues are the increase in trading costs through portfolio turnover, monitoring fees, increase in tracking error, and purchase cost of carbon emission data.

Trading cost and monitoring fees are low if the carbon intensity rankings are relatively stable. The more stable the ranking, the less turnover and the less monitoring is required. We have evaluated the stability of the carbon intensity ranking as follows. For a given threshold (1%, 2.5%, or 5%), we store the list of firms with a carbon intensity above this threshold. Then, we compute the correlation of the list from one year to the other. The average correlation is equal to 42% for the 1% and 2.5% thresholds and 48% for the 5% threshold. The high correlations suggest that the list of excluded firms is quite stable over time, thus limiting the cost of rebalancing the portfolio.

We also calculate two measures of tracking error, defined as the annualized volatility of the difference between the SNB's portfolio return and the return of a reference portfolio. The first reference portfolio we consider is the initial SNB's portfolio. For our preferred strategy with global exclusion and sectoral reinvestment, the tracking error is low because proceeds from excluded firms are reinvested in firms in the same sector. Even with a 5% threshold, the tracking error is only 0.2% per year.

The second reference portfolio we use is the U.S. MSCI index. The tracking error between the U.S. MSCI index and the original SNB's portfolio is equal to 1.1%, reflecting the investment strategy of the SNB. For any exclusion threshold in the global exclusion and sectoral reinvestment case, the tracking error is actually lower than 1.1% per year. Hence, concerns about increases in tracking error due to exclusion are unwarranted.

Finally, the cost for carbon data is minimal given the size of the SNB's equity portfolio. In addition, corporate carbon disclosure will become more prevalent and the cost for carbon data will decrease over time, as an increasing number of investors will share the cost of the data collection.

5 Discussion of Results and Alternative Strategies

The exclusion strategies we presented in the prior section are very effective at reducing the carbon footprint of the SNB’s portfolio, without an impact on its financial performance. A fundamental question though is what the ultimate goal of a carbon conscious investment strategy for the SNB should be. Is it risk management and the wish not to hold “brown” companies? Or is it to have an impact, i.e., to bring about change and to reduce global carbon emissions?

The SNB would implement the different exclusion strategies we discussed by selling shares in secondary markets, i.e., it would sell its holdings of high carbon intensity companies on the stock exchange to different investors. Such a strategy per se would not affect the targeted company, in the sense that the company would not have less capital to carry out its investments. It merely reallocates the financed carbon emissions to a different investor. Proponents of exclusion strategies ought to be aware that the effect on global carbon emissions is at best indirect: It could be that fewer investors would participate in a future equity or debt financing round for the excluded companies and that therefore the company’s cost of capital increases in the future. It could also be that the remaining investors become dissatisfied with management and push for change, but then the solution to the problem is delegated from those who exit to those who stay. Exclusion strategies have been criticized as individually effective but globally ineffective. If the goal of a carbon conscious investment approach was to reduce global carbon emissions, then an effective strategy would need to aim at putting more pressure on the most carbon intensive companies to reduce their carbon emissions.

Such a more active approach would probably require a political mandate, as Thomas Jordan, chairman of the governing board of the SNB, has frequently pointed out. The SNB would however not be the first central bank to receive such a mandate; the British government made environmental and climate goals an explicit part of the Bank of England’s monetary policy in March 2021.

In our preferred strategy (global exclusion with sectoral reinvestment), we sell compa-

nies in a specific sector and reinvest the proceeds in the same sector, which may increase pressure on companies to improve their carbon footprint. Still, the sectors are very broadly defined and the excluded companies may convincingly argue that the chosen replacement companies have little in common with themselves (e.g., a utility producing electricity with coal is sold and the proceeds are reinvested in a utility producing electricity with renewable energy). In such a scenario, they would not feel much pressure to change. What if we implemented a strategy in which we followed a stricter best-in-class reinvestment approach, where we sell one utility company producing electricity with coal and invest in the least polluting publicly listed utility producing electricity with coal available in the U.S. market? If enough investors carried out such a reallocation to truly *comparable* companies, the strategy could be more effective at increasing the pressure to improve the carbon footprint of the targeted companies.

With such an exclusion strategy at the primary industry level, the SNB would see, as before, an immediate reduction in its own carbon footprint. As Figure 8 reveals, in 2019, with the 1% exclusion, total carbon emissions attributed to the SNB's portfolio would be reduced from 7.4 million tonnes to 6 million tonnes, corresponding to a 18% reduction. Increasing the exclusion to 5% of the market value would cut total emissions by 33%. As indicated in Table 2 (Panel D), financial performance would not be affected in any significant way. If this strategy forced the most polluting companies to reconsider their carbon intensity, it would have in addition a long-term effect of reducing global carbon emissions. To estimate the global reduction in carbon emissions, one has to make assumptions on how the excluded companies would react. Suppose that each of the excluded companies would strive to improve its carbon intensity to become like the average of the non-excluded companies in its primary industry. For instance, in 2019 the 1% exclusion strategy would lead to nine electric utilities getting from an average carbon intensity of 4,567 tonnes per million U.S. dollars revenue to a carbon intensity of 2,223 tonnes per million U.S. dollars of revenue. Assuming that revenues of these companies would not change, total emissions by these nine firms would decrease from 329 million tonnes to 159 million tonnes in 2019, a 52% reduction. With this strategy, the impact

on the SNB’s own portfolio footprint would be lower than in the global exclusion with sectoral reinvestment strategy because the SNB would continue to hold some shares in the ‘best of the worst’ companies, but it would have contributed to a substantial reduction in global carbon emissions.

An alternative strategy to reduce global emissions follows a “voice” approach. The SNB would sell no shares and remain shareholder in all portfolio companies. However, it would publicly disclose that it will vote from now on at AGMs in favor of, say, activist strategies similar to the one successfully carried out by Engine 1 at Exxon. The effectiveness of such a strategy to reduce global emissions depends on the frequency of activism campaigns, the success of those campaigns, and the post-campaign impact of the activist on carbon emissions. For example, if every other of the 13 highest carbon intensity firms was targeted, and if the campaign was successful in half of the cases, and if the activist managed to reduce carbon emissions at targeted companies by 25%, the carbon footprint of the SNB’s portfolio would be reduced by $0.5 \times 0.5 \times 0.25 \times 20\% = 1.25\%$, where 20% corresponds to the reduction in the carbon footprint in the 1% exclusion strategy in 2019. This reduction in the portfolio’s footprint would translate one-to-one in a reduction of global carbon emissions. There would, however, be no immediate reduction in the carbon footprint of SNB’s portfolio.

6 Conclusion

The SNB held foreign currency reserves in excess of CHF 900 billion at the end of 2020. In recent years, a public debate has begun on whether the SNB should follow a sustainable and responsible investment approach. We examine the carbon footprint of the SNB’s U.S. equity portfolio, compare it with several benchmarks, and ask to what extent a more carbon conscious investment approach could reduce the SNB’s footprint.

Over the 2013–2019 period, the SNB’s portfolio has the same carbon footprint as the portfolio of BlackRock, the world’s largest passive investment management company. The Government Pension Fund Global of Norway, which has taken a more active approach

regarding carbon emissions, has a significantly lower footprint than the SNB.

However, should it choose to do so, we demonstrate that the SNB could implement a simple strategy that would significantly and immediately reduce its own carbon footprint to the level of the GPFG's portfolio, without an impact on portfolio's financial performance and with negligible costs. Because there is a small subset of particularly carbon intensive firms, the exclusion of 89 firms in a portfolio of 1,991 firms (representing 5% of the portfolio market value) would reduce total financed carbon emissions by almost 60%.

Strategies that not only reduce the carbon footprint of the SNB's own portfolio by shifting carbon emissions to other investors, but also contribute to an actual reduction in global carbon emissions, require a longer-term approach and likely a revised political mandate for the SNB.

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Table 1. Financial Performance and Carbon Emissions

	SNB	GPF	BlackRock	MSCI
Annualized return (in %)	13.8	13.2	13.2	13.7
Annualized volatility (in %)	16.0	17.2	16.8	16.3
Sharpe ratio	0.83	0.76	0.77	0.81
Tracking error (in %)	1.11	1.43	1.38	0.00
Carbon footprint	128.7	96.0	130.0	104.3
Carbon emissions	5.93	4.31	6.09	5.19

Note: The table reports financial performance and the carbon characteristics (footprint and emissions) of the three portfolios under study and the MSCI index. Carbon footprint is in tonnes of CO₂ equivalent per U.S. million dollars invested. Carbon emissions are in million tonnes of CO₂ equivalent. Statistics are calculated based on actual U.S. equity portfolio holdings with available carbon data between 2013 and 2019.

Table 2. Financial Performance and Carbon Emissions of Alternative Strategies

	Panel A			Panel B		
	Global exclusion and reinvestment			Sectoral exclusion and reinvestment		
	1%	2.5%	5%	1%	2.5%	5%
Annualized return (in %)	13.8	13.9	14.1	13.8	13.8	13.8
Annualized volatility (in %)	16.1	16.2	16.3	16.0	16.0	16.0
Sharpe ratio	0.83	0.83	0.84	0.83	0.83	0.83
Tracking error (in %)	1.00	0.89	0.91	1.07	1.06	1.04
Carbon footprint	102.2	70.5	51.7	123.6	119.2	111.9
Carbon emissions	4.64	3.30	2.45	5.71	5.50	5.16

	Panel C			Panel D		
	Global exclusion with sectoral reinvestment			Global exclusion with Primary industry reinvestment		
	1%	2.5%	5%	1%	2.5%	5%
Annualized return (in %)	13.8	13.8	13.7	13.8	13.8	13.9
Annualized volatility (in %)	16.0	16.0	16.0	16.0	16.0	16.0
Sharpe ratio	0.83	0.83	0.82	0.83	0.83	0.84
Tracking error (in %)	1.11	1.11	1.11	1.11	1.11	1.14
Carbon footprint	103.5	80.1	59.8	107.5	94.9	88.5
Carbon emissions	4.71	3.73	2.81	4.92	4.34	4.04

Note: The table reports financial performance and the carbon characteristics (footprint and emissions) of the four alternative investment strategies. Carbon footprint is in tonnes of CO₂ equivalent per U.S. million dollars of revenues. Carbon emissions are in million tonnes of CO₂ equivalent.

Figure 1. Current Carbon Measures of the U.S. MSCI Index (Excluding Banks)

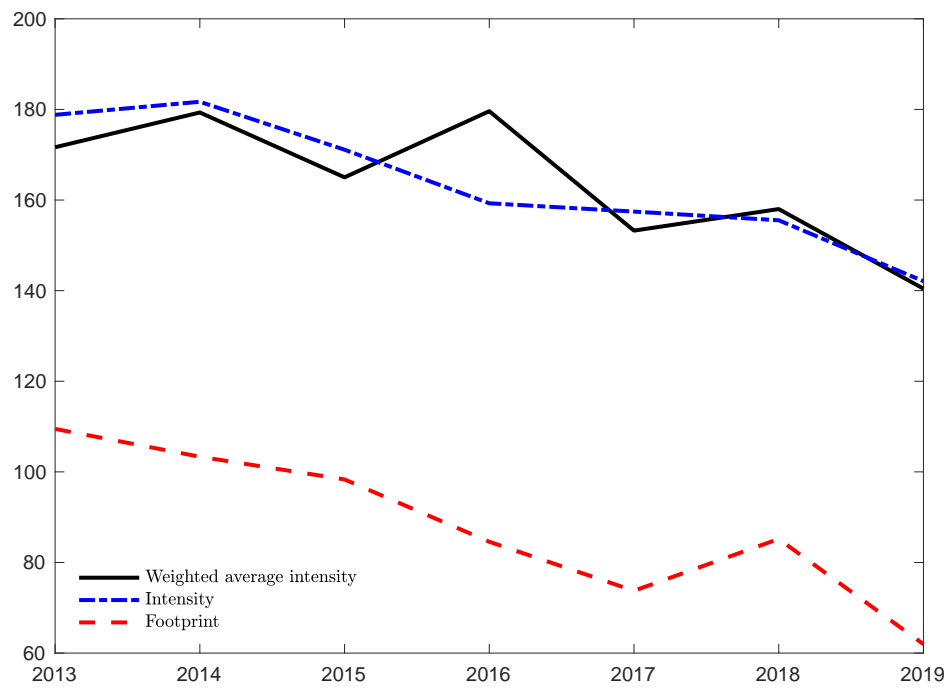


Figure 2. Current Carbon Measures of the SNB Portfolio vs. Benchmarks

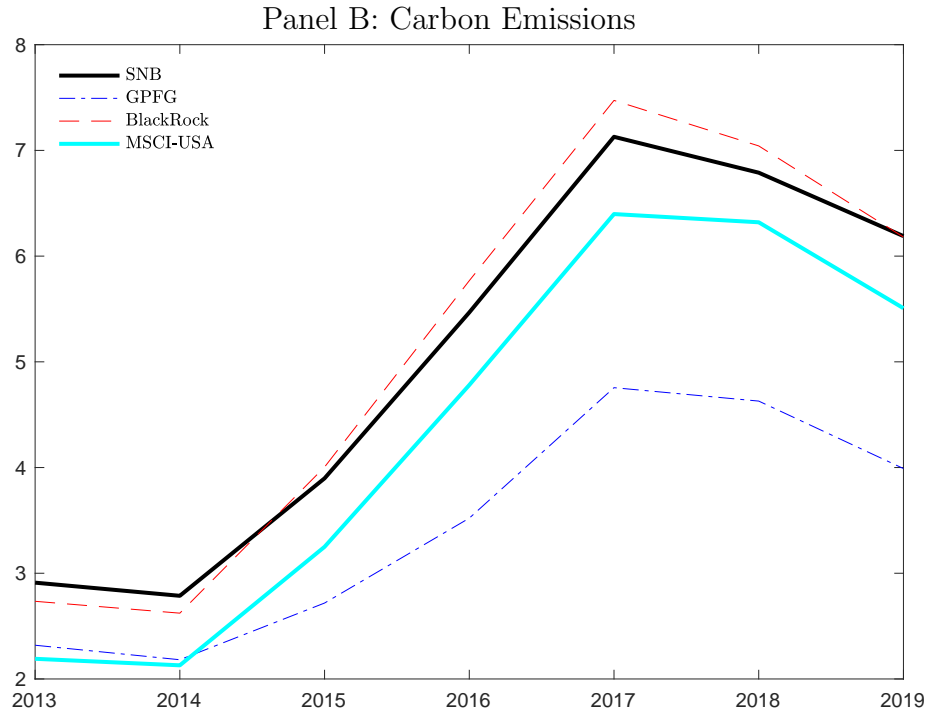
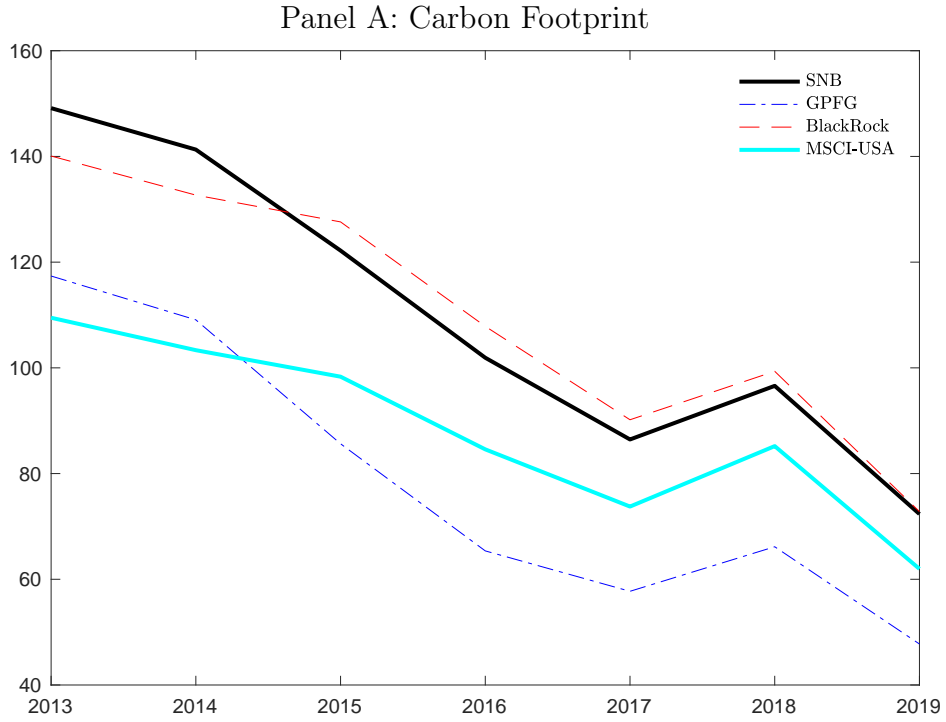


Figure 3. Distribution of Scope 1–2 Carbon Intensity (log scale)

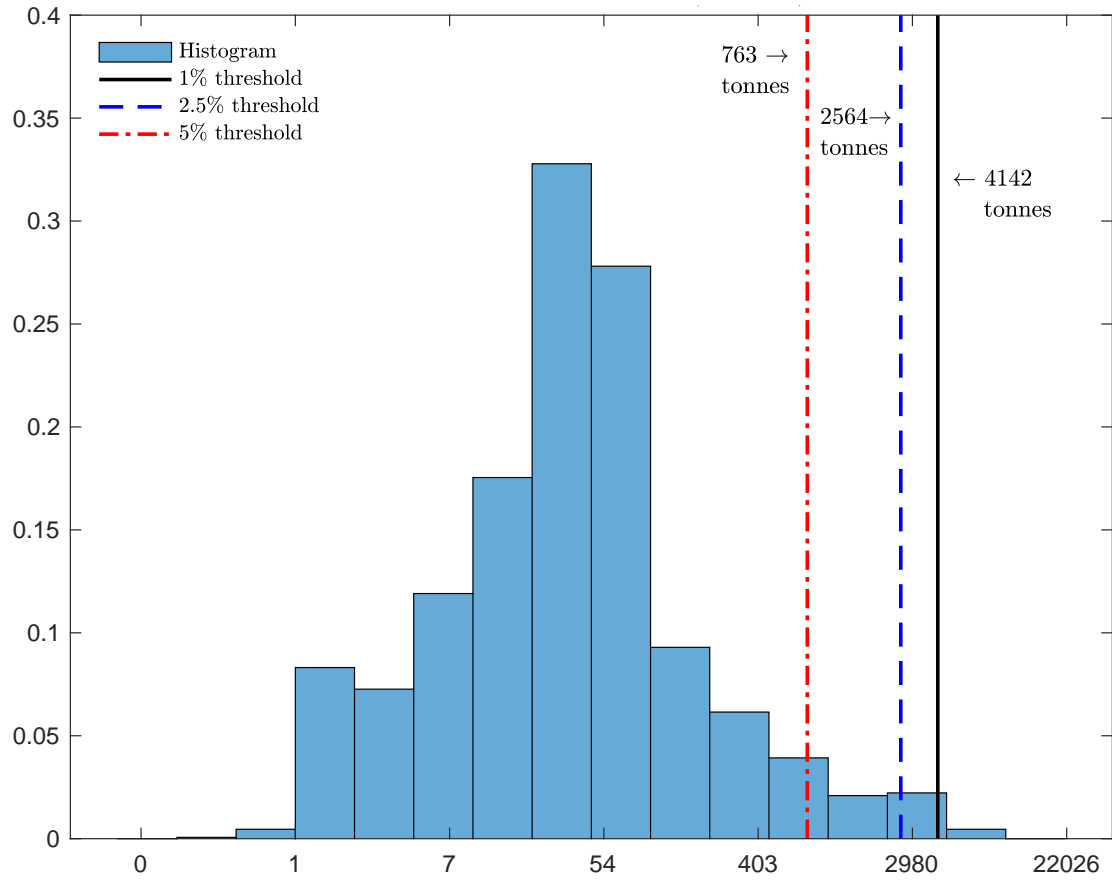


Figure 4. Distribution of Scope 1-2 Carbon Intensity by Sector

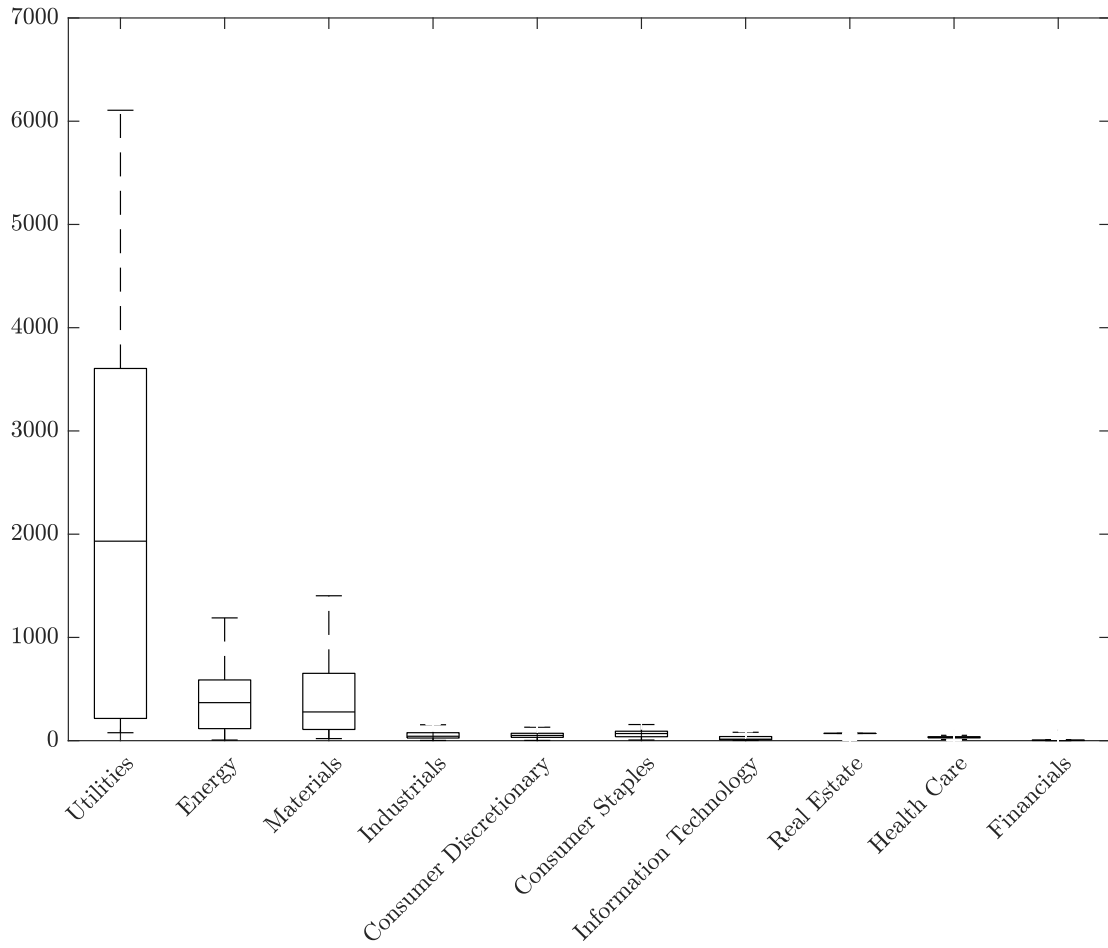


Figure 5. Carbon Measures with Global Exclusion and Reinvestment

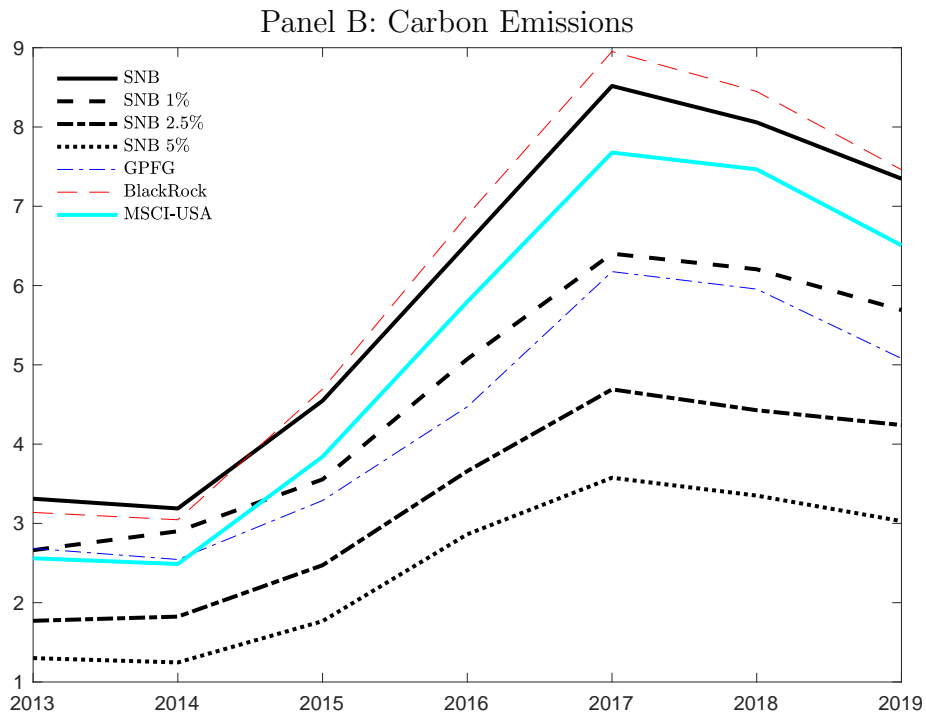
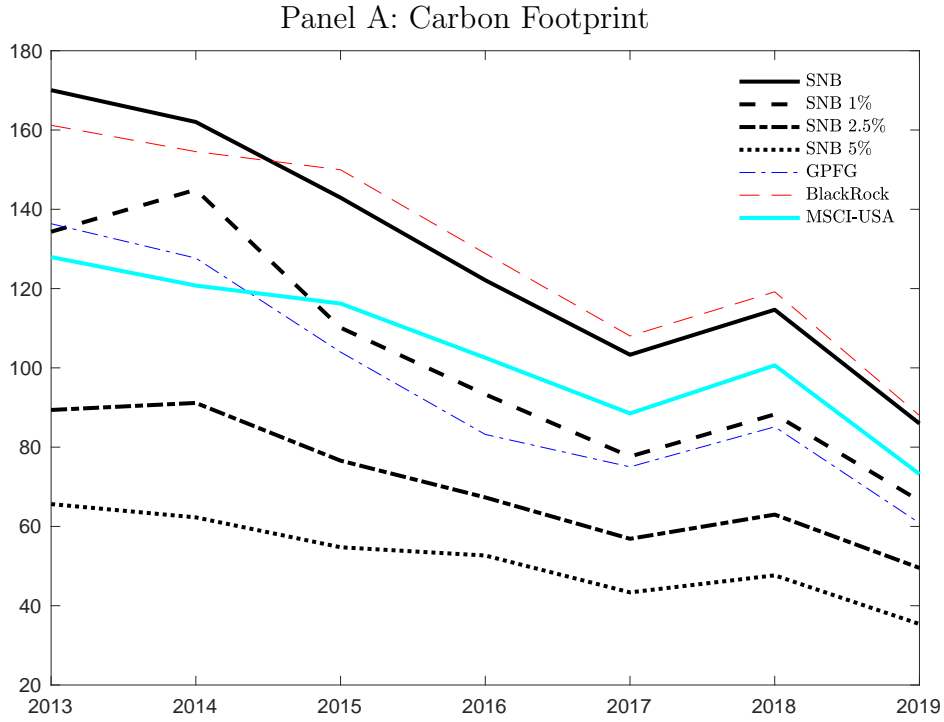


Figure 6. Carbon Measures with Sectoral Exclusion and Reinvestment

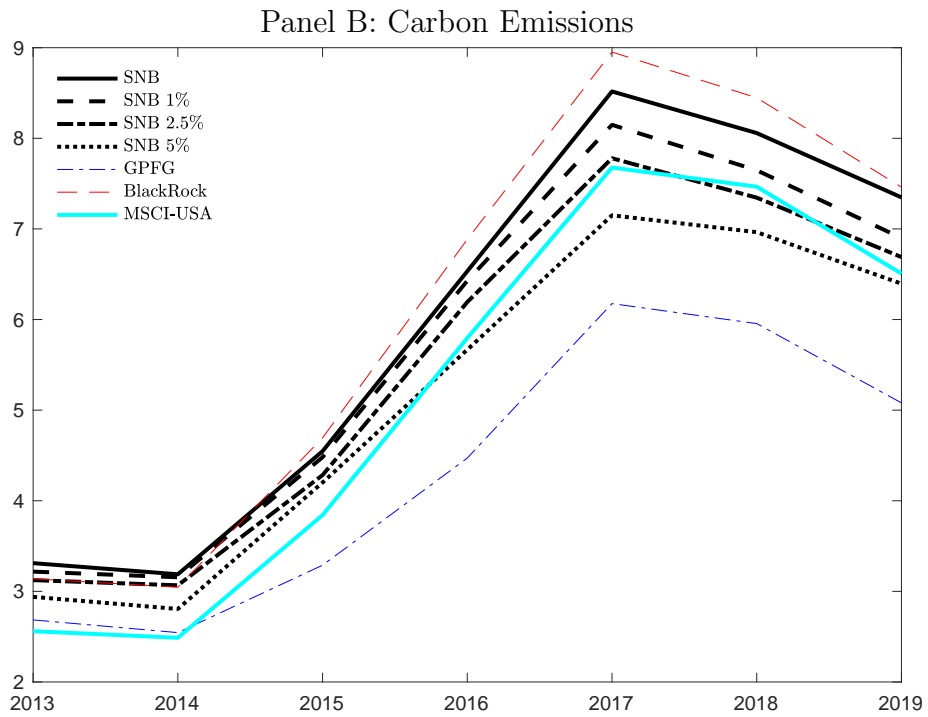
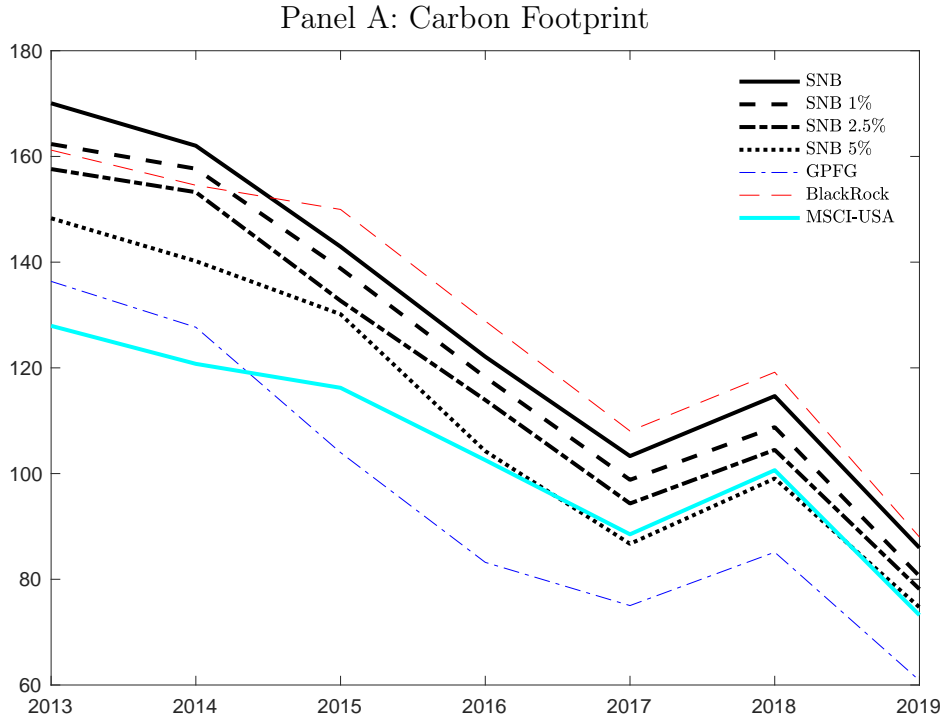


Figure 7. Carbon Measures with Global Exclusion and Sectoral Reinvestment

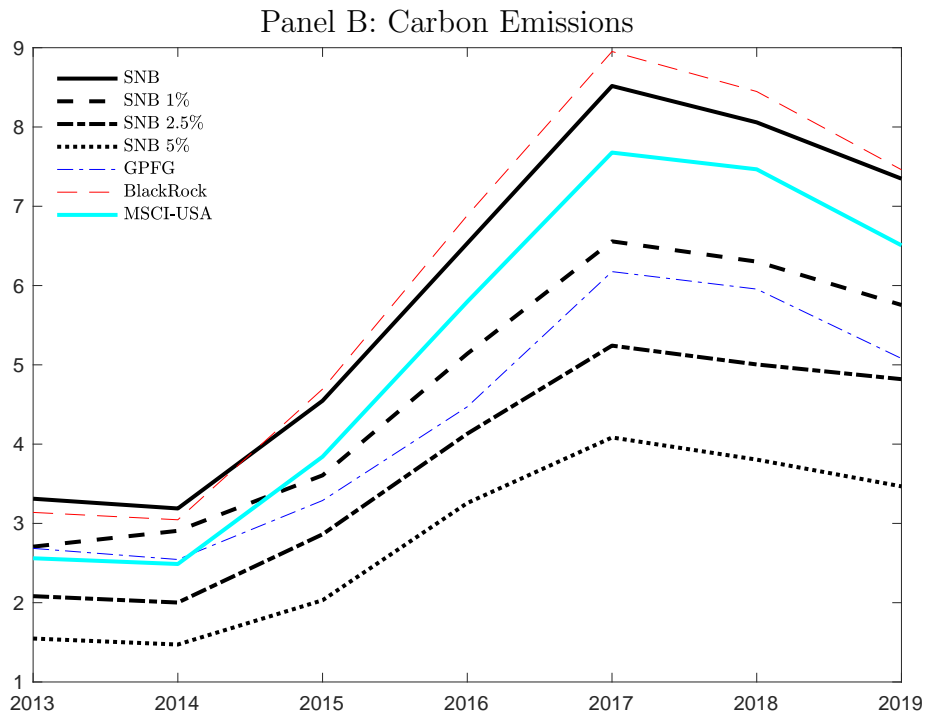
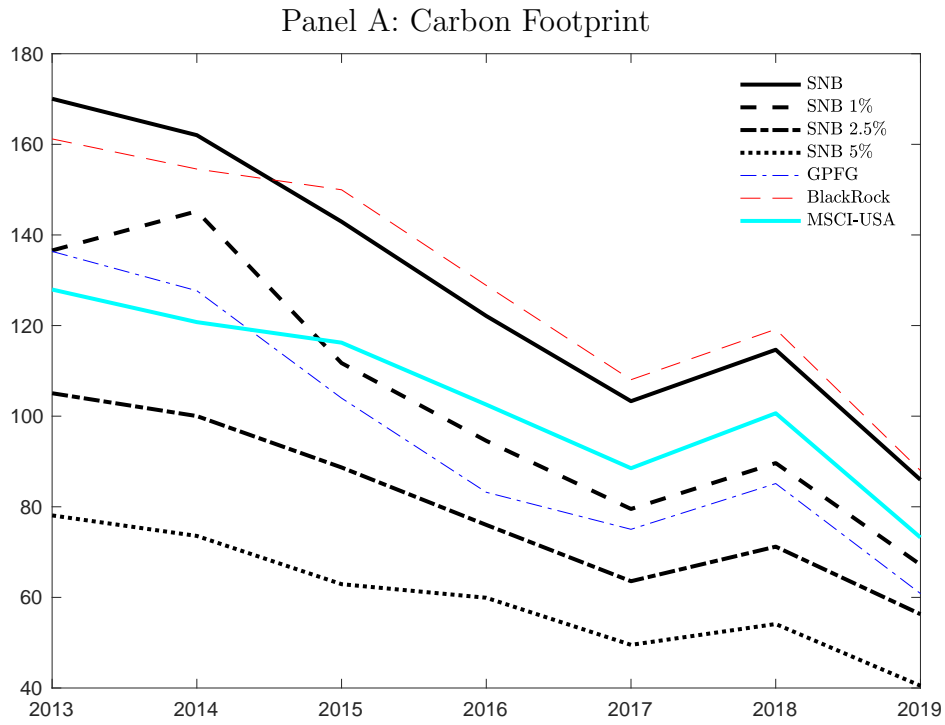
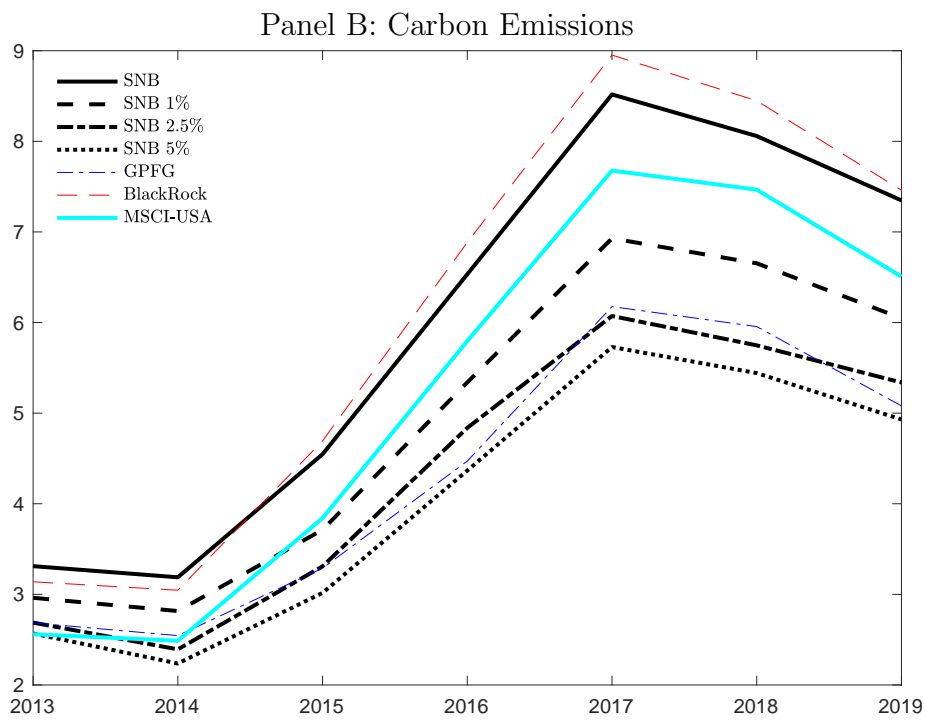
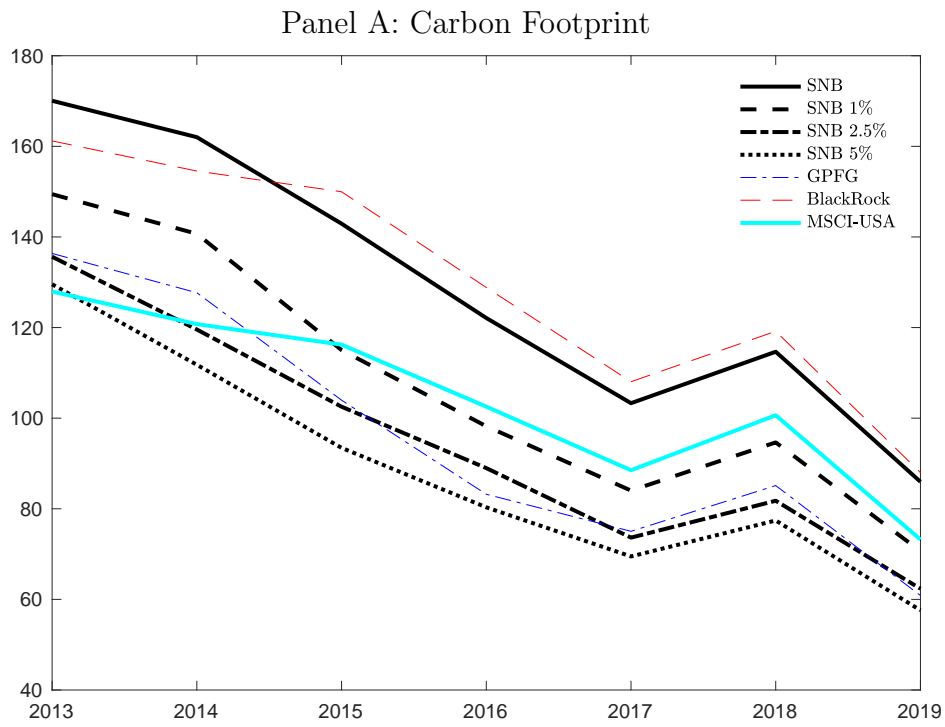


Figure 8. Carbon Measures with Global Exclusion and Sub-Sectoral Reinvestment



Appendix

A Public Statements on ESG and Carbon Emissions Made by SNB, GPF, and BlackRock

A.1 SNB

From the annual report 2019, section “Non-financial aspects of managing privately issued securities:”

“The SNB holds part of its foreign exchange reserves in the form of shares and corporate bonds in order to take advantage of the positive return contribution of these asset classes and improve the long-term risk/return ratio. When managing such privately issued securities, the SNB also takes non-financial aspects into consideration. Owing to its special role vis-à-vis the banking sector, the SNB refrains from investing in shares of systemically important banks worldwide. The SNB is also committed to respecting Switzerland’s fundamental standards and values in its investment policy. Consequently, it does not invest in shares and bonds of companies whose products or production processes grossly violate values that are broadly accepted at a political and societal level. The SNB therefore does not purchase securities issued by companies that seriously violate fundamental human rights, systematically cause severe environmental damage or are involved in the production of internationally condemned weapons. Condemned weapons include B grade and C grade weapons, cluster munitions and anti-personnel mines. In addition, companies involved in the production of nuclear weapons for countries that are not among the five legitimate nuclear-weapon states defined under the Nuclear Non-Proliferation Treaty (China, France, Russia, United Kingdom, United States) are excluded. To identify the companies concerned, the SNB defines the exclusion criteria and reviews the whole investment universe in a two-phase process. The first phase consists of examining and processing public information in order to identify companies whose activities are very likely to fall under the exclusion criteria. During the second phase, a detailed assessment is performed on each identified company to ascertain whether it should be excluded or not. The SNB relies on the recommendations made by specialised external service providers in deciding on the exclusion of companies, and reviews its decisions on a regular basis.

It should be noted that the constitutional and legislative authorities have deliberately not tasked the SNB with using its asset management activities to selectively influence the development of certain economic sectors. The SNB’s investment policy therefore cannot be geared to pursuing structural policies, i.e. advantaging or disadvantaging specific

economic sectors via positive or negative selections, or inhibiting or promoting economic, political or social change. Calls for the SNB to cease investing in certain sectors must be assessed against this backdrop. Taking into account the aforementioned exceptions, the SNB replicates the individual stock markets in their entirety in order to remain as neutral as possible. As a result, the SNB holds equities in the various economic sectors based on market capitalisation. This approach ensures that the portfolio's exposure to different risks is similar to that of the global universe of listed companies, and that structural changes in the global economy are also reflected in the SNB's portfolio.”

A.2 GPFG

From <https://www.nbim.no/en/the-fund/responsible-investment/risk-management/>:

Responsible investment is an integral part of the fund's investment strategy. Our aim is to identify long-term investment opportunities and reduce the fund's exposure to unacceptable risks. We aim to identify long-term investment opportunities and reduce our exposure to unacceptable risks. We assess how companies impact on the environment and society and see opportunities in companies that enable more environmentally friendly economic activity. There are also companies we choose not to invest in for sustainability or ethical reasons.

Risk assessments. We monitor our investments and assess sustainability issues as part of our risk management and our investment decisions. We encourage companies to move from words to numbers, so that we can evaluate their efforts and better understand financial risks and opportunities. To perform analyses of this kind, we need governance and sustainability data. We support the recommendations of the Task Force on Climate-related Financial Disclosures (TCFD) set up by the G20's Financial Stability Board. We are working with companies to ensure that they are equipped for the transition to a low-carbon economy. We invest specially in climate mandates, adjust the portfolio through divestments, and consider climate issues in our investment decisions. We also analyse green-house gas emissions from companies in our portfolio and various climate scenarios for the fund.

Sustainable investments. Our goal is to use sustainability data to identify long-term investment opportunities. We see opportunities in investing in companies with solutions that enable more environmentally friendly economic activity. These investments can have positive effects on other companies in the portfolio. These positive externalities can include reduced pollution, lower energy costs and more efficient use of resources. Companies producing such technologies may profit in turn from changes in demand and

regulation. We invest in such companies through among others dedicated environment-related mandates.

Divestment of companies. Given our understanding of sustainable economic growth, there are also sectors and companies where the fund should not be invested. By not investing in such companies, we reduce the fund's exposure to unacceptable risks. The Ministry of Finance has established ethically motivated guidelines for observation and exclusion of companies from the fund. The fund must not be invested in companies that produce certain types of weapons, base their operations on coal, or produce tobacco. The fund must also not be invested in companies that through their conduct contribute to violations of fundamental ethical norms. The Ministry of Finance has established an independent Council on Ethics to make ethical assessments of companies. Finally, the fund itself may decide to divest from companies that impose substantial costs on other companies and society as a whole, and so are not considered long-term sustainable.

A.3 BlackRock

From <https://www.blackrock.com/corporate/literature/publication/blk-esg-investment-statement-web.pdf>:

At BlackRock, we have always focused on helping our clients try to reach their long-term investment goals by providing resilient and well-constructed portfolios. Our investment conviction is that sustainability and climate-integrated portfolios can provide better risk-adjusted returns to investors over the long-term, and that sustainability-related data provides an increasingly important set of tools to identify unpriced risks and opportunities within portfolios. BlackRock's active investors are responsible for integrating material sustainability-related insights, consistent with their existing investment process, with the objective of improving long-term risk-adjusted returns. BlackRock's firm-wide investment process is structured to identify ESG risks and opportunities alongside traditional measures within our active investment processes. ESG integration is part of both our active investment process and index investment processes and oversight. BlackRock has a consistent framework for ESG integration that also permits a diversity of approaches across different investment teams and strategies. ESG considerations that are material will vary by client objectives, investment style, sector, and market trends. Sustainability measures help inform the due diligence, portfolio construction, and monitoring processes of our active and alternatives platforms, as well as our approach to risk management. In our index investments business, we work with index providers to expand and improve the universe of sustainable indexes, and our investment stewardship processes encourage the companies in which our clients are invested to manage and disclose material sustainability risks effectively. We structure our ESG integration efforts around three main themes:

investment processes, material insights, and transparency: these pillars drive ESG integration at BlackRock, and we support them by equipping our employees with useful ESG data, tools, and education.