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SWITZERLAND

SELECTED ISSUES

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CONTENTS

UNDERLYING AND BEYOND THE NUMBERS—ASSESSING SNB BALANCE SHEET CHANGES IN 2022[1]

The SNB's balance sheet changed significantly in 2022. This SIP clarifies the main underlying drivers, discusses potential implications, or lack thereof, on monetary and fiscal policies, and assesses the SNB's financial performance. Key findings include:

- *The SNB's financial outcome in 2022 reflected largely market developments; once adjusted for market conditions, it was broadly in line with its historical performance, though on the low side.*
- *Central banks' financial results are not directly comparable with each other, given their non-profit nature, the differences in their mandates and, importantly, their different accounting policies. In particular, many other central banks would have recorded much larger financial losses in 2022 if mark-to-market accounting were applied.*
- *Moreover, comparisons versus central banks with similar features to the SNB (such as large FX holdings and mark-to-market accounting) are complicated by additional factors such as balance sheet size, funding nature of FX reserves (monetary backing assets or fiscal reserves), macroeconomic environment (e.g., exchange rate movements due to safe-haven inflows or inflation differentials), and the timeframe of the comparisons.*
- *The SNB's financial loss in 2022 is not expected to have an impact on monetary policy operations. The SNB has appropriately warned about risks to its balance sheet, including during periods of high profitability. Also, the SNB put in place sound safeguards against such risks, and provided transparent communications on its investment strategy.*
- *Nevertheless, large balance sheets are subject to risks, highlighting communication challenges during periods of both large profits and losses. In this context, the SNB should continue to regularly review its investment strategy and maintain adequate safeguards.*

A. SNB Balance Sheet Changes in 2022

1. In 2022, the SNB's balance sheet underwent two significant changes. First, after rising ten-fold since 2007, the SNB's balance sheet contracted by 17 percent in 2022, dropping from CHF1,057 billion at end-2021 to CHF881 billion (Table 1). Second, the liability side saw a major shift, from sight liabilities (down by CHF188 billion or 26 percent) to repos/bills (up by CHF165 billion).

[1] Prepared by Li Zeng and Gloria Li (EUR). The authors would also like to thank Mark Horton, S. Pelin Berkmen, and seminar participants at the Swiss National Bank for their helpful comments.

Table 1. Switzerland: Swiss National Bank Balance Sheet Changes, 2022 Versus 2021

CHF billions	December 2021	December 2022	Change	CHF billions	December 2021	December 2022	Change
Assets	1,057	881	*-175*	**Liabilities**	1,057	881	*-175*
FX investments	966	801	*-166*	Sight liabilities	727	539	*-188*
o.w. inv. losses			*-131*	CHF repos & bills	0	165	*165*
CHF repos	3	0	-3	Other liabilities	125	111	-14
Other assets	87	81	-7	Equity	204	66	*-138*

Source: Swiss National Bank.

2. The contraction of the balance sheet was mainly driven by a decline in foreign exchange (FX) investments. The drop in FX investments in turn was mainly due to investment losses: In 2022, the SNB's FX investment losses were CHF131 billion, due both to price changes and valuation changes from exchange rate movements. Such losses also led to a significant decline in the SNB**'**s equity, from CHF204 billion at end-2021 to CHF66 billion in December 2022.[2] The SNB also sold CHF22.3 billion of FX on a net basis, contributing to the decline of FX investments. The drop in equity also reflected the profit distribution in 2022.

3. The shift from sight liabilities to repos/bills reflected liquidity absorptions by the SNB to support the new tiering arrangement of sight deposits. As the policy rate turned positive, the SNB adjusted the tiering of sight deposits so that the policy rate would be paid to the high tier of sight deposits, opposite to when the policy rate was negative.[3] The transition—from ensuring ample liquidity to keep money market rates near the low-tier rate, to keeping rates near the high-tier rate by balancing liquidity supply with demand—required a significant reduction of interbank liquidity (Box 1).

B. Implications on SNB Profit Distribution and Equity

Implications in the Near Term

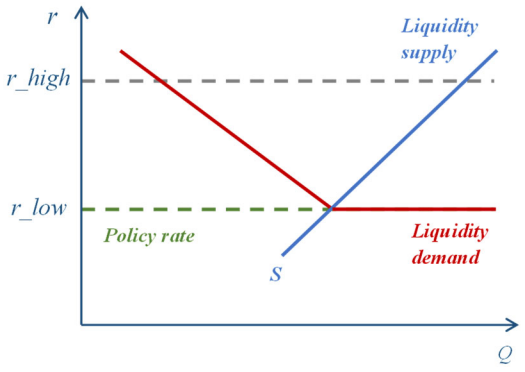
4. The SNB's financial loss in 2022 implies no profit distribution in 2023 (Box2). After allocating CHF9.6 billion to provisions for currency reserves, the annual distributable income in 2022 was CHF -142 billion. Adding the previous balance of CHF102.5 billion, the distribution reserve became CHF -39.5 billion. According to the rules for dividend payments and the agreement between the SNB and the Federal Department of Finance (FDF) on profit transfers to the Confederation and the cantons, there will be no profit distribution in 2023.

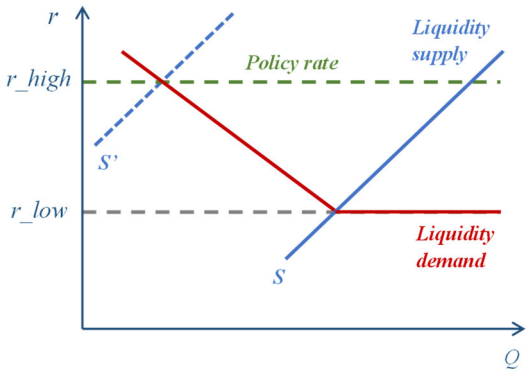
[2] In 2022, the SNB's net results from Swiss franc positions turned from CHF 1.1 billion in 2021 to CHF -1.0 billion.

[3] The tiering of sight deposits creates an incentive for banks to engage in interbank trading, which in turn helps to keep SARON as a meaningful market-based reference rate. When the policy interest rate was negative, the remuneration of sight deposits up to the exemption threshold was zero, while those above the exemption threshold were remunerated at the (negative) policy rate. Currently, sight deposits up to a certain threshold are remunerated at the (positive) policy rate, while those above the threshold are remunerated at the policy rate minus 50bps.

Box 1. A Stylized Illustration: Sight Deposits Tiering and SNB Liquidity Absorption

- When the policy interest rate was negative, the SNB used the tiering of sight deposits to *reduce the interest burden on banks, while creating an incentive for interbank transactions.*
- Under the old tiering, policy rate was the interest rate paid to the low tier of SNB sight deposits.[1/]
- To keep short-term market rates close to the policy rate, the SNB needed to ensure ample liquidity in the banking system, that is, the liquidity supply curve should be close to *S* or to its right.
- After the policy interest rate turned positive, the SNB kept the tiering arrangement to *continue to provide an incentive for interbank transactions*.
- Under the new tiering, policy rate is the interest rate paid to the high tier of SNB sight deposits.[1/]
- In transition to the new tiering, the SNB needed to reduce liquidity supply from proximity to *S* to proximity to *S'*, to balance it with liquidity demand and keep market rates close to the policy rate.





[1/] When the policy interest rate was negative, the remuneration to sight deposits up to the exemption threshold was zero, while those above the threshold were remunerated at the (negative) policy rate. Currently, sight deposits up to a certain threshold are remunerated at the (positive) policy rate, while those above the threshold are remunerated at the policy rate minus 50bps.

5. Could the SNB distribute profits in 2024? Based on the current rules, the SNB would need to make a profit of at least CHF50 billion in 2023 for that to happen: CHF10.5 billion—10 percent of the current provisions for currency reserves—will be allocated to provisions for currency reserves, while the rest need to cover the negative distribution reserve balance (CHF39.5 billion), before any distribution can happen. Given the SNB's total assets of CHF881 billion at end-2022, this would require an asset return rate of around 5.7 percent.

Box 2. Swiss National Bank: Equity Structure and Profit Appropriation and Distribution

The SNB's equity capital has three components: share capital (fixed at CHF25 million); provisions for currency reserves (PCR), a buffer against all forms of risk of loss; and a distribution reserve (DR) or profit/loss carried forward, which can be negative at times.[1/]

Each year the SNB follows three steps to allocate its profit.

1. Make an allocation to the PCR based on the rules set by the SNB in accordance with the National Bank Act. The current minimum annual allocation is 10 percent of the provisions at the end of the previous year. This will take place even if the SNB has a financial loss during the year. In such a case, the allocation to the PCR will make the *annual distributable income* more negative (explained below).

Box 2. Swiss National Bank: Equity Structure and Profit Appropriation and Distribution (concluded)

2. Calculate the *net profit or loss*:

   Net profit/loss = *annual distributable income* + previous DR balance, where

   Annual distributable income = annual profit/loss – amount allocated to the PCR.

3. If the net profit is positive, the SNB will then pay a dividend to the shareholders, followed by profit transfers to the government based on the rules set in the agreement with the Federal Department of Finance (FDF).[2/] The remaining balance of the net profit—which cannot be negative in this case—will be the DR carried forward to the next period.

The profit distribution agreement with the FDF is updated every five years. The latest agreement between the FDF and the SNB on the SNB's profit distributions for the financial years 2020 to 2025 can be found at this link. The SNB may adjust the allocation requirement for the PCR. For instance, in 2020, the SNB raised the minimum annual allocation to the PCR from 8 percent to 10 percent of the provisions at the end of the previous year.

Swiss National Bank: Profit Appropriation and Distribution, 2021–23

SNB Equity (CHF millions)	End-2021 (Stock)	Appropriation of 2021 profit (flow change)	Beginning-2022 * (Stock)	Dividend, and profit transfers to government in 2022 (flow change)	End-2022 (Stock)	Appropriation of 2022 profit (flow change)	Beginning-2023 * (Stock)	Dividend, and profit transfers to government in 2023 (flow change)
Share capital	25		25		25		25	
Provisions for currency reserves	86,981	8,698	95,679		95,679	9568	105,247	
Distribution reserve	90,943	17,602	108,545	Dividend: 1.5 Transfer to Gov.: 6,000	102,544	-142047	-39,504	Dividend: None. Transfer to Gov.: None.
Annual result in the year ending	26,300				-132,480			
Total equity	204,249		204,249		65,768		65,768	

Sources: Swiss National Bank Annual Reports. * Beginning of a year versus the end of the previous year is used here for the clarity of illustration. It does not mean that actual changes take place at the beginning of each year.

[1/] According to the SNB 2022 Annual Report, at December 31 2022, 65,989 of its 100,000 shares were voting shares. 77.74 percent of the voting shares were held by public sector shareholders (cantons, cantonal banks, and other public law corporations/institutions), while the rest 22.26 percent were held by private sector shareholders.

[2/] The SNB has a public mandate, including the note-issuing privilege, due to which the SNB earns profits on average in the long run. Insofar as the profits are not needed for provisions for currency reserves, it is the public sector that is entitled to the amount remaining after the payment of a dividend. See SNB Q&A: "Why are the Confederation and cantons entitled to the SNB's net profit?"

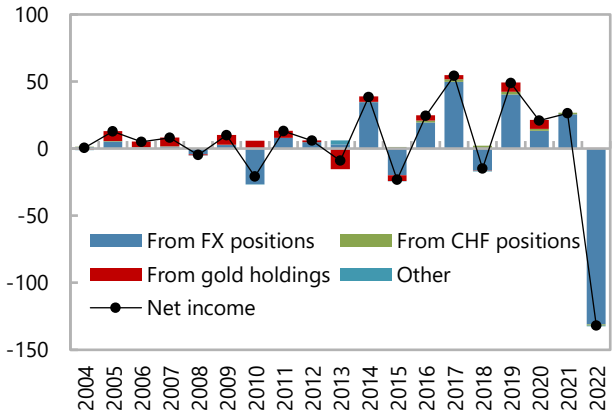
Implications from a Long-term Perspective

6. As the balance sheet expanded, the SNB has cautioned against the associated risks and has taken measures to strengthen its resilience. Starting in 2010, especially since 2014, the SNB's financial performance has been largely driven by the returns from its FX positions (Figure 1). Prior to 2022, the SNB had already incurred significant losses from FX investments three times, in 2010, 2015

and 2018, respectively.[4] To bolster the resilience of its balance sheet, the SNB revised the rules governing the allocation of provisions for currency reserves three times, in 2009, 2016, and 2020.

7. Despite the loss in 2022, the SNB's cumulative gains from the FX positions since 2004 are still positive. During 2004–2022, gold contributed the most to the SNB's cumulative profits (about CHF42 billion), while the cumulative gains from the franc and FX positions were CHF13 billion and CHF12 billion, respectively (Figure 2). However, if the comparison is made at the end of 2021, the cumulative gains from the FX positions would far surpass those from gold and franc positions.

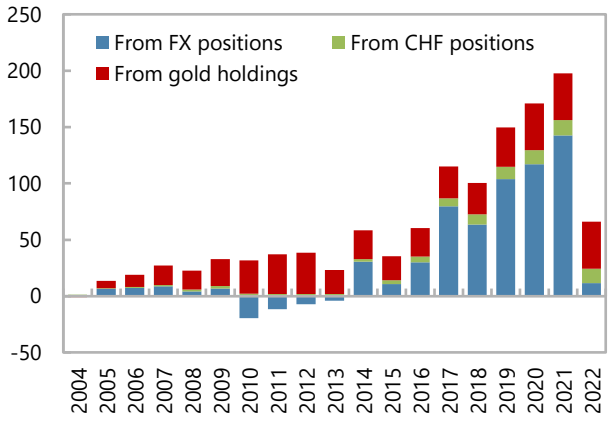
Figure 1. Swiss National Bank: Net Income
(Billion francs)



Source: Swiss National Bank.

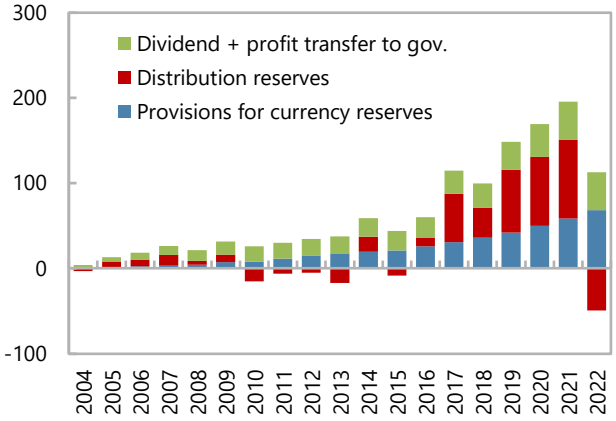
8. The SNB's efforts to safeguard the balance sheet have paid off. As of the end of 2021, only around 22.8 percent of the cumulative profits from 2004 to 2021 had been distributed (Figure 3). This is why, despite the loss in 2022, the SNB's equity has still increased by CHF19 billion since 2004. However, there are still risks associated with the large balance sheet: Given the SNB's equity of CHF65.8 billion and total assets of CHF881 billion at end-2022, if the SNB were to have a negative asset return of 7.5 percent in 2023, its equity would be completely wiped out.[5, 6]

Figure 2. Swiss National Bank: Cumulative Income (Billion franc)



Source: Swiss National Bank.

Figure 3. Swiss National Bank: Cumulative Net Income (Billion francs)



Source: Swiss National Bank.

[4] The FX investment losses in 2010 and 2015 were primarily driven by valuation changes due to the appreciation of the franc.

[5] By this definition, the SNB's asset return rate in 2022 was -12.5 percent (CHF –132.5 billion / CHF 1057 billion).

[6] Unlike usual businesses, central banks can operate with negative equity.

C. Implications for Monetary and Fiscal Policies

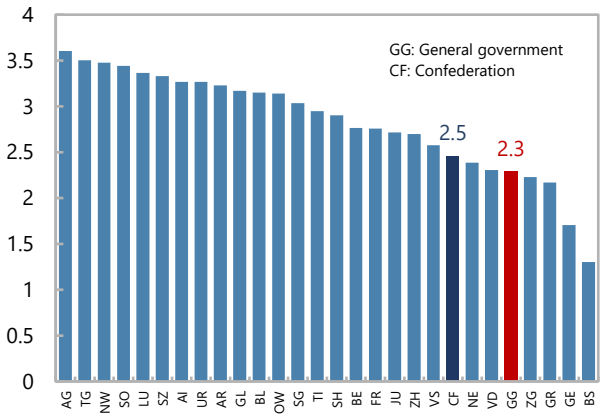
9. The SNB's financial loss in 2022 is unlikely to have an impact on monetary policy operations. Among the tools often used by the SNB (policy interest rate, repos/bills, communication, and FXI), FXI may be directly affected. But the still-large FX reserves (USD850 billion at end-2022) suggest that the SNB's ability to intervene in the FX market, in both directions, will not be impeded.

10. The need of recapitalization appears low. First, the SNB still has equity of CHF66 billion at end-2022. Second, there are no legal requirements that would trigger a recapitalization of the SNB in the case of negative equity capital. More importantly, unlike usual business entities, the recapitalization need for a central bank arises more from *policy insolvency*—the inability to implement monetary policy effectively—rather than *technical insolvency*, which is not a concern for the SNB even if its equity capital turns negative temporarily. Instead, the central banks' performances are determined by if they meet their mandates.[7]

11. Not receiving profit transfers from the SNB may put some pressure on public finances. While the overall picture does not seem particularly worrisome—the CHF6 billion SNB payout in 2022 accounted for about 2.3 percent of total general government revenue, the stress would be higher for some cantons (Figure 4). Besides, the federal government may need to make up for the SNB transfers previously envisioned in the plan to offset Covid-related extraordinary spending, should they not materialize.

Figure 4. Swiss National Bank: Profit Transfers to Confederation and Cantons, 2022

(Percent of government revenue)



Sources: Swiss Federal Department Finance, IMF staff estimates and calculations.

Note: The revenue share for the general government is lower than the weighted average of those for the confederation and the cantonal governments, because general government revenues also include those of the social security funds. The full names of the cantons can be found here.

D. Assessment of the SNB's Financial Performance in 2022

12. The assessment will focus on the SNB's FX investment performance, since it was the main driver of its financial loss in 2022. First, the FX investment returns in 2022 will be evaluated against the SNB's past performance. Second, the SNB's financial performance will be compared to that of central banks in some other advanced economies.

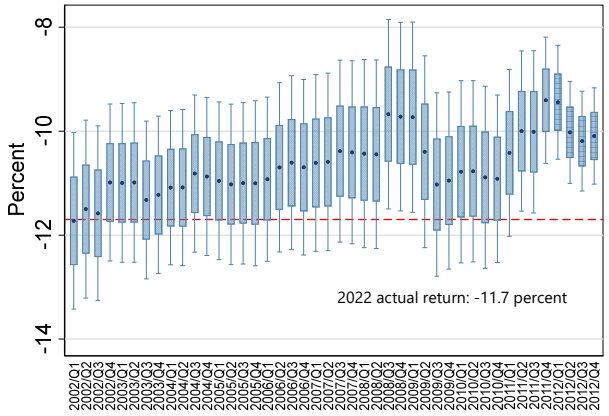
[7] See discussions in, for example, Stella and Lonnberg (2008) and BIS (2023).

Assessment Based on the Past Performance of the SNB

13. To evaluate the SNB against its past performance, the FX investment return rate in 2022 is compared to a set of constructed benchmarks. The first step is to regress the SNB's historical quarterly investment returns against major market indices, including equity and government bond indices of the US, the euro area, Japan, and the UK.[8] Performance benchmarks for 2022 are then constructed based on the regression results and the actual data of these market indices in the year. Although the benchmarks are not very sensitive to the inclusion of new regressors (such as China or emerging market indices), they do vary with the sample periods. Thus, different sample periods are used, with the longest spanning from 2002Q1 to 2021Q4 and the shortest from 2012Q4 to 2021Q4.

14. While the SNB's FX investment return in 2022 appears low relative to the benchmarks, it still largely falls within the confidence intervals (Figure 5). The evaluation results show that the large negative return in 2022 was mainly driven by overall market developments—the SNB's return was -11.7 percent, while the median of the estimated benchmarks is -10.8 percent. The differences versus the benchmarks are relatively small (between 0 to -2.3 percentage points) and are not statistically significant in most cases. However, given the large size of the SNB's balance sheet (over CHF1 trillion at end-2021), even minor differences in return rates could result in substantial losses.

Figure 5. Swiss National Bank: FX Investment Return in 2022 Versus Benchmarks



Sources: Haver Analytics, SNB, IMF staff estimates.

Note: X-axis shows the beginning of each regression sample. All regression samples end on 2021Q4. Shown in the chart are compound 2022 annual returns based on actual or estimated benchmark quarterly returns. The standard deviations of the benchmarks are estimated with bootstrapping. The boxes indicate estimated benchmarks ± 1 standard deviation, while the lines indicate benchmarks ± 2 standard deviations.

Comparison with Central Banks in Selected Advanced Economies

15. Comparing the financial performance of central banks is not straightforward, not least because they are not normal businesses driven by profit. Their mandates are not all the same, and they face different policy challenges, institutional setups, and cost-benefit considerations when implementing their monetary policies. Therefore, the financial performances of many central banks are not directly comparable.

[8] The quarterly returns used in the regressions exclude the valuation changes due to exchange rate movements. They are calculated using data from Switzerland's Integrated International Investment Position Statement:

$$FX\ investment\ return_t = \frac{Revaluations\ due\ to\ price\ changes_t}{FX\ investment\ stock_{beginning\ of\ t} + (transactions_t + other\ volume\ changes_t)/2}$$

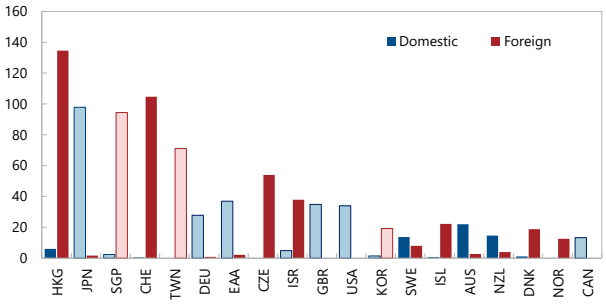
16. Even abstracting from the aspects mentioned above, there are still factors that must be considered to make meaningful comparisons between the SNB and other central banks:

- **Accounting policies, especially whether a mark-to-market rule is applied to security holdings**. In this regard, there are two groups of central banks that differ from the SNB (Figure 6, Table 2).

  - **The U.S. Federal Reserve (Fed), the Bank of Japan (BoJ), the European Central Bank (ECB), the Bundesbank, and the Bank of England (BoE)**. The securities holdings in domestic currencies of these central banks far exceed their FX holdings, and they do not apply, or do not fully apply, mark-to-market accounting to securities holdings in domestic currencies. Using the Fed as an example, it held USD8.4 trillion of treasury securities and MBS as of the end of 2022, recorded at amortized cost. The fair value of these securities at market prices fell by USD1.2 trillion in 2022. If mark-to-market accounting were applied to these securities, the Fed would have suffered a major financial loss in 2022, rather than a profit of USD58.8 billion as reported. The BoJ, ECB, Bundesbank, and BoE all face a similar situation.

  - **The Monetary Authority of Singapore (MAS), the Bank of Korea (BoK), and the central bank of Taiwan Province of China**. Like the SNB, these central banks also hold primarily FX assets, but they do not apply mark-to-market accounting to these assets, recording them at cost instead. As a result, their financial results are not directly comparable that of the SNB.

Figure 6. Selected Central Banks: Domestic Versus Foreign Assets (Percent of GDP)



Sources: Annual reports, financial accounts/statements of central banks, Haver Analytics, IMF staff calculations.

Note: Based on data available on or before March 15, 2023. Include only investment assets (cash/deposits, equity shares and debt securities). For the euro area, portfolios of the Eurosystem are shown. For Norges Bank, the assets of Government Pension Fund Global are excluded. Darker blue and red colors indicate that mark-to-market accounting is applied. Lighter colors suggest that mark-to-market accounting is not, or is not fully applied.

- **Government indemnity. BoE**, the Reserve Bank of New Zealand (**RBNZ**) and Bank of Canada (**BoC**) have government indemnity for QE-related losses, while the **BoK** has full government compensation for losses exceeding reserves. For example, the RBNZ's LSAP program assets fell by NZD 6.2 billion between June 2021 and June 2022, mostly due to unrealized mark-to-market losses. However, the reduction was largely offset by the Crown Indemnity, therefore not reflected as part of the RBNZ's financial loss.

Table 2. Switzerland: Financial Performance of Central Banks in Selected Advanced Economies

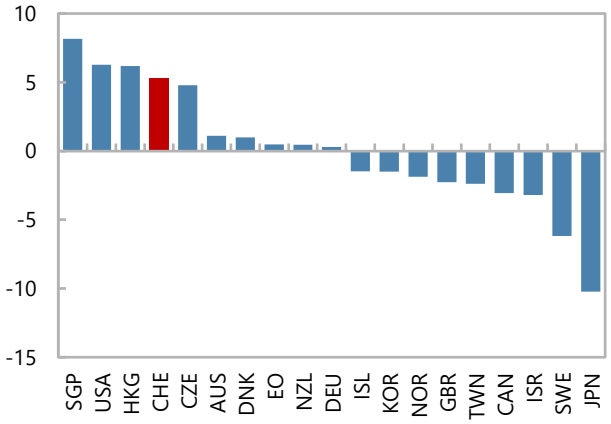
Central Bank	Balance Sheet	Net Income	Remarks
The Federal Reserve, U.S.	USD 8.6 trillion (2022)	USD 58.8 billion (2022)	Mostly domestic assets. Holdings of treasury securities and MBS—USD8.4 trillion at end-2022—are recorded at amortized cost. The cumulative unrealized gains (losses) of the portfolio declined by USD1.2 trillion in 2022.
Bank of Japan	JPY 685.8 trillion (September 2022)	JPY 1,592 billion (April 2022 - September 2022)	Mostly domestic assets. Holdings of Japanese government securities—JPY546 trillion in September 2022—are recorded at amortized cost. The total return index of JGB declined by about 5.5 percent in 2022. During April-September 2022, BOJ's FX assets gained JPY1.5 trillion from exchange rate movements, and lost JPY56.6 billion from other sources. The Ministry of Finance is the designated authority of the official FX reserves, managing them in collaboration with the BOJ.
Bundesbank, Germany	EUR 2.9 trillion (2022)	EUR -172 million (2022)	Mostly domestic assets. Euro securities of euro area residents held for monetary policy purpose—EUR 1.1 trillion at end-2022, around 37 percent of the Bundesbank's total assets—are recorded at amortized cost. The total return index of euro government bonds declined by about 18.5 percent during 2022.
Norges Bank, Norway	NOK13.2 trillion (2022)	NOR -10.6 billion (2022)	In addition to official FX reserves (NOK610 billion at end-2022), the Norges Bank also manages the Government Pension Fund Global or GPFG (NOK12.4 trillion at end-2022). GPFG's investment return rate was -14.1 percent in 2022, with a loss equivalent to about USD164 billion. Norges Bank's net income does not include GPFP's profits/losses. In 2022, the losses from financial instruments (NOK55.1 billion) were largely offset by foreign exchange gains (NOK45.5 billion).
Bank of England	GBP 1.03 trillion (2021Q3)	GBP 7 million (March 2021 - February 2022)	Mostly domestic assets. The sterling loan to Asset Purchase Facility (APF)—GBP867 billion at end-2021Q3—is measured at amortized cost. The government has provided indemnification to the BoE and the APF against any losses that may arise from the QE program. The total return index of gilts declined by about 25 percent in 2022.
European Central Bank	EUR 698.9 billion (2022)	EUR 0 (2022)	Released EUR1.627 billion of provisions for financial risks. Mostly domestic assets. Euro securities of euro area residents held for monetary policy purpose—EUR457 billion at end-2022, 65 percent of total assets—are recorded at amortized cost. The total return index of euro government bonds declined by about 18.5 percent in 2022.
Central bank of Taiwan Province of China	NTD 19.4 trillion (2022)	n.a.	The gain or loss from the assets or liabilities of international reserve, resulted from changes in parity of the national currency, or changes in the value, parity or exchange rate of these assets and liabilities relative to the national currency, shall not be listed in the annual income statement.
Monetary Authority of Singapore	SGD 696.8 billion (March 2022)	SGD -7.4 billion (April 2021 - March 2022)	Foreign financial assets (SGD555.7 billion on March 31, 2022) and liabilities (SGD56.2 billion on March 31, 2022) are stated at cost. The Government of Singapore Investment Corporation (GIC) is a Singaporean sovereign wealth fund.
Hong Kong Monetary Authority	HKD 4.0 trillion (2022)	HKD -249.5 billion (2022)	In the deficit for the year, net realized and unrealized losses in 2022 were HKD205.2 billion.
Bank of Korea	KRW 582.8 trillion (2022)	n.a.	Realized gains/losses on the foreign currency translation are recognized as a foreign exchange revaluation adjustment account; unrealized profits/losses on FX transactions are not recognized. The Korea Investment Corporation (KIC) is a Korean sovereign wealth fund. Any loss by the BoK during any fiscal year exceeding the reserves shall be made up by the Government in accordance with the National Fiscal Management Act.
Bank of Canada	CAD 410.7 billion (2022)	CAD -1.1 billion (2022)	Around one third of domestic bond holdings are recorded at amortized cost (2022Q3 Condensed Interim Financial Statements). Assets under indemnity agreements with the government increased by CAD25.0 billion in 2022. Equity was CAD -97 million at end-2022. In Canada, the Department of Finance is the designated authority of the official FX reserves.
Reserve Bank of Australia	AUD 538.1 billion (June 2022)	AUD -36.7 billion (July 2021 - June 2022)	Mostly domestic assets. The stock of FX investment was AUD66.5 billion at the end of June 2022. FX investment loss in the year ending June 30, 2022 was AUD703 million, while FX valuation gains were AUD1.8 billion. The financial loss led to a negative total equity of AUD12.4 billion. FutureFund is an Australian sovereign wealth fund.
Bank of Israel	ILS 826.3 billion (2022)	ILS 14.9 billion (2022)	Loss from revaluation to fair value of foreign financial assets was ISL 43.1 billion. Valuation gains due to exchange rate movements were ISL58.0 billion. Total equity and reserves were ILS -47.5 billion at end-2022.
Sveriges Riksbank	SEK 1.5 trillion (2022)	SEK -80.7 billion (2022)	The loss would be SEK 85.7 billion without the release of SEK5 billion financial risk provision. More domestic assets than foreign assets. Income from FX reserves was SEK13.6 billion, of which SEK47.4 billion were *realized and unrealized* results due to changes in exchange rates.
Danmarks Nationalbank	DKK 625.4 billion (2022)	DKK -8.5 billion (2022)	Claims on central banks and supranational institutions accounted for 74.5 percent and 78.9 percent of total foreign assets at the end of 2021 and 2022, respectively.
Reserve Bank of New Zealand	NZD 93.9 billion (June 2022)	NZD -86 million (July 2021 - June 2022)	Mostly domestic assets. On 30 June 2022, LSAP program assets were $6.2 billion lower than in 2021, largely due to unrealized mark-to-market losses. This reduction was largely offset by an increase in the indemnity from the Crown for the LSAP program, which was valued at $8.7 billion at 30 June 2022 (2021: $3.1 billion). NZ Super Fund is a sovereign wealth fund in New Zealand.
Czech National Bank	CZK 3.2 trillion (2022)	CZK -411.9 million (2022)	Equity was CZK -481.2 billion at end-2022, about 7 percent of 2022 GDP.
Central Bank of Iceland	ISK 874.6 billion (2022)	ISK -18.4 billion (2022)	Foreign assets excluding balance with IMF were ISK818 billion and ISK727 billion at the end of 2021 and 2022, respectively. In 2022, changes in foreign assets values before exchange rate difference were ISK -33.0 billion, and valuation gains from exchange rate movements were ISK31.4 billion.

Sources: Central bank annual reports, financial accounts/statements and, in some cases, central bank laws of reported economies; finance ministries of Japan and Canada; websites of mentioned sovereign wealth funds; Haver Analytics.
Note: Highlighted in green are three central banks with high comparability with the SNB and that had better financial performance than the SNB in 2022. Four central banks have negative equity in the reporting period: Bank of Canada, Bank of Israel, Czech National Bank, and Reserve Bank of Australia.

- **Funding nature of FX assets and institutional setup of FX management**. In Switzerland, the large FX reserves are primarily the results of FX interventions (FXIs) based on monetary policy considerations. Because of their monetary origin, the SNB is the designated authority of managing such FX reserves. This is not the case in some other economies. In Hong Kong, the Exchange Fund managed by the Hong Kong Monetary Authority (**HKMA**) consists of not only FX assets backing the monetary base, but also fiscal reserves and funds from other public agencies and institutions. In **Norway**, the Norges Bank manages the Norwegian Government Pension Fund Global (GPFG), but there is a clear separation in its balance sheet—the profits/losses of the GPFG are not reflected in the Norges Bank's income. In both countries, the structure of central bank liabilities is quite different than for the SNB. In **Japan** and **Canada**, instead of the central banks, the finance ministries are the designated authorities of the official FX reserves. In **Singapore**, **South Korea**, **Australia**, and **New Zealand**, significant amounts of public FX assets (some funded by fiscal reserves) are managed by sovereign wealth funds outside the central banks.

- **Valuation effects due to exchange rate movements**. The Swiss franc has a long-term appreciation trend, reflecting domestic-foreign inflation differentials, other macroeconomic fundamentals and, at times, safe-haven capital inflows. In 2022, the valuation changes caused by franc appreciation accounted for around 20 percent the SNB's FX investment losses. As explained in Table 2, this was not the case for many other central banks, such as **BoJ**, **Riksbank,** Bank of Israel (**BoI**), **Norges Bank**, and the Reserve Bank of Australia (**RBA**). In 2022, due to sizable domestic currency depreciations, these central banks' FX investment losses from price changes were largely or more than offset by valuation gains resulting from exchange rate movements.

Figure 7. Nominal Effective Exchange Rate Changes, Dec. 2022 Versus Dec. 2021 (Percent)



Source: Bank for International Settlements via Haver Analytics.

17. After considering the aforementioned factors, only Danmarks Nationalbank and Central Bank of Iceland seem to have a relatively high degree of comparability with the SNB.[9] Both central banks also primarily hold FX assets and apply mark-to-market accounting to these assets. It appeared that their financial losses in 2022 were smaller than the SNB's—After adjusting for valuation changes due to exchange rate movements, the return rates of their FX assets were around -1.4 percent and -3.7 percent, respectively. However, there are important caveats to bear in mind. The financial performance of the two central banks seemed to have largely benefited from the

[9] The Czech National Bank also has a relatively high comparability with the SNB, but its 2022 financial results were not available yet.

high shares of cash/deposits in their FX portfolios: For Danmarks Nationalbank, this ratio was 74.5 and 78.9 percent at the end of 2021 and 2022, respectively.[10] Although this ratio was only some 19 percent for Central Bank of Iceland at the end of 2021, it had risen to 50 percent by the end of 2022. While such a high-cash/deposits strategy worked out well for Danmarks Nationalbank and Central Bank of Iceland under the specific market conditions in 2022, it is probably neither feasible for the SNB—considering its much larger balance sheet—nor desirable, especially from a longer-term perspective.[11]

E. Summary

18. This paper reviews and assesses the significant changes in the SNB's balance sheet in 2022. One was the sharp contraction mainly driven by FX investment losses, which also led to a significant decrease in equity. The other was the sizable shift in liabilities from sight liabilities to repos/bills. This shift was the result of the liquidity absorptions by the SNB to support the transition of sight deposit tiering arrangements.

19. The SNB incurred a sizable financial loss in 2022, largely driven by market developments. When adjusted for market conditions, the SNB's investment return in 2022 was broadly in line with its historical performance, though on the low side. While some other central banks reported better financial results, they are not directly comparable with each other, given the non-profit nature of central banks, differences in their mandates, accounting practices and the macroeconomic and corporate settings they face.

20. The SNB's financial loss is not expected to have material impacts on Switzerland's macroeconomic policies. The loss is unlikely to impede monetary policy operations, and a recapitalization of the SNB seems unnecessary, partly thanks to the safeguards in place. Not receiving profit transfers from the SNB in 2023 will put some pressure on public finances. The overall picture does not seem particularly worrisome, but the stress would vary across cantons.

21. Large balance sheets are subject to risks, particularly given elevated uncertainty surrounding global financial conditions, highlighting communication challenges. To address such risks and challenges, the SNB issued early warnings of potential volatility in its profits, put in place sound safeguards (e.g., provision allocations and cautious profit distributions), and provided transparent communications on its investment strategy. Going forward, the SNB should continue these practices, regularly review its investment strategy and maintain adequate safeguards.

[10] The high shares of cash/deposits in Danmarks Nationalbank's FX reserves are likely motivated by the need to intervene in the FX market to maintain the pegged exchange rate versus the euro.

[11] The SNB's FX investments used to be primarily government bonds. To strengthen the security while preserving the long-term value of the portfolio, the SNB has expanded its investment universe over time, adding corporate bonds in 2004 and equities in 2005 (see Governor Jordan's comments on the SNB's monetary and investment policy in 2017). According to the SNB 2022 Annual Report, at the end of 2021, its FX investments consisted of about 13 percent of sight deposits and call money, 64 percent of repos, money market instrument and bonds, and 23 percent of equities.

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ECB MONETARY POLICY SPILLOVERS ON SWISS STOCK MARKET[1]—SOURCE OF SHOCKS MATTERS

As a small, advanced open economy, Switzerland is highly exposed to external shocks. This Selected Issue Paper studies the monetary policy spillovers from European Central Bank (ECB) to Switzerland and quantifies the transmission to the Swiss stock market by decomposing the monetary policy shocks into two orthogonal shocks: the pure monetary policy shock and the information news shock. The results of the paper show that the degree of monetary policy spillover depends on the nature and type of the monetary policy shock. Tightening driven by contractionary monetary policy shocks leads to a decline in the stock market, while tightening driven by positive information news shocks relieves market uncertainty and leads to an increase in stock market. A cross-country analysis shows that ECB monetary spillover to the Swiss stock market is largely in line with other non-euro area European countries, but smaller in magnitude compared to euro-area countries.

A. Global Monetary Policy Reshaped

1. Global financial conditions have changed dramatically during the past several years. Many economies extended unprecedentedly accommodative monetary policy to mitigate the macroeconomic impact of the COVID-19 pandemic in 2020. The ensuing post-pandemic recovery combined with other factors led to rapidly rising inflation, which reached decades highs during 2022. Many major economies, including the euro area, responded with an increasingly aggressive monetary policy tightening through interest rate hikes and quantitative tightening, leading to a reshaped global monetary policy situation.

2. As a small advanced open economy, Switzerland is tightly linked to the rest of the world through both financial and trade linkages. Changes of monetary policy in major economies, therefore, could easily pass through to the Swiss economy via various channels. Existing literature has documented the cross-border spillover effects of monetary policy both empirically and theoretically.[2] However, most of them focused either on the spillover effects on emerging economies or large advanced economies; only limited evidence is available on the impact of monetary policy spillovers on small advanced open economies.

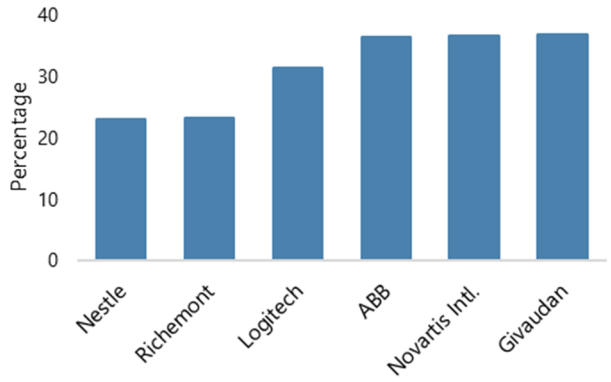
3. This paper analyzes the impact of ECB monetary policy on the non-euro area through the lens of Swiss stock market. As monetary policy works through various transmission channels to impact real economic activity, financial market channels are first and foremost in determining both the speed and the extent of policy transmission. Switzerland offers an ideal setting for this analysis for two reasons. First, the Swiss economy has close ties with the euro area. The Swiss stock market is dominated by multinational companies that derive their revenues from global activities with a tight

[1] Prepared by Tianxiao Zheng (EUR). The author would like to thank S. Pelin Berkmen, Mark Horton, and seminar participants at the Swiss National Bank for their helpful comments.

[2] See for instance empirical studies by Ammer et al (2010), Ehrmann and Fratzscher (2009), Miranda-Agrippino and Rey (2020) and theoretical study by Jiang et al (2020).

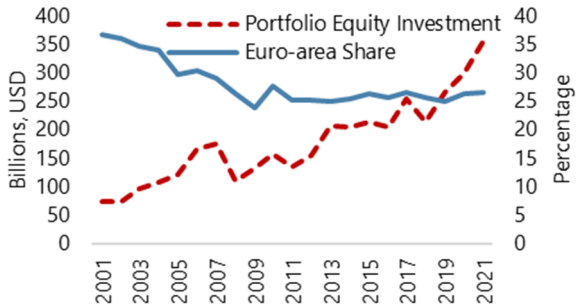
link to the euro area. Moreover, euro-area investors hold large amounts of portfolio equity investment in Switzerland. The amount of portfolio equity investment grew from USD 50 billion in early 2000s to USD 350 billion in 2021. Third, Switzerland offers an interesting domestic policy setting. The SNB enforced a minimum exchange rate (MER) of 1.20 Swiss franc per Euro between September 2011 and January 2015, which allows to test the impact of domestic policy regime change on the size and scope of spillover effects of foreign monetary policy shocks on domestic financial markets.

Figure1. Selected Swiss Companies' Income Share from Europe



Source: Company websites; IMF staff calculations.

Figure 2. Eurozone Portfolio Investment in Switzerland



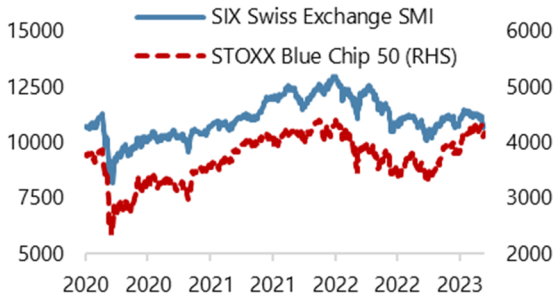
Source: Haver Analytics; IMF staff calculations.

B. Swiss Stock Market

4. The Swiss Stock Exchange is currently the third largest in Europe, with a free float market capitalization of CHF1.6 trillion as of February 2022. There are around 250 listed companies, covering a wide range of sizes and sectors, including small and mid-caps, family businesses, and international companies. The representative Swiss Market Index (SMI) is composed of 20 of the largest and most liquid stocks and is Switzerland's blue-chip index and the most followed in the country. The securities contained in the SMI currently represent approximately 70 percent of the free-float Swiss equity market capitalization, as well as 80 to 90 percent of the total trading turnover of Swiss and Liechtenstein equities listed on the Swiss Stock Exchange.

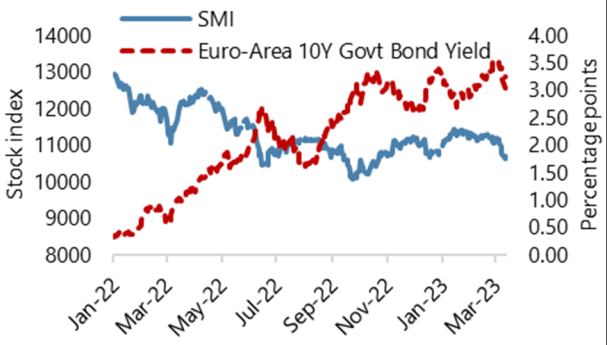
5. The Swiss stock market exhibits strong co-movement with financial markets in the euro area. Figure 3 plots the stock market indices SMI and the STOXX Blue Chip, with the later representing some of the largest companies in the Eurozone in terms of free-float market capitalization and considered as one of the most liquid indices for the Eurozone. As the figure shows, the dynamics of SMI and STOXX exhibit nearly identical patterns over the time, implying common driving factors behind the two indices. Furthermore, as euro-area government bond yields started rising following the recent monetary tightening cycle in 2022, Swiss stocks underwent a major repricing. Figure 4 shows that SMI and euro-area 10-year government bond yield diverged as ECB monetary policy tightened, displaying a strong negative comovement.

Figure 3. Selected Stock Market Index of Switzerland and Eurozone



Source: Haver Analytics; IMF staff calculations.

Figure 4. Swiss Market Index and Euro Area Bond Yield



Source: Haver Analytics; IMF staff calculations.

C. Measuring ECB Monetary Policy Shock

6. There are various channels through which monetary policy could affect the equity market. First, monetary policy could affect future earnings growth for companies and alter the discount rate used by market participants for future cash flows. Second, as interest rates rise following contractionary monetary policy, bonds, certificates of deposit and other vehicles pay more attractive yields and investors reallocate investment away from stock market (portfolio rebalancing). Third, prior research shows that financial integration could affect the propagation of shocks across international financial markets, with an impact on equity market (Rey, 2013). Finally, research also points out that real integration via global production networks plays an important role in the transmission of major economies' monetary policy shocks to world stock markets (Giovanni and Hale, 2022).

7. Monetary policy changes by central banks can could be decomposed into two sources: **information about central bank forecasts of economic fundamentals, i.e., information news shock, and monetary surprises that are largely unpredictable and contain no significant central bank information about the economic outlook, i.e., monetary policy shock**. A monetary policy announcement may contain mixed sources of information and send puzzling signals to the financial market. Stock markets may be influenced not only by the announced policy itself but also by the forecasting information contained in the announcement. The opposite forces from these two sources may cause puzzling reactions such as stock prices rising after a contractionary policy shock.[3] To decompose ECB monetary policy changes, we follow the framework developed by Bu et al (2021)

[3] Recent paper by Hager and Nitschka (2022) analyzes the impact of ECB policy decisions on Swiss financial market based on shocks identified by Altavilla (2019). This SIP differs from their work and contributes to the literature by employing a novel identification procedure to decompose observed ECB monetary policy changes into pure monetary policy shock and information news shock components, providing new findings on ECB monetary policy spillovers. The shock decomposition also helps reconcile findings in some studies that find small or insignificant impact from ECB monetary spillovers. For more details, see Ciminelli et al (2022).

and Cimenelli et al (2022). An advantage of this methodology is that it provides a unified measure of ECB monetary policy that bridges periods of conventional and unconventional policymaking—target rates, forward guidance, and asset purchases.

8. This framework assumes the outcome of monetary policy decisions is reflected in movements of zero-coupon yields with full maturity structure, i.e. maturities from 1 year to 30 years. To identify the monetary policy shock and information news shock, we employ a heteroskedasticity-based, partial least squares (PLS) approach to (i) identify pure monetary shocks by exploiting the sensitivity of ECB zero-coupon yields at different maturities to announcements by the ECB Governing Council Meetings, and (ii) identify information news shocks by taking the residuals from projecting the ECB benchmark interest rates into the monetary policy shocks, such that information news shocks are orthogonal to monetary policy shocks.

- In the first step, sensitivity of the ECB zero-coupon yields with various maturities to monetary policy shocks is estimated via time series regressions, i.e., by normalizing the unobserved monetary policy shocks to a one-to-one relationship with the benchmark yield according to Equation (1). In this case, we follow the literature and use the 2-year yield.[4]

  $$\Delta R_{i,t} = \theta_i + \beta_i \Delta R_{2,t} + \xi_{i,t}, \quad (1)$$

  where $\Delta R_{i,t}$ denotes the daily change in the yield of zero-coupon bonds with maturity of i-year at time t. In this analysis, we use AAA rated Eurozone central government bonds with maturities from 1 to 30 years. β_i denotes the sensitivity of the zero-coupon yields to the unobserved monetary policy shock.

- In the second step, the monetary policy shock is identified from cross-sectional regressions of daily change in the zero-coupon yields $\Delta R_{i,t}$ on the estimated sensitivity β_i at each time t, according to equation (2):

  $$\Delta R_{i,t} = \alpha_i + e_t \hat{\beta}_i + \mu_{i,t}, \quad (2)$$

  where the estimated coefficient e_t denotes the monetary policy shock.

- In the third step, information news shock is estimated as the residuals from regressing the benchmark yields $\Delta R_{2,t}$ on the estimated monetary shock $\hat{e}_t$ following equation (3). By construction, the information news shock is orthogonal to the monetary policy shock.

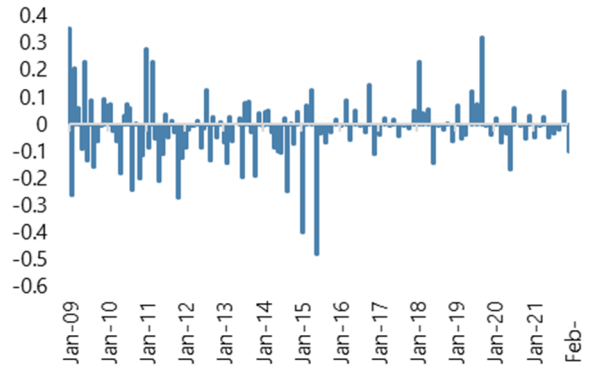
  $$\Delta R_{2,t} = \gamma + \delta \hat{e}_t + \epsilon_t, \quad (3)$$

  where the estimated residuals $\hat{\epsilon}_t$ represents the information set that is not captured by monetary policy shock $\hat{e}_t$ and denotes the information news shock.

[4] Previous analysis (Ciminelli et al. (2022)) also shows that results of normalizing to 5-year and 10-year yields are effectively identical.

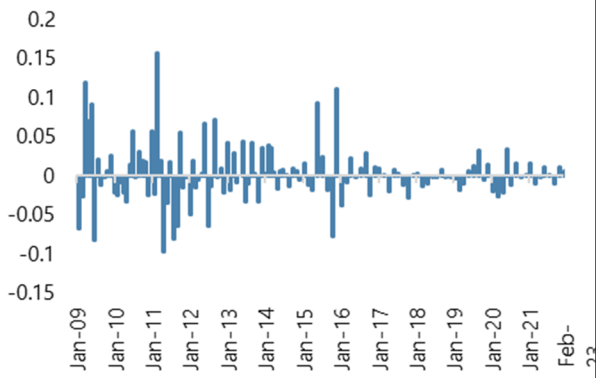
9. The identification of the two shocks allows us to decompose monetary policy changes into different driving forces and capture the nuances of changes in ECB monetary policy. Figure 4 and 5 plot the estimated monetary surprise shock and information news shock. It shows that there were sizable movements following the global financial crisis and during the unconventional monetary policy (UMP) period. For instance, most of the monetary policy movements during the UMP period generate large expansionary monetary surprise shocks, driven by announcement of large asset purchase programs and continued interest rate cuts to the negative interest level. An example is the announcement of the interest rate cut by 10 basis points to negative zone during an ECB Governing Council meeting in December 2015, which constitutes a large decline in the monetary shock. During the COVID period, most monetary policy movements led to expansionary monetary surprise shocks, reflecting supportive monetary decisions from the ECB.

Figure 5. Monetary Surprise



Source: IMF staff calculations.

Figure 6. Information News



Source: IMF staff calculations.

D. Data and Econometric Framework

10. We use daily data on Swiss stock market to estimate the spillover effect from ECB monetary policy changes. To capture the movements of Swiss stock market, we use SMI as the benchmark dependent variable. As a robustness check, we also use the Swiss Performance Index (SPI), which is another closely-followed performance index that includes approximately 230 equities.[5] Both variables are transformed into logarithmic changes. Other daily variables include changes of Swiss shadow interest rates[6] as a proxy of shifts of the SNB's monetary policy stance and changes of nominal effective exchange rate (NEER) to capture exchange rate movements that may affect the stock market performance. The sample period is January 2009 through December 2021.

[5] Since SMI is largely concentrated in multinational firms that have close ties with the euro-area, using SPI helps extend the analysis to cover equity securities of companies that are more focused on Switzerland.

[6] The data on Swiss shadow rate is a monetary policy stance metrics composed by Leo Krippner and LJK Limited https://www.ljkmfa.com/.

11. We estimate OLS regressions of the following form

$$\Delta Y_t = \alpha + \beta_1 \hat{e}_t + \beta_2 \hat{\epsilon}_t + \gamma_1 \Delta NEER_t + \gamma_2 \Delta SST_t + \nu_t \text{ , (4)}$$

where ΔY_t denotes the $t-1$ to t logarithmic changes of Swiss stock indices SMI or SPI, $\hat{e}_t$ denotes the estimated monetary policy shock, $\hat{\epsilon}_t$ denotes the estimated information news shock, $\Delta NEER_t$ denotes changes in NEER, and ΔSST_t denotes changes in the Swiss shadow interest rate.

12. Switzerland provides a good setting to test the impact of domestic monetary regime change on the scope of spillover effects of ECB monetary policy shocks on domestic financial markets. On September 6, 2011, an exchange rate floor of 1.20 Swiss franc per Euro was introduced by the SNB, which lasted until January 15, 2015. The aim was to attenuate appreciation pressure that the Swiss franc had been experiencing since the financial crisis of 2007–08. The Swiss franc is considered a "safe-haven currency", making it particularly popular with investors when global risk sentiment deteriorates. The global financial crisis and the European sovereign debt crisis, together with international low interest rate environment, led to appreciations of the franc, which posed considerable challenges for the competitiveness of the Swiss export sector as well as pressing low inflation into negative territory. During that period, the minimum exchange rate (MER) was the key monetary policy instrument of the SNB, which offers a perfect example to study the interactive effect between the domestic policy setting and external monetary policy spillovers. To evaluate whether the ECB monetary spillover effects are significantly affected by this exceptional change of SNB policy, we split the sample into MER period and post-MER period to distinguish the impact with the introduction of MER.

E. Results

13. Table 1 presents the key result that contractionary monetary policy shocks have a significantly negative impact on Swiss stock market performance, while positive information news shocks have a significantly positive impact on stock market performance. Column (1) shows that following a one standard deviation tightening monetary policy shock, Swiss stock market returns decline by around 1 percent, and following a one standard deviation monetary tightening driven by information news shock, Swiss stock market returns increase by 1.8 percent. The results, including for the size of the coefficient, are robust to using alternative stock market index SPI (Column (4)). Given that SPI has wider coverage of domestic companies, this result also suggests that direct spillovers through financial channels with broad market impact are the major driving forces. Moreover, these findings suggest that sources of monetary policy shocks matter to the directions of cross-border spillovers. Following a surprise monetary tightening that is not expected by market participants, investors readjust their expectation of companies' future growth and rebalance their investments away from stocks, which leads to a decline in stock prices. On the contrary, positive information news shock could lower market participants' uncertainty regarding the economic outlook and leads to higher asset prices.

14. The results in Table 1 reveal that the direction of the reported spillover effects is not affected by the MER introduction, however the average size of ECB monetary spillover effects

on the Swiss stock price indexes was stronger during the MER introduction period than during the post MER period. This outcome is consistent with the asymmetric design of the MER policy, which allowed the Swiss franc to depreciate freely, but capped its appreciation. The estimates obtained for spillover effects observed during the MER period suggests that changes of market participants' expectations would be an important channel of monetary transmission. For instance, following a positive information news shock, expectation of better economic outlook drives capital inflows to the Swiss equity market and leads to higher stock market return. This effect could have been amplified during the MER period due to investors' belief of an undervalued Swiss franc which would have driven further capital inflows following positive shocks until the arbitrage room disappeared.

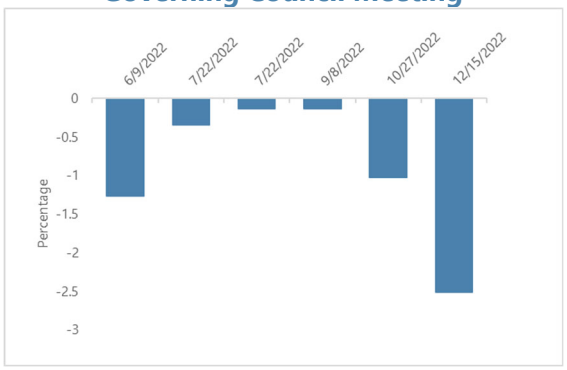
Table 1. Switzerland: Impact of ECB Monetary Policy on Swiss Stock Market

	SMI			SPI		
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Full sample	Swiss Franc floor period	Post floor period	Full sample	Swiss Franc floor period	Post floor period
Monetary surprise shock	-0.0101***	-0.0280***	-0.0114***	-0.0098***	-0.0289***	-0.0111***
	(0.002)	(0.004)	(0.002)	(0.002)	(0.004)	(0.002)
Information news shock	0.0181***	0.0178***	0.0072***	0.0173***	0.0180***	0.0062**
	(0.002)	(0.004)	(0.003)	(0.002)	(0.004)	(0.003)
SMI lag	-0.0058	-0.0094	-0.0212			
	(0.016)	(0.032)	(0.021)			
NEER	-0.0042***	-0.0040***	-0.0055***	-0.0041***	-0.0039***	-0.0052***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Shadow rate	0.0088	0.0306*	0.0001	0.0095	0.0305*	0.0012
	(0.008)	(0.017)	(0.009)	(0.007)	(0.016)	(0.009)
SPI lag				0.0112	-0.0009	-0.0031
				(0.016)	(0.032)	(0.021)
Constant	0.0002	0.0008***	0.0001	0.0004**	0.0009***	0.0003
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R-squared	0.137	0.267	0.100	0.139	0.275	0.099

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

15. Recent ECB monetary tightening episodes have significant negative spillovers to Swiss stock market. On June 9, 2022, the ECB Governing Council announced its intention to raise interest rates and a broader shift (tightening) in the future course of monetary policy to ease inflation pressure. The consecutive interest rate hikes have sent signals of tighter economic conditions and generates months of declining prices across the Swiss stock market. Figure 6 plots the percentage change in SMI following each ECB Governing Council meeting from June to December 2022. On average, the SMI drops by close to 1 percent on the day of ECB monetary tightening announcements, with June and December meeting showing the highest decline. This result indicates a downbeat outlook for corporate profits and a looming view of slowing-down economic activity that has been impacted by tighter monetary policies. Looking forward, continued ECB monetary policy tightening may still bring pressures to the Swiss stock market. Importantly, these spillovers are likely to tilt to the negative side given uncertain economic outlook surrounding ECB's monetary policy decisions.

Figure 7. Change in SMI Following ECB Governing Council Meeting



Source: IMF staff calculations.

F. Cross-Country Analysis

16. Cross-country analysis focuses on ECB monetary policy spillovers in the full sample period and compares Switzerland with euro-area countries as well as other non-Eurozone countries. Analysis of euro-area countries provides information regarding the "domestic" transmission of ECB monetary policy and provides a benchmark for the comparison. We choose Germany, Italy, and Greece as representative euro-area countries. This selection covers a range of stock markets in the euro-area with different market sizes and thus offers a broad-based assessment of the impact of ECB monetary policy transmissions. From non-euro area countries, we choose Sweden and Iceland for comparison, one representing a non-Eurozone EU country and one representing a non-EU European country. Among the non-euro area European countries, these two are small open advanced economies, similar to Switzerland. They also feature different market sizes (Iceland has smaller market capitalization) and thus allow for a diversified assessment of the ECB monetary policy spillovers.

17. Analysis shows that ECB monetary policy spillovers to non-euro area countries exhibit the same direction and similar magnitude compared to Switzerland. A tightening monetary surprise shock leads to significant decline in stock returns of Iceland and Sweden, while a positive information news shock leads to an increase in stock returns. The degree of spillovers to Swedish stock market is similar to that of Switzerland. The smaller magnitude of the reaction in Iceland stock market could reflect its relatively small market capitalization and the concentration of domestic firms listed on the market, with a lower magnitude of cross-border linkage providing a buffer for the pass-through of euro-area monetary policy to the domestic stock market.

18. Compared to non-euro area countries, the transmission of ECB monetary policy to euro-area stock markets are higher. Both the estimated coefficients of the monetary surprise shock and the information news shock are higher than that of Switzerland and the two non-euro area countries, implying bigger and more direct impact of ECB monetary policy on euro-area stock markets. This finding is consistent with previous studies that monetary policy changes have more immediate impact on domestic stock markets while the international transmissions also works

through real channels such as global production network besides standard financial channels (Giovani and Hale 2022).

Table 2. Switzerland: Impact of ECB Monetary Policy on Other European Countries

	Eurozone countries			Non-eurozone countries	
	(1)	(2)	(3)	(4)	(5)
VARIABLES	Italy MBI	Germany DAX	Greece ASE	Sweden AFF	Iceland ICEX
Monetary surprise shock	-0.0188***	-0.0147***	-0.0204***	-0.0131***	-0.0040*
	(0.003)	(0.002)	(0.004)	(0.002)	(0.002)
Information news shock	0.0458***	0.0335***	0.0405***	0.0257***	0.0072***
	(0.003)	(0.002)	(0.004)	(0.002)	(0.002)
MBI lag	-0.0293*				
	(0.016)				
DAX lag		0.0116			
		(0.016)			
ASE lag			0.0575***		
			(0.017)		
AFF lag				-0.0006	
				(0.017)	
ICEX lag					0.0459***
					(0.017)
Constant	0.0001	0.0002	0.0000	0.0004**	0.0002
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R-squared	0.082	0.065	0.047	0.049	0.006

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

G. Summary

19. This paper studies the cross-boarder propagation of ECB monetary policy shocks on Swiss stock markets and differentiates between the sources of monetary policy changes into monetary policy shock and information news shock. As one of the largest stock markets in Europe, the Swiss stock market attracts a large number of multinational companies as well as international investors from Europe. Our analysis shows that ECB monetary policy changes have significant impact on the Swiss stock market. Moreover, the direction and degree of the spillover depend on the sources of monetary policy changes. A tightening ECB monetary surprise shock leads to a decline in Swiss stock market performance, while a positive information news shock leads to an increase in stock market returns. We also show that the domestic monetary policy setting matters to the magnitude of the spillover. The average size of ECB monetary spillover effects on the Swiss stock index was stronger during the MER period versus the post-MER period, possibly reflecting the asymmetric design of the MER policy. A cross-country analysis shows that ECB monetary spillover to the Swiss stock market is largely in line with other non-euro area European countries, but smaller in magnitude compared to euro-area countries.

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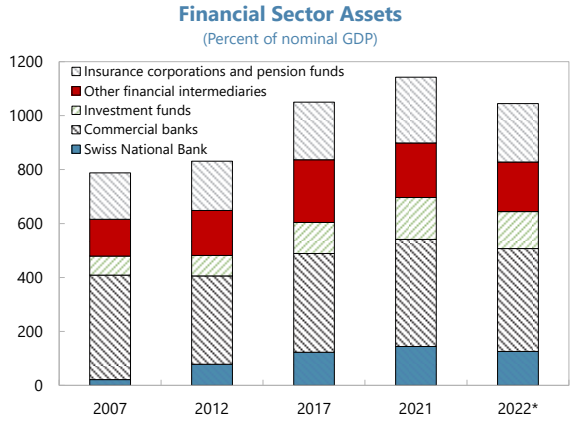
NON-BANK FINANCIAL INSTITUTIONS AND VULNERABILITIES: THE CASE OF SWITZERLAND[1]

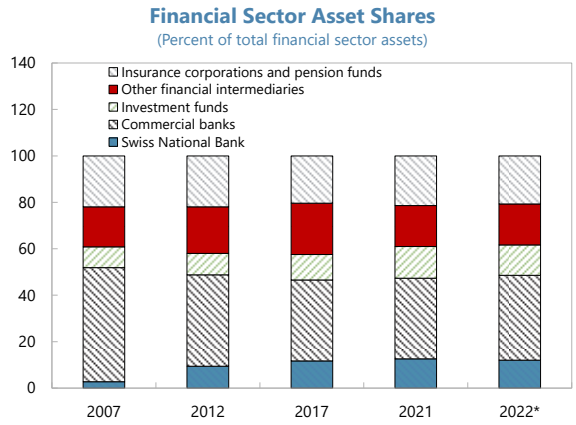
Non-bank financial institutions (NBFIs) play a critical role in financial intermediation in Switzerland. This paper finds that Swiss NBFIs appear broadly sound using sectoral-level balance sheet data and notes that exposures to managed products and interlinkages warrant close monitoring given uncertainties surrounding global financial conditions. Continued efforts to close regulatory data gaps and incentivize stronger risk management of NBFIs would help safeguard financial stability.

A. Motivation

1. NBFIs have exhibited strong growth since the global financial crisis (GFC), becoming an important part of Switzerland's financial system. The share of financial sector assets held by commercial banks shrunk from 49.2 percent in 2007 to 34.7 percent in 2021. As a comparison, investment funds, other financial intermediaries (OFIs), and pension funds and insurance companies held 13.6 to 21.4 percent of financial sector assets in 2021[2]. This reflects the increasing diversification of financial intermediation, but it also brings challenges to financial regulation and supervision. The sizes of main NBFI segments[3] also ranged from 137 percent to 236 percent of GDP as of 2021, suggesting their significant macro relevance in addition to the importance to financial stability.

Figure 1. Switzerland's Financial System





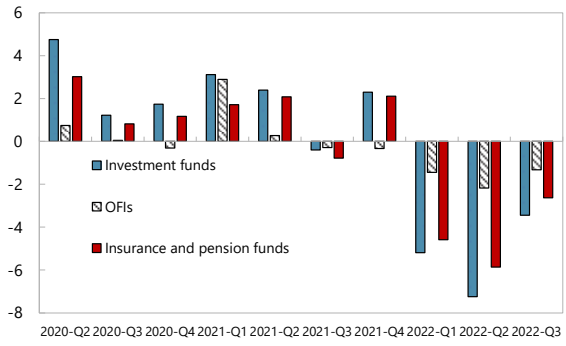
Sources: SNB, Haver Analytics, and IMF staff calculations.
Note: 2022* shows cumulative data from Q1 to Q3.

[1] Prepared by Yu Shi (EUR). The author would like to thank seminar participants at the SNB, the Swiss Financial Market Supervisory Authority (FINMA), and the Federal Department of Finance for their helpful comments.

[2] The role of NBFIs in credit extension remains relatively limited. They account for less than 5 percent of the domestic credit in Switzerland.

[3] See Annex A.1 for the classification of NBFIs into three main segments: investment funds, other financial intermediaries, and insurance and pension funds.

2. Significant asset price corrections in the first three quarters of 2022 have led to sizable financial losses of NBFIs. According to the SNB's financial accounts data, investment funds, OFIs, and insurance corporations and pension funds have cumulatively lost 15.6 percent, 4.8 percent, and 12.7 percent of their financial assets, respectively, from 2022Q1 to 2022Q3. For selected pension funds whose asset brackets are available at a more granular level, most of the losses were associated with foreign and domestic equities, as well as CHF bonds (Table 1). The insurance sector is weathering the losses well given its adequate level of capital buffers. Nevertheless, with major central banks continuing to tighten monetary policy and imbalances in the residential real estate market still elevated (Staff report, ¶26), NBFIs could face further pressures going forward. The recent stress episodes related to NBFIs, including pension funds in the UK and long-term project finance companies in Korea (IMF, 2023), have also underscored the importance of a horizontal screening of risks in NBFIs and analyzing their financial stability implications as well as potential spillovers to the whole economy.



Sources: SNB and IMF staff calculations.

Table 1. Switzerland: Performance Contribution of Selected Swiss Pension Funds (quarterly)

	Q1 22	Q2 22	Q3 22	Q4 22	YTD
Liquidity	-0.03%	-0.11%	-0.07%	0.14%	-0.06%
CHF bonds	-1.39%	-1.11%	-0.61%	0.03%	-3.00%
Foreign currency bonds	-0.21%	-0.20%	-0.14%	-0.04%	-0.56%
Convertible bonds	-0.01%	-0.02%	0.00%	0.01%	-0.03%
Swiss equities	-0.83%	-1.56%	-0.66%	0.62%	-2.39%
Foreign equities	-1.00%	-2.42%	-0.93%	0.84%	-3.43%
Alternative investments	0.07%	-0.04%	-0.05%	-0.04%	-0.06%
Real estate	-0.05%	-0.72%	-0.02%	0.25%	-0.54%
Mortgages	-0.01%	-0.02%	0.00%	0.01%	-0.02%
Other	-0.01%	-0.02%	-0.01%	0.00%	-0.03%
Total	-3.47%	-6.22%	-2.49%	1.83%	-10.11%

Source: Credit Suisse Swiss Pension Fund Index

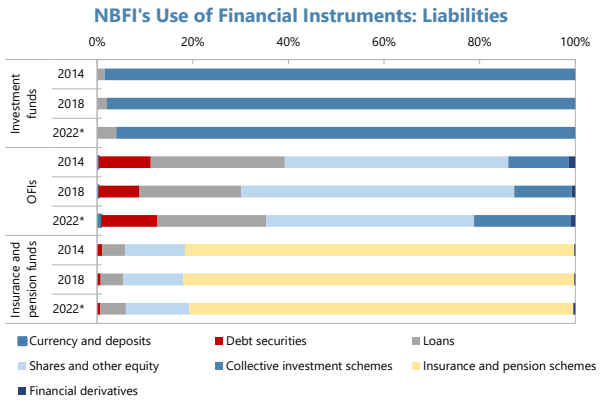
3. This paper provides a thorough review of financial stability risks in different NBFI segments in Switzerland. The analyses rely mostly on publicly available data from the SNB and Eurostat, and compare leverage risk, liquidity risk, and interconnectedness of Swiss NBFIs across countries and over time. A data framework that could help quantify the macroeconomic impact of NBFI losses is also discussed in the paper. In addition, this paper briefly describes the regulatory and supervisory approach for different NBFIs, including some recent data collection efforts. Finally, a set of considerations focusing on further closing regulatory data gaps and enhancing risk management for NBFIs is discussed.

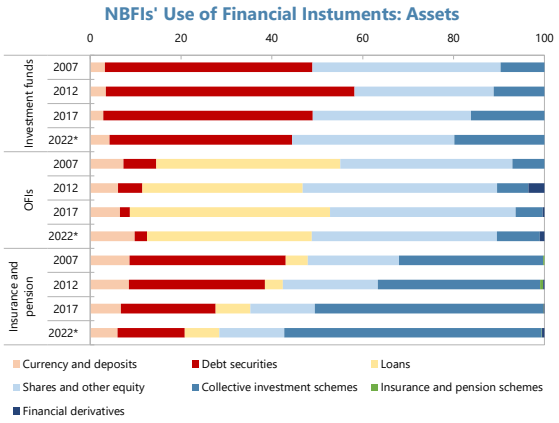
B. Financial Stability Risks

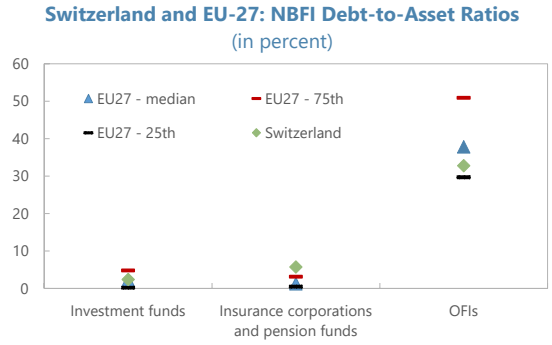
Leverage Risk

4. Aggregate on-balance-sheet leverage risks of Swiss NBFIs appear relatively low, but off-balance-sheet activities by investment funds warrant close monitoring. According to the Swiss financial accounts data, insurers and pension funds in Switzerland use a very small share of debt instruments for financing – around 5 percent of their total financial liabilities (Figure 2). The ratio is also on the lower end compared to member countries of the European Union (EU). For OFIs, the share of financial liabilities in debt securities and loans reached 34.5 percent in the first three quarters of 2022 but remained at a comfortable level compared to their EU peers. Investment funds are mostly financed via investment fund shares/collective investment schemes (CIS), but their active use of derivatives and complex trading strategies makes it generally difficult to measure leverage (Adrian and Jones, 2018). Given the increasing allocation of financial assets to CIS by insurers and pension funds, as well as by OFIs, close monitoring of the use of leverage by investment funds will be critical to identify leverage risks for the entire NBFI sector.

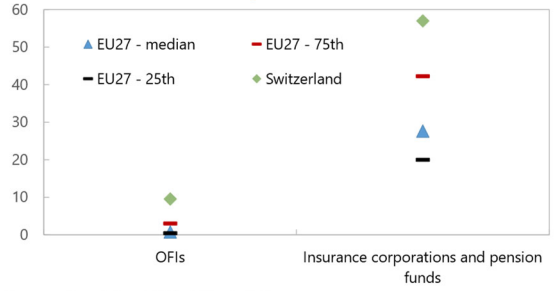
Figure 2. NBFI Leverage Ratios and Asset Allocation







Sources: Eurostat and IMF staff calculations
Note: The debt-to-asset ratio is calculated as the ratio of financial liabilities in debt securities and loans to total financial assets.

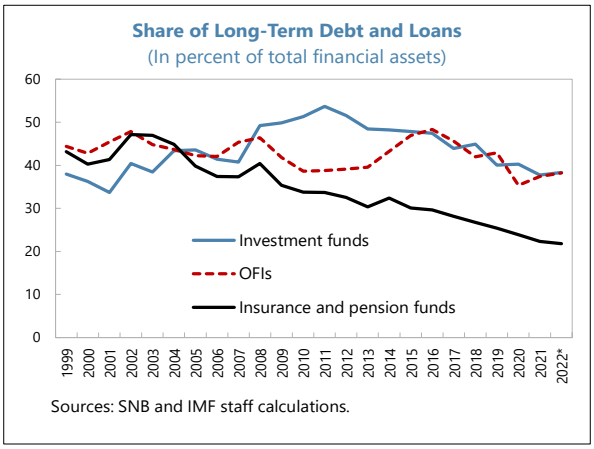


Sources: Eurostat and IMF staff calculations
Note: The share of assets in investment funds is calculated as the ratio of financial assets in the form of investment funds shares to total financial assets.

Sources: SNB, Eurostat, and IMF staff calculations

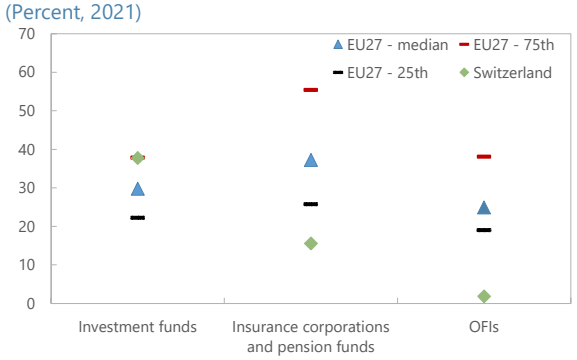
Liquidity Risk

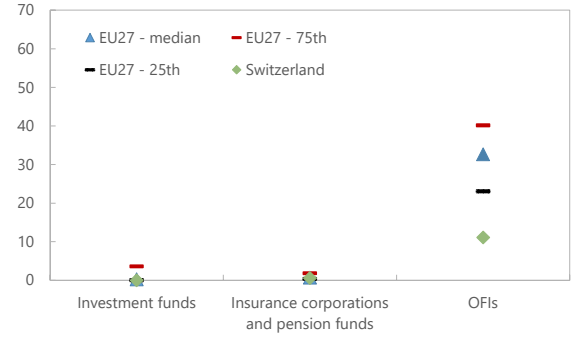
5. Liquidity mismatches are less of a concern for Swiss NBFIs compared their EU peers, although pockets of vulnerability remain. At the aggregate level, all NBFI segments in Switzerland have reduced their holdings of long-term debt securities and loans in recent years. Besides, insurers have a strong incentive to match durations on both the asset side and the liabilities side to perform well in the annual Swiss Solvency Test (SST). As for pension funds, more than 90 percent of the funds in Switzerland are in a defined-contribution scheme, thus they face less liquidity risk and would have more time to recover the losses in 2022. From a cross-country perspective, insurance companies, pension funds, as well as OFIs in Switzerland invest significantly less in long-term debt instruments (Figure 3). On the other hand, the holding of long-term debt assets by Swiss investment funds are on the higher end compared to their EU peers, close to the 75th percentile. Given that these funds are mostly financed by investment fund shares and can face margin calls or redemptions, liquidity risks can intensify in this segment.



Sources: SNB and IMF staff calculations.

Figure 3. NBFI Liquidity Positions – Cross-Country Comparison





Sources: Eurostat and IMF staff calculations.

6. Liquidity risks can also emerge in the non-financial corporation (NFC) sector, for example among commodity trading firms. Commodity traders are critical intermediaries between the producers and consumers of key commodities. They usually hold large inventories and actively trade derivative contracts for risk-hedging, and hence can face serious liquidity challenges during a period of high commodity price volatilities. Given that these firms are not regulated as financial institutions, the lack of data collection makes it particularly difficult for market participants and supervisors to gauge their liquidity risk exposure. Balance sheet data of selected public commodity traders suggest that their holdings of liquidity assets are generally not sufficient to cover short-term

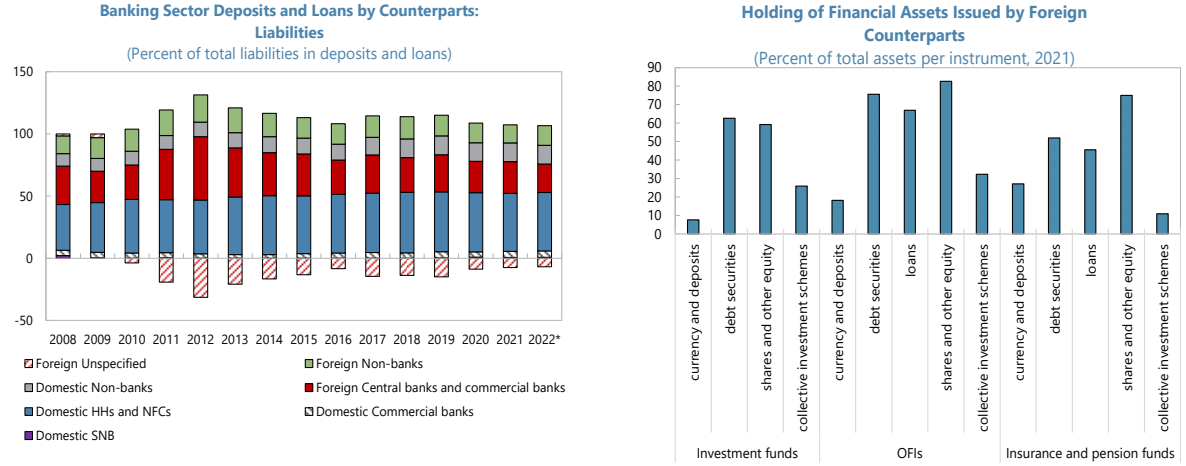
liabilities (IMF, 2023). Although for some of them, this concern is mitigated by having separate liquidity arrangements with commercial banks.

Interconnectedness

7. Significant data gaps exist in measuring interconnectedness among NBFIs. The Financial Stability Board (FSB)'s annual NBFI monitor publishes cross-sector financial exposures regarding both financial claims and liabilities across banks, insurance companies, OFIs, pension funds, households, government, and NFCs for a group of 29 jurisdictions. For each EU member state, Eurostat also reports pairwise financial asset and liability exposures in six instruments[4] among five different financial sector segments.[5] While Switzerland regularly contributes to the FSB's NBFI monitor, there are little Switzerland-specific data available for financial linkages across banks and non-banks. The lack of data on interconnectedness makes it difficult to assess systemic financial risks related to each NBFI segment.

8. According to the limited data available, Swiss NBFIs have become more interconnected among different segments, as well as with the banking sector and with foreign counterparts. Insurance companies, pension funds, and OFIs have increasingly relied on investment funds to manage their financial assets (Figure 2). In case these investment funds use similar investment strategies, concentration risks related to specific asset markets can also arise.[6] In addition, the share of banking sector deposits and loans held by non-banks has increased from 24 percent in 2008 to 31 percent in 2021. Most NBFIs also hold a significant amount of foreign assets, and thus can be exposed to financial stability risks in foreign jurisdictions.

Figure 4. Switzerland NBFIs: Banking Sector and Foreign Exposures



Sources: SNB and IMF staff calculations.
Note: 2022* shows cumulative data from Q1 to Q3.

[4] Short-term and long-term debt securities, short-term and long-term loans, listed shares, investment fund shares.

[5] Monetary financial institutions (central bank, commercial banks, and money market funds), non-money market funds, OFIs, insurance companies, and pension funds.

[6] For example, the recent stress episode in the UK was partly related to the concentration of pension fund assets in long-term gilts. Their collective sales of these "liquid" bonds led to large price declines in the gilts market.

9. Another important aspect of interconnectedness is the financial linkage between NBFIs and non-financial institutional sectors. A key data initiative after the GFC has been the development of the integrated system of sectoral accounts and balance sheets, including the from-whom-to-whom framework (Mink, 2011; BIS-ECB-IMF, 2015), to help monitor the build-up of financial risks and understand financial connections among different institutional sectors. A standard from-whom-to-whom framework includes information of the stocks and flows of assets and liabilities for each financial instrument and each pair of the institutional sectors on a non-consolidated basis (see Table 2 for a standard template of a given financial instrument). The framework allows for tracing the debtor/creditor relationships between institutional sectors and analyzing how balance sheet weakness can contribute to the origin and propagation of a financial crisis (see the IMF's balance sheet approach for more details).

Table 2. Switzerland: Template: From Whom-to-Whom Transactions for One Financial Instrument
(non-consolidated)

Debtor by residency and by resident sector \ Creditor by residency and by resident sector		Residents					Non Residents	All creditors
		Non-Financial Corporations	Financial Corporations	General Government	Households	Non-Profit institutions serving households		
Residents	Non-financial corporations							
	Fiancial corporations							
	General government							
	Households							
	Non-profit institutions serving households							
Non-Residents								
All debtors								

10. The SNB reports from-whom-to-whom data for debt securities, but not for other financial instruments. The data are available in the context of IMF SDDS Plus for five institutional sectors: financial corporations, non-financial corporations, general government, households, and non-profit institutions serving households, and rest of the world. Compared to the euro area, most debt securities held by Swiss NFCs, financial corporations, and households are issued by foreign counterparts. In addition, there is a much stronger connection within the NFC sector as 22 percent of the debt securities held by Swiss NFCs are issued by other domestic NFCs. On the other hand, the strong feedback loop between financial corporations and governments that is present in the euro area is not seen in Switzerland.

Table 3. Switzerland: Holdings of Debt Securities Issued by Counterparts

(Percent of total assets in debt securities, 2022Q3)

	Switzerland				
	NFC	FC	GOV	HH	ROW
NFC	22.0	8.0	14.6	12.5	27.3
FC	18.3	13.1	39.5	21.8	55.2
GOV	2.0	6.6	6.0	0.9	17.5
HH	0.0	0.0	0.0	0.0	0.0
ROW	57.8	72.4	39.9	64.8	0.0
Total (bn CHF)	31.4	1440.1	23.7	80.0	
	Euro Area - 19 countries				
	NFC	FC	GOV	HH	ROW
NFC	7.9	8.8	4.5	6.9	6.4
FC	29.5	31.9	22.3	57.1	52.8
GOV	26.4	54.2	47.5	26.4	40.8
HH	0.0	0.0	0.0	0.0	0.0
ROW	36.3	5.2	25.7	9.7	0.0
Total (bn EUR)	218.1	14180.8	472.7	471.2	

Source: SNB, Eurostat, and IMF staff calculations.
Note: NFC = non-financial corporations, FC = financial corporations, GOV = government, HH = households and NPISH, ROW = rest of the world. The columns are creditors, and the rows are debtors. Each cell shows the debtor's holding of debt securities issued by the creditor as a percent of the debtor's total debt securities holdings.

11. Enhancing data collection for the from-whom-to-whom linkages would improve the assessment of spillovers through financial linkages. One area of improvement is to expand the from-whom-to-whom data to other financial instruments. For example, recording stocks of cross-sector holdings of equity shares would help with analyzing the possible transmission of sectoral financial losses to the whole economy via equity valuation changes. A decline of the equity valuation of one sector, after absorbing financial losses, would translate into financial losses of its equity shareholders, passing sectoral investment losses to other institutional sectors. Depending on the network structure, cross-sector equity-holding linkages can amplify or mitigate the impact of sector specific shocks (Castren and Rancan, 2014; ECB Financial Stability Review, June 2009; also see Appendix A.2 for how to calculate the spillover through equity-holding linkages). Another area of improvement would be to further disaggregate the financial sector into commercial banks and NBFI segments. Given the diverse business models of different financial institutions, grouping the NBFIs together with banks would mask important heterogeneity in their connection with other sectors. Data on interlinkages between banks and NBFIs are also critical for a timely assessment of the systemic implications of any stress episodes in the financial sector (for example, the recent Credit Suisse event).

C. NBFI Supervision and Regulatory Data Collection

12. Insurance. Switzerland has a highly sophisticated regulatory framework of the insurance sector, centered around FINMA's Swiss Solvency Test, and combined with the insurers' own forward-looking assessment of risk and solvency situation. This framework has contributed to better risk

management practices of the Swiss insurance sector. Insurance companies are also required by law to produce an annual report and a supervisory report to disclose financial data and other supervisory information.

13. Pension funds. The supervision of the pension sector in Switzerland is relatively fragmented, with a two-tier structure of eight cantonal authorities and one federal body, the federal Oberaufsichtskommision Berufliche Vorsorge (OAK BV). The pension sector has continued to consolidate in recent years, yet the number of supervised schemes remained above 1,300 in 2021. The OAK BV collects data on the financial situation of pension schemes on an annual basis and publishes annual surveys of the pension sector. Nevertheless, the lack of granular data hampers the possibility of conducting a systemic risk analysis of the sector.

14. Investment funds/asset management companies. FINMA uses a combined approach of direct and indirect supervisions with a range of supervisory tools for asset management activities. On an annual basis, financial and operational data including income, costs, profits and losses, and capital structure are collected from fund management companies, managers of collective assets, investment companies with variable capital, and limited partnerships for collective investment. Since 2022, FINMA has also started collecting data on collective investment schemes from both Swiss funds and foreign funds managed from Switzerland. The data collection is risk based with a threshold of CHF 500 million of net fund assets and includes information on key investment strategy, asset class exposures, and risk measures such as fund leverage, liquidity risk and management, and counterparty risks.

15. Financial market infrastructures (FMIs), fintech, and crypto. Systemically important FMIs, including central counterparties and central securities depositors, are supervised jointly by FINMA and the SNB to ensure the stability of the financial system. FINMA also serves in the role of supervisor of trading venues and focuses on ensuring compliance with legal and organizational requirements. With respect to the fintech sector, all institutions with a FinTech license or a license as a DLT trading facility are subject to supervision by FINMA. The supervision of the fintech sector also takes a combined approach of direct supervisions and indirect supervisions through external audit firms. In addition, FINMA can collect data of fintech companies on a needs-based approach.

D. Concluding Considerations

16. The current environment of rising inflation and interest rates, tighter financial conditions, and volatile asset prices calls for a prudent regulatory and supervisory approach of the NBFIs. As global central banks face the challenging trade-off between safeguarding financial stability and maintaining price stability, it is of the utmost importance to identify timely vulnerabilities in the NBFI sector and to understand channels of spillovers to other sectors. Proper public disclosure and clear communication will also be critical to support market discipline and maintain investor confidence.

17. Closing regulatory data gaps and incentivizing stronger risk management of NBFIs are priorities. In the case of Switzerland, further efforts on regulatory data collection should focus on: (i)

understanding the interconnectedness within the financial sector, including between commercial banks and NBFIs, as well as across different NBFIs segments; (ii) analyzing potential concentration risks related to common investment strategies by NBFIs and the possibilities of sell-offs in specific markets; (iii) tracing potential forward and backward spillovers between NBFIs and non-financial institutional sectors through financial linkages, and understanding the real economy impact on in case risks materialize in the NBFI sector. Regulators should also encourage robust risk and liquidity management of NBFI entities themselves to address their exposure to vulnerabilities.

18. Enhanced coordination between the SNB and NBFI regulators would help identify risks and manage crisis situations. Swift data sharing arrangements among the SNB and different NBFI regulators are essential to achieve timely identification of cross-sectoral risks. Given the high exposure of NBFIs to foreign markets, close collaboration with foreign central banks and financial regulators would facilitate further closing data and information gaps.

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Annex I. Further Breakdown of NBFIs

Investment Funds

- Money Market Funds (MMFs)
  - Constant Net Asset Value MMFs
- Non-Money Market Funds (non-MMFs)
  - Open-end funds
    - Real estate funds
    - Equity funds
    - Bond funds
    - Mixed or balanced funds
    - Hedge funds
    - Other open-end funds
  - Closed-end funds
    - Real estate funds
    - Equity funds
    - Bond funds
    - Mixed or balanced funds
    - Hedge funds
    - Other closed-end funds

Other Financial Intermediaries (OFIs)

- Financial vehicle corporations engaged in securitization transactions
- Financial corporations engaged in lending (FCLs)
- Security and derivative dealers
- Specialized financial corporations
- Other OFIs (including central clearing counterparties)
- Trusts, estate and agency accounts
- Corporate groups' captive financial entities (including foreign owned SPE-type captives)
- Other captive finance companies and money lenders

Insurance Corporations and Pension Funds

- Insurance corporations: Life and Non-life insurance corporations
- Pension funds: Defined benefit and defined contribution funds

Annex II. Using the From-Whom-to-Whom Table to Calculate the Spillover of Financial Losses via Equity Valuation Changes

Consider an economy with $\{n\} = 1,2, \dots, i, \dots n$ institutional sectors. Each sector holds a number of financial assets including cash C_i, equity shares of other sectors E_{ji}, and loans to other sectors L_{ji}:

$$Asset_i = C_i + \sum_{j \neq i} E_{ji} + \sum_{j \neq i} L_{ji}$$

On the liabilities side, it is assumed that financial liabilities of each sector consist of equity shares and loans, which should be equal to or greater than zero depending on the specific sector (households do not issue equity shares for example for example).

$$Liabilities_i = E_i + L_i$$
$$E_i \geq 0, L_i \geq 0$$

Balancing the asset side and the liability side together with market clearing conditions imply that:

$$C_i + \sum_{j \neq i} E_{ji} + \sum_{j \neq i} L_{ji} = E_i + L_i \quad (1)$$

$$\sum_{j \neq i} E_{ij} = E_i \quad (2)$$

$$\sum_{j \neq i} L_{ij} = L_i \quad (3)$$

Assuming that financial losses of each sector are fully absorbed through equity valuation losses on the liabilities side, (1) and (2) can then be combined into one equation:

$$\Delta E_i = \Delta \sum_{j \neq i} E_{ji}$$

$$= \sum_j \frac{E_{ji}}{E_j} \Delta E_j$$

Writing the equation for each sector i in a matrix form would lead to:

$$\Delta E = \epsilon \Delta E, \quad (4)$$

where $\Delta E = [\Delta E_1, \Delta E_2, \dots, \Delta E_i, \dots, \Delta E_n]'$ is the changes of equity valuation of each sector; and

$$\epsilon = \begin{bmatrix} \frac{E_{11}}{E_1} & \cdots & \frac{E_{n1}}{E_n} \\ \vdots & \ddots & \vdots \\ \frac{E_{1n}}{E_n} & \cdots & \frac{E_{nn}}{E_n} \end{bmatrix}$$

is the cross-sector equity holding structure prior to the shocks.

By iterating over the impact of initial shocks on sectoral equity valuation losses using equation (4), we can compute the spillover of the shock beyond the direct sector linkages. The amplifying effect of the network can be calculated when equation (4) converges to a fixed point.

CLIMATE CHANGE MITIGATION IN SWITZERLAND[1]

As part of its national determined contribution and its long-term low emission development strategy, Switzerland committed to reduce its greenhouse gas emissions by at least 50 percent by 2030, compared to 1990, and to net zero by 2050. Under existing policies, Switzerland's emissions might fall short of its 2030 target. Achievement of its 2030 commitment hinges on the adoption of a proposed revision of the CO_2 Act (Third CO_2 Act) currently being debated in Parliament.

While the measures contained in the proposal would align Switzerland's aggregate emissions trajectory with its 2030 target, they do not place individual sectors on a trajectory consistent with their respective 2040 emission targets. To ensure cost-effective reductions of domestic emissions beyond 2030—or in the run-up to it, if planned policies do not deliver the projected emission reductions—Switzerland should consider a range of options for sector-specific measures. These could include the following:

- *Applying a feebate mechanism on emissions from industry currently covered by negotiated reduction commitments. The parameters of the mechanism (e.g., benchmark emission intensity) would be harmonized with those of the Swiss ETS so as to level the playing field between firms covered by the ETS and those currently covered by negotiated reduction commitments.*

- *Introducing a carbon content-based component in the Mineral Oil Tax and Surtax on Motor Fuels. Switzerland's excise duty on liquid motor fuels has, in real terms, remained unchanged since 1990 and does not efficiently internalize the (marginal) external costs of motor fuel consumption (e.g., local air pollution, greenhouse gas emissions, congestion). The introduction of a CHF 50/tCO_2e (equivalently, CHF 0.12/liter of gasoline), starting in 2030, could yield an additional 0.6 Mt CO_2 reduction and revenues up to CHF 0.54 bn per year. This revenue could be used to fund emissions reduction, such as infrastructure investments supporting the deployment of zero-emission vehicles.*

- *Raising the CO_2 levy to CHF 210/tCO_2e, the level that was considered in an earlier proposal for revision of the CO_2 Act, from 2030 onward. The impact on buildings emissions would be modest in the short-term (-0.5 Mt CO_2 by 2035) but could contribute substantially to decarbonization in the medium term as price elasticity increases due to improved home insulation and availability of alternative heating systems. Revenues could reach up to CHF 0.54 bn per year and GDP impacts would be small and transitory.*

More broadly, Switzerland should continue to provide clear guidance on the direction of future climate policy by specifying emission reduction policies applicable beyond 2030 after completion of the current legislative process of the revision of the CO_2 Act.

[1] This paper was prepared by Geoffroy Dolphin (EUR). The author would like to thank S. Pelin Berkmen, and seminar participants at the Federal Department of Finance for their helpful comments.

A. Background

1. Switzerland narrowly missed its 2020 national greenhouse gas (GHG) emissions target. In the run up to 2020, Switzerland had both a *national* and an *international* emission reduction target. Its national target was a 20 percent reduction in GHG emissions (compared to 1990 levels), to be achieved exclusively by measures reducing domestic emissions. Its international target, which it committed to under the Kyoto Protocol, was a reduction of emissions by 15.8 percent (compared to 1990 levels), on average, over the period 2013–2020.[2] In 2020, Switzerland's GHG emissions were 19.6 percent below 1990 levels, narrowly missing the national target. However, it achieved its international target thanks to emission reductions through emission compensation projects abroad.

2. Most sectors reduced their emissions between 1990–2020, but not all met their sector-specific targets. The highest emission reductions were achieved in the buildings sector (-38 percent), with a slight difference between commercial (-33 percent) and residential buildings (-40 percent). This was followed by industry (-18 percent), agriculture (-12 percent) and transport (-7.7 percent). Among those sectors, industry exceeded its reduction target (-15 percent), while transport and buildings missed their respective targets (-10 percent and -40 percent, respectively). However, Switzerland's emission reduction performance in those sectors has been comparable—and sometimes better—than that of other European economies (Table 1). For instance, Switzerland's emission reductions in the buildings sector are substantially higher than in other European countries and in the EU—in ; but emission reductions in industry have been lower than those of large European economies such as the UK and France.

Table 1. Switzerland: GHG Emissions in Switzerland and Selected European Countries, 2020
(percent change from 1990)

	CHE[1/]	AUT	FRA	ITA	PRT	GBR	EU27
Total emissions (excl. LULUCF)[2/ 4/]	-19.6	-6.2	-27.8	-26.7	-1.5	-49.3	-31.9
Electricity and Heat	37.1 [3/]	-47.9	-39.7	-44.8	-42.4	-75.4	-46.8
Industry (combustion and process)	-17.8	11.2	-42.8	-42.0	-1.6	-54.7	-39.5
Road transport	-6.5	52.8	-9.8	-16.3	40.9	-19.1	11.2
Buildings	-37.7	-37.5	-30.2	2.2	8.1	-20.8	-29.9
Agriculture	-12.5	-14.2	-12.9	-11.4	-2.1	-16.6	-20.8

Source: IMF Staff based on Eurostat.
1/ Numbers in green (red) indicate emission reductions higher (lower) than the EU27 average.
2/ LULUCF refers to Land Use, Land Use Change and Forestry.
3/ The high percentage change in emissions from power and heat is explained by the low absolute emissions in that sector in 1990 (2.15 Mt CO_2e) and an increase in emissions (0.8 Mt CO_2e) resulting from an increase in power and heat generation from waste incineration.
4/ GHG emissions in 2020 were substantially affected by the economic slowdown caused by the COVID19 pandemic. This affects (downward) the figures presented in the table above. The EU country aggregate excludes the UK.

[2] Switzerland's international target includes emission reductions achieved abroad and net emissions from carbon sinks.

3. Switzerland has set 2030 and 2050 emission reduction targets aligned with its international commitment under the Paris Agreement. In 2017, Switzerland ratified the Paris Agreement, which made Switzerland's pledge to reduce GHG emissions by at least 50 percent (compared to 1990) by 2030 binding.[3] This target was set in Switzerland's nationally determined contribution, developed as required by Art. 4, para 1 and 2 of the Paris Agreement. The targets defined in the Climate Protection Act derive from Switzerland's Long Term Climate Change Strategy, developed as required by Art. 4, para. 19 of the Paris Agreement and adopted in January 2021 by the Federal Council (Federal Council, 2021). This strategy, which sets guidelines for Switzerland's long-term climate policy, projects that approximately 12 Mt CO_2e will still be emitted in 2050.[4] In addition, this strategy suggests that measures to reduce emissions embedded in Switzerland's imports should also be considered. These emissions are currently about twice as high as domestic emissions and have risen over time (Federal Council, 2021).

4. To achieve these targets, Switzerland is examining a proposal for a Third CO_2 Act and passed a Climate Protection Act in September 2022. Switzerland has developed a comprehensive climate mitigation framework, primarily contained in the Federal Act on the Reduction of CO_2 Emissions (hereafter, CO_2 Act). The CO_2 Act specifies cross-sector and sector-specific policies and measures to achieve emissions reduction targets. The first version of the CO_2 Act came into force in 2000 and, in 2013, the Swiss parliament passed a revision (Second CO_2 Act) to align these instruments with 2020 emissions reduction targets. In 2020, a proposal for a revision of the Act ("revision totale"), in view of achieving emission reductions over the period 2021–2030, was adopted by the Swiss parliament.[5] It was however rejected by popular vote in June 2021 and Switzerland's emission reduction efforts have relied on an 'emergency' extension of the CO_2 Act (through 2024) since then. Parliament is now examining a new revised proposal.[6] Looking beyond 2030, the Parliament adopted the Climate Protection Act (pending consideration by referendum in June 2023), which specifies a net zero objective by 2050, together with intermediary targets specified at the sector-level for 2040. It specifies an emissions pathway to net zero. This is essential to mobilize, this decade, the capital investments that will be needed to achieve 2040 and 2050 emission reduction objectives (Box 1).

[3] This target was approved in June 2017 by the Swiss Parliament, at the same time it approved the ratification of the Paris Agreement (see https://www.fedlex.admin.ch/eli/oc/2017/618/fr). However, due to the rejection of the third revision to the CO_2 Act in June 2021, the 2030 emission targets have not been enshrined in the Act yet.

[4] It is planned that those be captured and permanently stored, or offset by negative emission technologies such as direct air capture (DAC).

[5] The version adopted in September 2020 (but rejected by referendum in June 2021) is accessible at https://www.fedlex.admin.ch/eli/fga/2020/2013/fr. The version of the CO_2 Act currently in force can be found at https://www.fedlex.admin.ch/eli/cc/2012/855/en.

[6] This proposal, detailing the measures to achieve emission reductions over the period 2025–2030, was adopted by the Federal Council in September 2022. It is currently being debated in the Swiss Parliament (Council of States) and may be submitted to a popular vote once adopted.

Box 1. Climate Policy for Net Zero: Getting Expectations Right

Achieving the emission reductions consistent with Switzerland's 2030 and 2050 targets will require significant investments across all economic sectors. The Energy Perspectives 2050+ estimate the *additional* investment need at CHF109bn (2017 prices) through 2050.

The largest share of these investments (approximately two thirds) is expected to come from the private sector (reference: IEA). However, the long lifetimes and irreversibility (to a degree) of capital investments make investment decisions highly sensitive to expectations about future policies. In addition, unless emissions intensive capital is retired before the end of its economically valuable lifetime (IEA 2021), investment decisions made in this decade will play a large part in determining countries' emissions pathways through 2050. Therefore, implementing a regulatory framework that provides sufficient incentives to draw private capital toward such investments is essential. This, in turn, requires a credible climate policy path. In Switzerland, the Long-Term Climate Strategy provides guidance regarding the long-term emissions pathway but does not define the policies and measures to achieve it. The Climate Protection Act is a step in that direction, as it enshrines in law the 2040 and 2050 (sector-level) emission reduction targets.

5. Switzerland is projected to achieve its 2030 emission reduction goals, but this outcome hinges on the passage and timely implementation of the measures contained in the Third CO_2 Act and the successful achievement of emission reductions abroad. The 2030 target GHG emissions level for Switzerland is 27Mt CO_2e, a 50 percent reduction compared to 1990 level. Accounting for measures contained in the latest proposal for a Third CO_2 Act, projected economy-wide GHG emissions in 2030 are 35.6Mt CO_2e (Figure 1) (FOEN, 2022).[7] This represents a 34 percent reduction in domestic emissions, as stipulated in the proposal for a Third CO_2 Act. The shortfall (8.6 Mt CO_2e) is expected to be met through emission reductions abroad. Indeed, the proposal introduced in September 2022 indicates that at least 60 percent of emission reductions between 2021 and 2030 should be achieved by measures reducing domestic emissions, whereas the remaining emission reductions will be achieved abroad and credited to Switzerland under the regime instituted by Article 6.2 of the Paris Agreement.[8] To that end, the Swiss government has undertaken to sign bilateral agreements with a number of countries. For instance, the Federal Council approved an agreement with Peru on October 14, 2020 and an agreement with Ghana on November 18, 2020.[9] These agreement provide the legal framework governing the bilateral cooperation and define the requirements for the recognition of transfers of emission reductions.

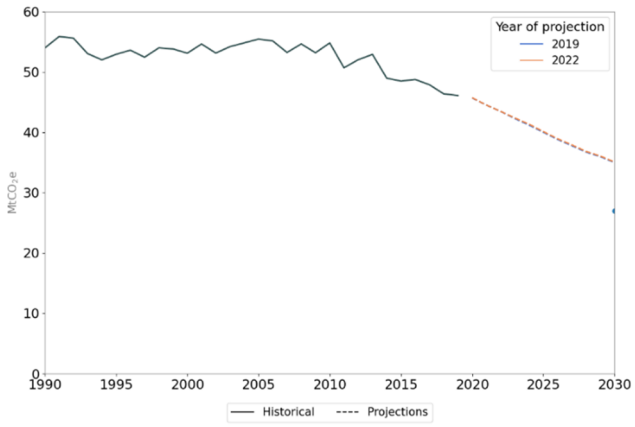
[7] This is slightly higher than the projected emissions contained in Switzerland's 4th Biennial Report to UNFCCC (35Mt CO_2e) and which accounted for the version of the CO_2 Act submitted to referendum in 2021. Both proposals envisage substantial emission reductions abroad. For more details on emission projections for Switzerland, including the underlying modelling framework, see FOEN (2022).

[8] The version of the CO_2 Act currently in force stipulates that at least 75 percent of the reduction in GHG emissions must be achieved through measures reducing domestic emissions.

[9] For details on these and later agreements, see https://www.bafu.admin.ch/bafu/fr/home/themes/climat/info-specialistes/climat--affaires-internationales/staatsvertraege-umsetzung-klimauebereinkommen-von-paris-artikel6.html.

6. The measures contained in the proposal for a Third CO_2 Act are necessary to achieve the 2030 emission targets. Without further strengthening of existing policies, Switzerland's aggregate 2030 emissions are projected to remain at their 2020 level (Table 2, "CPAT (WEM)").[10] With planned (i.e., already enacted) strengthening of existing measures (Table 2, "EEA (WEM)"), GHG emissions will decrease further but will not reach levels compatible with 2030 targets (Table 2, "EEA (WAM)").[11] Measures contained in the proposal for a Third CO_2 Act are expected to yield the largest additional emission reductions in the road transport and buildings sectors, when compared to a scenario with existing measures.[12] These sectors constitute the largest sources of emissions in Switzerland (transport: 30 percent; buildings: 26 percent, in 2021) and, given Switzerland's largely decarbonized power sector, the largest sources of emission reduction potential. Accordingly, the Third CO_2 Act introduces measures to support emission reductions in these sectors. This is reflected in projected emission reductions in the road transport and buildings sector: in the transport sector, mitigation measures are projected to yield an additional 2.1Mt CO_2e reduction; whereas it is projected to yield an additional 0.5Mt CO_2e in buildings.

Figure 1. Historical and Projected GHG Emissions in Switzerland, 1990–2030



Source: historical emissions: EDGAR; Projections: (European Environment Agency, 2023) .
Note: This figure shows historical and projected greenhouse gas emissions for Switzerland. Projections are for the "With Additional Measures (WAM)" scenario. The blue dot represents Switzerland's 2030 NDC target.

[10] Analysis is done using the IMF's Carbon Pricing Assessment Tool (CPAT). CPAT was developed jointly by IMF and World Bank staff and evolved from an earlier IMF tool used, for example, in IMF (2019a and b). For descriptions of the model and its parameterization, see IMF (2019b), Appendix III, and the Appendix of Black et al (2021). Results generally align with EEA (2022).

[11] EEA refers to European Environment Agency; WEM to "With Existing Measures"; WAM to "With Additional Measures". For further information, see notes in Table 2 below.

[12] This proposal maintains existing carbon pricing mechanisms but does not extend them nor raise their stringency. Instead, it enhances direct support measures (e.g., subsidies) for decarbonization. For instance, the share of revenues from the CO_2 levy earmarked for the National Buildings Program will increase to 49 percent.

Table 2. Switzerland: Summary of Switzerland's Mitigation Targets and Projected Emissions Reductions

Scope	Target (relative to 1990)	Assessment (relative to 1990)			
		2020	2030		
			CPAT (WEM) 1/ 2/	EEA (WEM) 1/	EEA (WAM) 1/
Economy-wide, emissions	Through 2030: -50%*; through 2050: -100%	-19.6%	-19%	-27%	-34%
Power, emissions	N/A	37.1%	4.7%	-29%	-36% 3/
Industry, emissions (combustion + process)	Through 2040: -50%; through 2050: -90%	-17.8%	-31%	-28%	-32% 3/
Transport, emissions	Through 2040: -57%; through 2050: -100%	-6.5%	-7%	-14%	-28%
Buildings, emissions	Through 2040: -82%; through 2050: -100%	-37.7%	-39%	-50%	-53%
Agriculture, emissions	Through 2040: -30%; through 2050: -40%	-12.5%	0%	-14%	-18%
Power, renewable share	At least 11,400 GWh of non-hydro renewable energy by 2035.	65%	70%	NA	NA

Source: (Federal Office for the Environment, 2023), (Federal Council, 2022), European Environment Agency (2022); IMF staff estimates using CPAT. Intermediary (2040) and 2050 targets are as specified in the Climate Protection Act.
Notes:
1/ WAM refers to 'with additional measures' and accounts for policies that are in the planning stages but have not been implemented, while WEM refers to 'with existing measures' and only considers policies that are currently being implemented.
2/ CPAT assumes that policies existing in the last 'historical' year for which data is available are continued. It does not account for future increases in policy stringency that have been enacted.
3/ Power in the EEA analysis includes petroleum refining and manufacture of solid fuels, while these activities are included in industry for the IMF analysis.
*Not all emission reductions will be achieved domestically.

7. In addition to mitigation measures, Switzerland is working on several regulations to align its financial industry with the goal of the Paris Agreement. Accurate and transparent (i.e., available and accessible at low cost) information on the environmental performance of firms underlying financial instruments is a necessary condition for functioning markets for green financial instruments and, more broadly, sustainable finance activities (Gao & Schmittmann, 2022). Therefore, regulations aiming at improving the accuracy and transparency of climate information as well as regulations fighting greenwashing are an essential component of sustainable finance. Switzerland has taken several steps to improve disclosure of climate information. Specifically, the Swiss Federal

Council adopted the Ordinance on Climate Disclosures that will come into force on January 1, 2024.[13] Furthermore, the Climate Protection Act – if passed – would commit Switzerland to ensure that its financial industry contributes to a low carbon development (Art. 9.1) and authorizes the Federal Council to conclude agreements with the financial industry to align financial flows with climate objectives
(Art. 9.2). As part of its sustainable finance strategy Switzerland is also assessing the need for regulation to combat greenwashing (e.g., at the financial product- and entity-level).

8. In light of developments in the energy markets following the war in Ukraine, authorities have taken preemptive measures to ensure energy security in the short term while drafting legislation to ensure a low-carbon and secure energy system in the long term. Short-term measures targeted possible gas shortages due to Russia's war in Ukraine, as well as potential power generation shortfalls during winter peak hours. The authorities procured reserve generation capacity from hydro power plants and commissioned a reserve (gas) power plant as well as passed emergency measures, valid until 2025, to incentivize the development of utility scale solar PV plants. In the longer term, the authorities are aiming to further expand renewable energy capacity and strengthen security of electricity supply through the Federal Act on a Secure Electricity Supply from Renewable Energy Sources. Lifting barriers to the deployment of household and utility scale renewable power generation, as well as adequate transmission network expansion are essential to the achievement of Switzerland's power sector decarbonization. The authorities should ensure that incentives for a consistent development of generation and transmission capacity are in place, especially after 2025.

9. This paper reviews the climate policy framework and suggests options to achieve long-term goals in a cost-effective manner. The Swiss authorities have actively engaged in the development of climate mitigation and related sustainable finance policies over the last two years. This paper aims to contribute to the near-term (2030) as well as the medium- and long-term (2040 and 2050) policy debate. The analysis starts with a review of cross-sectoral policies and then discusses sector-specific emission reduction policies. Specifically, it places an emphasis on industry, road transport and buildings.

B. Climate Policy Instruments in Switzerland

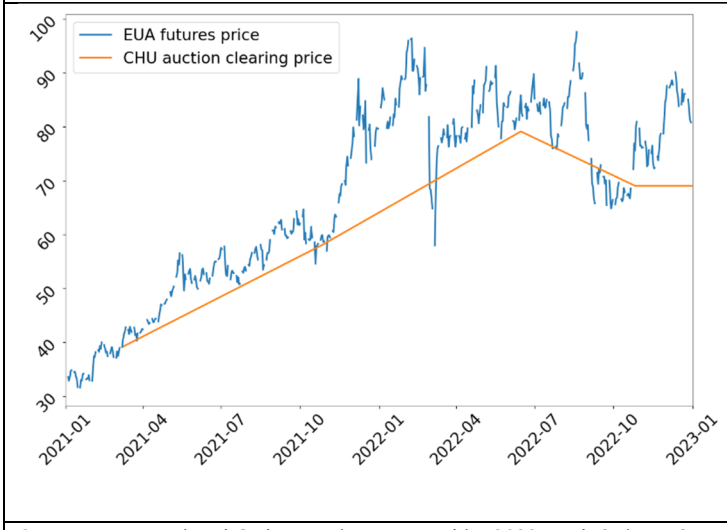
10. Switzerland's federal and cantonal authorities share competencies over policy instruments affecting domestic emissions. Legislative authority and implementation responsibility for climate policy instruments reside primarily with the federal government. This is the case, for instance, for instruments covering emissions from industry, power generation, road transport. The main instruments under federal responsibility are the Emissions Trading Scheme (ETS), the CO_2 levy on heating and process fuels, CO_2 emission regulations for newly registered vehicles, as well as the

[13] Large public companies, banks and insurance companies will have to report on both the effects that climate change has on them and the impact of their activities on climate change (i.e., the "double materiality" of climate change). The Ordinance, available at https://www.newsd.admin.ch/newsd/message/attachments/74006.pdf, specifies the reporting obligations of Section 6 of Title 32 of the Swiss Code of Obligations with regard to climate issues on the basis of the recommendations of the Task Force on Climate-related Financial Disclosures (TCFD).

negotiated reduction commitments in industry. Cantonal governments have substantial authority with regard to emissions and energy performance of buildings. They are responsible for the implementation of the National Buildings Program (NBP) and for implementing cantonal building codes, which contain provisions relating the energy performance of buildings. **Error! Reference source not found.** (appendix) summarizes these instruments.

11. Carbon pricing plays an important role in Switzerland's climate change mitigation strategy. Carbon pricing currently arises from two instruments: the Swiss ETS and the CO_2 levy. The ETS covers emissions from large emitters in industry, power and intra-EU aviation as well as flights from Switzerland to the European Economic Area (EEA) and the United Kingdom (UK), whereas the CO_2 levy applies to heating and process fuels. However, firms that enter voluntary agreements with the government ("negotiated reduction commitments") are exempt. The sectoral and GHG emissions coverage of carbon pricing instruments in Switzerland is broadly aligned with that of other European jurisdictions. In 2022, these two mechanisms covered about 40 percent of total GHG emissions. In the EU, approximately 41 percent of GHG emissions were covered by a national carbon pricing mechanism or the EU ETS (World Bank, 2022). In 2022, the CO_2 levy was set at 120 CHF/ton of CO_2e and the average price of emission allowances in the Swiss ETS was CHF 86/ton of CO_2e (Figure 2).

Figure 2. EUA and CHU Prices, 2021–2022



Sources: (International Carbon Action Partnership, 2023) and (Swiss ETS registry, 2023).

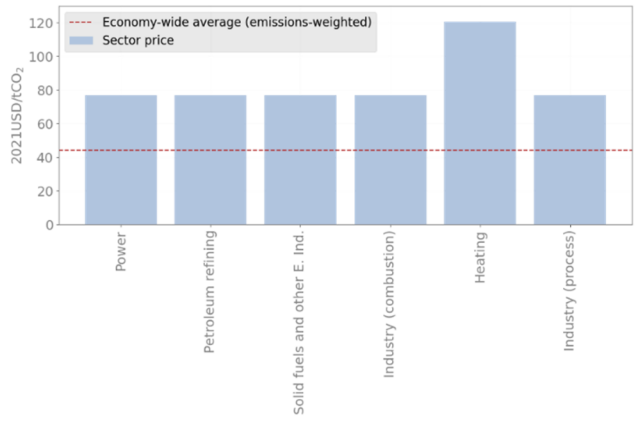
12. Since January 2020, Switzerland's ETS has been linked with the EU ETS, which has led to an alignment of price of Swiss ETS allowances (CHU) with EU ETS allowances (EUA).[14] Arbitrage across the two markets has led to an alignment of CHU prices with that of EUA (Figure 3) and brought emissions covered by the Swiss ETS closer to that of emissions covered by the CO_2 levy. In addition, this may have improved liquidity. The linking implied several changes to the Swiss ETS (Federal Office for the Environment, 2022). Rules for allocation of free emission allowances were harmonized and based on the same benchmarks of emissions performance as in the EU. The linking has also required an identical sectoral coverage, leading to the inclusion of aircraft operators and power plants in Switzerland's ETS. Given the recent changes approved by the EU in relation to the EU

[14] The linking agreement is available at: EUR-Lex - 22017A1207(01) - EN - EUR-Lex (europa.eu). The EU ETS Directive allows for linking, provided both systems are compatible, mandatory and have an absolute emission caps.

ETS,[15] Switzerland will have to consider adjustments to its own ETS and the implications for the covered sectors. Some of these implications are discussed below.

13. To ensure cost-effective emission reduction in the near and medium term, Switzerland should aim to harmonize carbon prices across sectors of the economy. The carbon price currently differs across sectors, resulting in potential cost-inefficiencies in overall emission reductions. The average price of CO_2 emissions (i.e., carbon price) in Switzerland was USD 44 per ton of CO_2 in 2022 (in USD2021, see Figure 3). However, cross-sectoral differences in applicable carbon prices result in different marginal incentives to reduce emissions. Until recently, a significant gap existed between the CO_2 levy and the price of emission allowances in the EU-CH ETS. This heterogeneity can be expected to close across some sectors as prices in the EU-CH ETS are expected to rise to EUR 130–140/tCO2e by 2030 (Pahle, Sitarz, & Osorio, 2022).

Figure 3. Economy-Wide Average and Sector-Level CO2 Prices in Switzerland, 2022



Sources: (Dolphin & Xiahou, 2022).
Notes: The figure shows the price of CO_2 in selected sectors where a price on emissions applies. Sectors in which emissions are not priced are not represented, which explains why the average is below the lowest price represented.

C. Policy Instruments and Options at the Sector Level

14. To achieve its 2030 emissions target, Switzerland must reduce its emissions by, on average, 4.7 percent per year. Since 1990, Switzerland has reduced its emissions of greenhouse gases at an average of 0.6 percent per year. However, emissions remained around their 1990 level until 2010 and decreased substantially since then. Between 2010 and 2020, the average annual percentage decrease in emissions was 1.9 percent. Overall, this pace of emission reduction was insufficient to achieve its 2020 emission reduction goal (i.e., a reduction of 20 percent below 1990 levels). Furthermore, this is less than half as much as is needed over between 2021–2030. This aggregate emission reduction pace translates into demanding emission reduction needs at the sectoral level (Table 3). For instance, the pace of emission reductions in road transport should double over 2020–2040, compared to 2010–2020; the pace of emission reductions in buildings should increase by about 50 percent.

[15] On April 25, 2023, the Council of the EU formally adopted five legislative instruments that were part of the Fit-for-55 policy package. This includes a Directive amending the parameters of the EU ETS. See: https://data.consilium.europa.eu/doc/document/PE-9-2023-INIT/en/pdf.

Table 3. Switzerland: Historical and Target-Consistent Annual Average Emissions Growth Rates
(percent)

	Historical: 1990–2010	Historical: 2010–2020	Target-consistent 2020–2040 1/
Total emissions (excl. LULUCF)	0.08	-2.31	-4.7 2/
Electricity and Heat	1.57	0.05	NA
Industry	-0.09	-1.77	-2.5
Road transport	0.58	-1.8	-3.8
Buildings	-0.2	-4.26	-6
Agriculture	-0.42	-0.5	-1.1

Source: IMF Staff based on (Agency, 2022) and Climate Protection Act.
Note: The historical and target-consistent emission growth rates are calculated as geometric averages over the period under consideration.
1/ The 2040 targets assumed in the calculation of target-consistent growth rates are those introduced in the Climate Protection Act.
2/ The target-consistent rate for "Total emissions (excl. LULUCF)" is calculated with regard to the 2030 target (i.e., a decrease of 50 percent in emissions, relative to 1990 level). A share of the necessary emission reductions will be achieved abroad.

15. The passage of the Third CO_2 Act is critical to achieve emission reduction objectives. Policy uncertainty created by the rejection of the prior version of the Third CO_2 Act (in 2021) is likely to have weighed negatively on the pace of investment in low-carbon technologies and, ultimately, on the pace of emission reductions. Timely adoption of the Third CO_2 Act and prompt development of the measures that will apply beyond 2030 would provide much needed, long-term, clarity.

Industry

16. GHG emissions from industry are expected to decline through 2030, but the pace of emission reduction must increase by 35 percent (compared to 2010–2020) to achieve 2040 targets. In 2021, process and combustion emissions from industry stood at 8.61Mt CO_2e, representing 19 percent of total GHG emissions. Under current policy (i.e., WEM scenario, which excludes strengthening of measures planned in the Third CO2 Act), emissions from industry are projected to reach 8.1Mt CO_2e by 2025 and 7.6Mt CO_2e in 2030 (FOEN, 2022). Under strengthened policy (i.e., WAM scenario, which includes measures planned in the Third CO_2 Act), these would reach 7.7Mt CO_2e in 2025 and 7.2 Mt CO_2e in 2030. This would represent an average pace of reduction over 2021–2030 of 1.2 percent and 1.9 percent, respectively. The emission reduction rates are below what is necessary to achieve the sector's 2040 target (Table 3). More precisely, the 2030 emission level for industry compatible with the 2040 target is 6.8Mt, suggesting a policy gap of approximately 0.4 Mt.

17. Further incentives to reduce emissions in industry could come in the form of a feebate mechanism, working alongside negotiated emission reduction commitments. Part of the projected emission reductions through 2030 will come from sources covered by the EU-CH ETS. However, based on the projected increase in the price of emission allowances in the EU ETS through

2030, industry-wide emissions would decline only by 0.29 Mt CO_2e in 2030.[16] This implies that negotiated emission reduction commitments or other, additional, measures should contribute substantially to emission reductions. A feebate mechanism, working alongside existing and future negotiated reduction commitments, represents one possible measure. In this case, firms within an industry would be subject to a fee given by:

{CO_2 price} × {Firm GHG intensity – industry-wide benchmark} × {firm output}

The feebate would be applied to emissions from fuel combustion (i.e., direct) and process emissions. The benchmarks applicable to firms not covered by the ETS (but covered by negotiated reduction commitments) could be aligned with EU ETS benchmarks to level the playing field between firms covered by the EU-CH ETS and firms outside the EU-CH ETS. A feebate could be less costly to firms than a pure carbon tax, though less efficient as it does not reduce output. The scheme could build off existing procedures for monitoring firms' direct emissions under the EU ETS.[17]

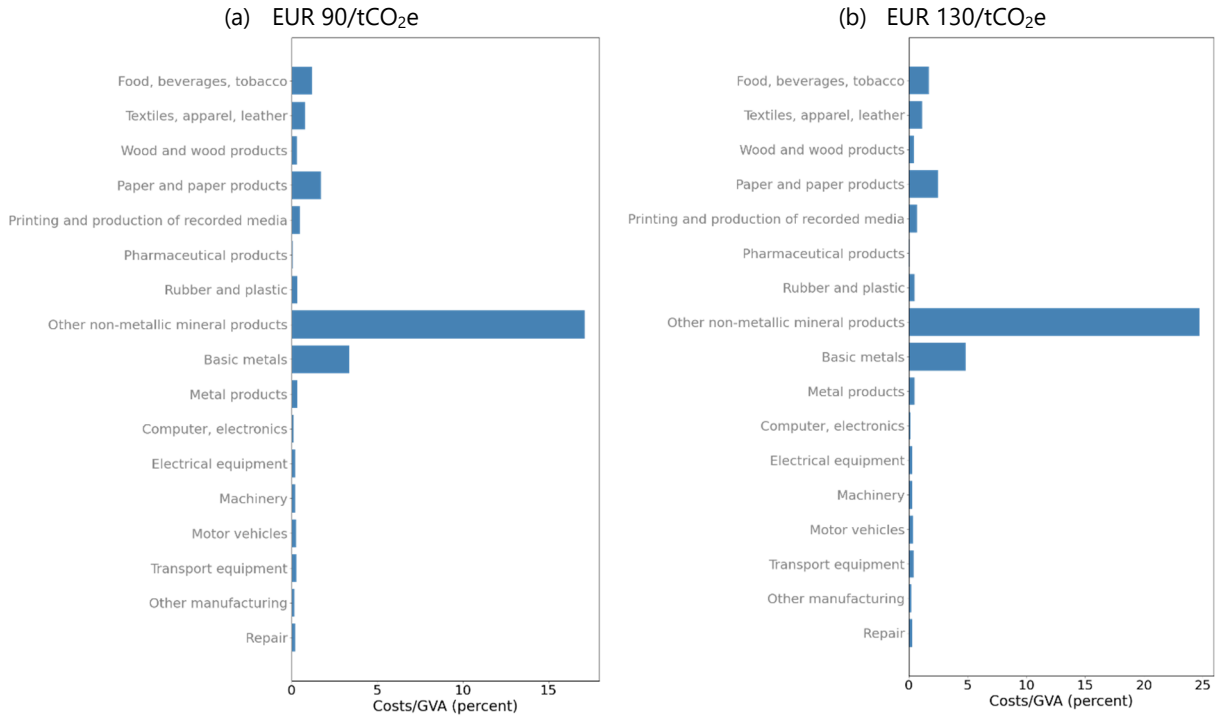
18. The projected increase in the price of emission allowances will raise the carbon cost of Swiss industries, unless they decarbonize their production processes. Higher carbon prices through 2030 will raise firms' carbon cost unless they are able to reduce their emissions. Given current emission intensities, a EUR90/tCO_2e represents between 0.03 percent (pharmaceutical products) and 17 percent (cement) of gross value added (GVA) (Figure 4).[18] To reduce their carbon cost, firms must find ways to reduce emissions (or keep emissions constant while increasing their value added), either through operational changes to their production process or investment in new, low carbon, production technologies. Figure 4 identifies non-metallic mineral products (e.g., cement, glass) as the sector facing the largest carbon cost. A large share of emissions in these sectors arises from industrial processes, not from the combustion of fossil fuels. Decarbonization of processes is thus key to reducing their carbon cost. To support the decarbonization of these "hard-to-abate" processes, additional policy mechanisms such as carbon contracts for difference (Richstein & Neuhoff, 2022) could be introduced. These would reduce the uncertainty of returns on investments in low-carbon technologies by ensuring a payment from (to) the government to (from) the investing firm if the carbon price is below (above) an agreed strike price.

[16] Based on modelling using CPAT and assuming a price of emission allowances of EUR 130/tCO_2e in 2030, rising linearly between 2023–2030. The 2030 price assumption is an average of price trajectories estimated by models accounting for policies included in the EU Fit for 55 policy package. For details on these trajectories and underlying models, see (Pahle, Sitarz, & Osorio, 2022).

[17] See (Vernon, 2023) for more details on introducing feebates alongside voluntary agreements.

[18] "Pollution payments" (in this case, carbon cost) as a share of gross value added is a typical measure of pollution cost. See for instance (Grubb, et al., 2022).

Figure 4. Carbon Cost to Swiss ETS Firms by Industry (percent of gross value added)

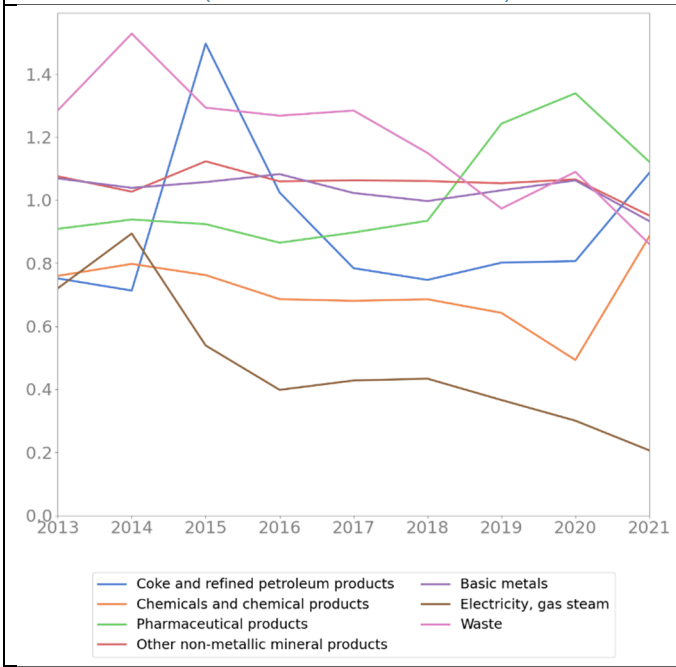


Source: IMF Staff based on Eurostat.
Note: Based on the latest available GHG emissions data for Switzerland (2019) in the Eurostat air emissions accounts.

19. Free allocation of emission allowances has so far helped reduce carbon cost, but these will be progressively phased out. Until now, industry support in light of this additional cost has taken the form of (free) allocation of emission allowances, with some industries receiving emission allowances exceeding their verified emissions (Figure 5). Since 2013, Swiss firms participating in the ETS have received, on average over 2013–2021, between 99 and 140 percent of their annual emissions for free. In 2022, approximately 726000 allowances were auctioned, representing 140 percent of verified emissions. However, free allowances in the EU ETS will be phased out gradually from 2026 (fully in 2034). This means that firms will progressively face the full cost of their GHG emissions, thereby facing a strengthened incentive to decarbonize their production processes. Yet, low-carbon industrial processes may, in the short to medium be more expensive than GHG-intensive ones, exposing export-oriented industries to potential losses in market share. The introduction of a Carbon Border Adjustment Mechanism (CBAM), in lieu of free allowances, may offer partial protection to EITE firms facing higher domestic carbon cost.[19]

[19] However, a CBAM may not be a perfect substitute for free allowances. Indeed, (Ritz, 2022) suggests that whether or not firms are equally compensated by free allowances or a CBAM depends on the level of carbon cost pass-through.

Figure 5. Free Allowances in the Swiss ETS for Selected Industries, 2013–2021
(share of verified emissions)

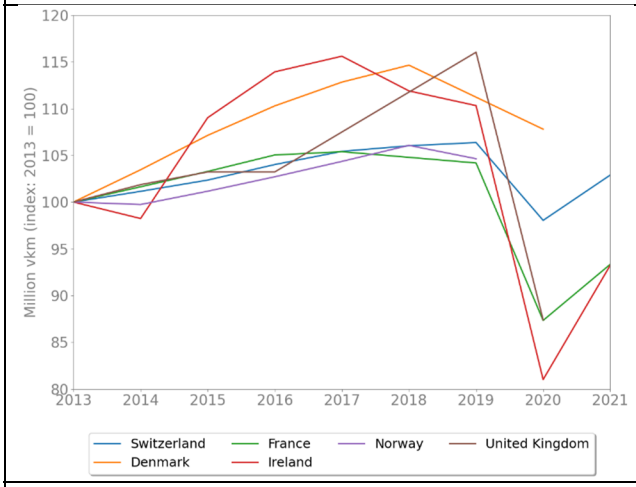


Source: Swiss ETS registry and IMF staff calculation.

Road Transport

20. The pace of emissions reduction in road transport has been too slow to achieve long-term emission reduction objectives. Between 2010–2020, emissions from road transport declined on average by 1.8 percent per year (Table 3). While improvements in vehicle emission performance—driven by regulatory requirements—and the progressive uptake of zero-emission vehicles have contributed to emission reductions, these were partly offset by an increase in vehicle miles travelled (Figure 6). Prior to the COVID19 pandemic, vehicle miles travelled for passenger cars (and total) in Switzerland had been on a steady upward trend, at least since 1990. To be compatible with 2040 targets, the pace of reduction of emissions from road transport must at least double. In the short to medium term (i.e., as along as the share of zero-emission vehicles in the vehicle fleet remains relatively low), this implies a reduction in vehicle miles travelled and enhanced shift to less CO_2-intensive modes of transport (e.g., rail).

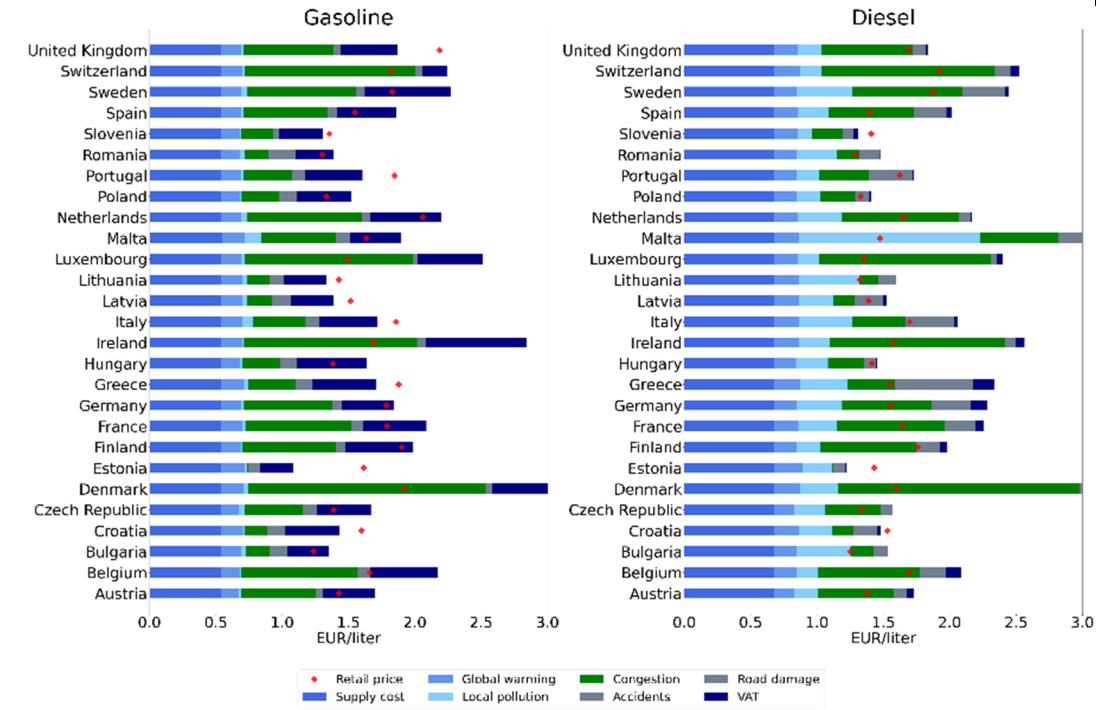
Figure 6. Vehicle Miles Travelled, 2013–2021



Sources: Eurostat.
Note: 2010 level is normalized to 100.

21. In real terms, Switzerland's excise duty on road transport fuels has remained constant over time and its value does not reflect the external damage caused by road fuel use in full. In 2022, Switzerland's road transport fuel duty was CHF 0.73/liter for unleaded petrol (equivalently, CHF 321/tCO_2) and CHF 0.75/liter of diesel making it the third highest in Europe after the Netherlands and Italy. However, this is well below the total damage cost associated with the consumption of road transport fuels in Switzerland, which, in 2021, stood at CHF 1.35 per liter for gasoline. Furthermore, the value of the excise duty has remained approximately constant in real terms over time (from CHF0.79 per liter in 1990, to CHF0.77 per liter in 2021 (2021 prices). These factors likely contributed to tepid progress on the reduction of emissions in the road transport sector, unlike in countries which have progressively strengthened energy duties over time, whether to achieve emission reduction objectives or for other purposes (Andersson, 2019; Sterner, 2007).

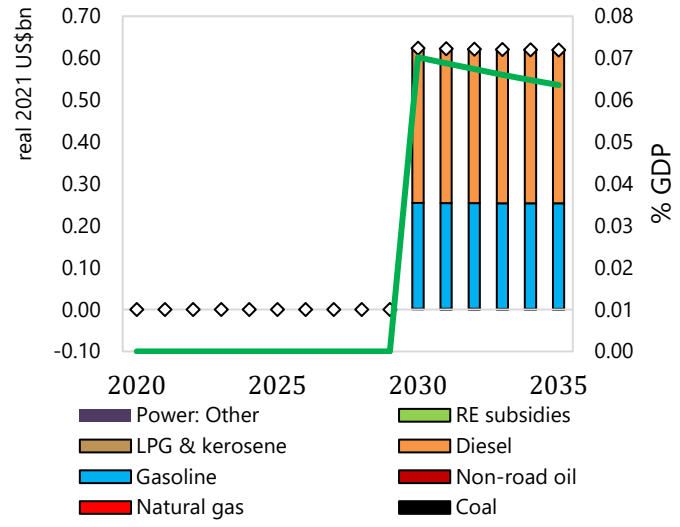
Figure 7. Efficient Price of Road Transport Fuels



Sources: Parry and others (2021).

22. The road fuel duty could be reformed to include a carbon content-based component. A CHF 50/tCO₂ carbon component could reduce emissions by 0.6Mt and raise up to CHF 0.54 billion in annual revenue. Further and accelerated reduction of emissions from road transport will require investment in infrastructure to support the deployment of low- or zero-carbon vehicles. The introduction of a carbon component in the Mineral Oil Tax on Motor fuels could raise additional revenue, which could be earmarked toward such investments. This would follow similar developments in, e.g., France and Portugal. In addition, this would further disincentivize road fuel consumption in Switzerland. To ease the impact of that change, the authorities could consider completely offsetting the initial impact—by keeping the duty rate constant in the year of change—and raising the price in steps. Furthermore, the policy change could be announced in advance of its implementation, together with a clear policy path. This would provide time to consumers to adapt and adjust investment decisions.

Figure 8. Estimated Revenues from a CHF 50/tCO2 on Road Transport Fuels



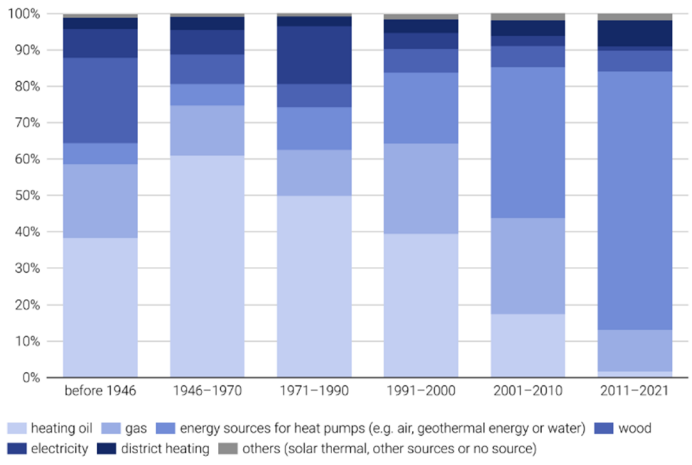
Sources: CPAT.

Buildings

23. As of 2021, emissions from residential and commercial buildings represented 25 percent of Switzerland's GHG emissions. Significant reductions in emissions from buildings have been achieved since 1990 (see Table 2). This reflects in part the installation of heating systems with low (or zero) carbon intensity in new constructions (Figure 9), driven by strong policy incentives in force since 2008. However, to achieve 2040 and 2050 emission targets, renovation of the existing building stock (i.e., replacement of fossil fuel-based heating systems and improved insulation) will be necessary (Nageli,

Figure 9. Residential Buildings by Main Heating Energy Source and Period of Construction, 2021

(percent)



Source: (Federal Statistical Office, 2023) .

Jakob, Catenazzi, & Ostermeyer, 2020). As of 2021, 58 percent of buildings were still heated by fossil fuels (heating oil and gas) while 17 percent were equipped with heat pumps. The share of the latter has quadrupled since 2000 (Federal Statistical Office, 2022), but primarily from installation in newly-constructed dwellings, which are also built to higher energy performance standards. Retrofitting existing, older buildings with heat pumps and improving their energy performance through better insulation may prove costlier.[20]

24. Switzerland's main policy instrument to drive down emissions from buildings is the CO_2 levy, coupled with subsidies for building refurbishment channeled through the National Buildings Program and energy performance standards for buildings defined by cantons. The program is partly funded by the revenues from the CO_2 levy and partly by cantonal funds.[21] In 2021, revenues from the CO_2 levy amounted to CHF 1.15 billion (Federal Office for the Environment, 2022) and CHF 337 million were thus earmarked for the NBP. The program's total disbursements amounted to CHF 361 million. This policy has proven to be an effective instrument to reduce emissions from Buildings. It is estimated that, by 2021, the program reduced annual emissions by 0.75 Mt since its inception in 2010 ([National Buildings Program, 2022]). On average, in 2021, the Buildings Program paid out CHF 196 per ton of CO_2 avoided.

25. Measures in the current proposal for a Third CO_2 Act are projected to yield 1Mt less emission reductions than measures contained in the previous proposal (Federal Office for the Environment, 2020; Federal Office for the Environment, 2022). The proposal for a Third CO_2 Act increases revenues from the CO_2 levy earmarked for the NBP, but leaves the levy rate unchanged at CHF 120/tCO_2. The previous proposal, introduced in 2017, included a maximum level of CHF 210/tCO_2 and replaced the NBP with energy performance standards for buildings from 2025 onward.[22] The current proposal aims to incentivize further reduction in buildings emissions through increased financial support for buildings refurbishment. Specifically, it would raise to 49 percent the share of revenues from the levy that could be used to finance emission reduction measures. Taken together, measures in the most recent proposal for a Third CO_2 Act achieve less emission reductions than the previous version.

26. Allowing the CO_2 levy to rise beyond CHF120/tCO_2e could prevent its erosion in real terms and induce further emission reductions. The higher inflation rates observed over the last two years have already eroded the level of the CO_2 levy in real terms, weakening its emission

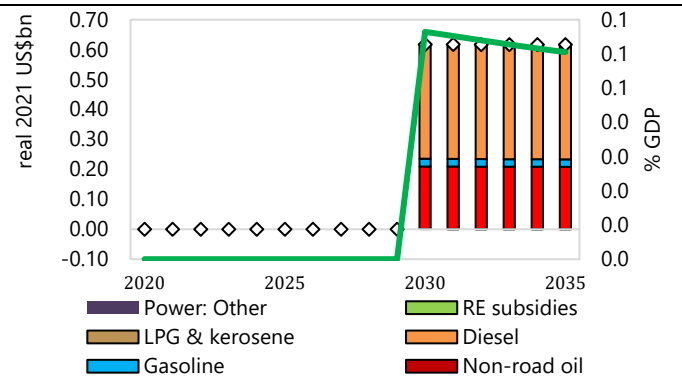
[20] For the Centre/West European region, the cost of building envelope refurbishment can vary between EUR 77/m2 (light refurbishment) to EUR 333/m2 (deep refurbishment) and yield energy savings between 12–78 percent (De Vita, Capros, Paroussos, & al., 2021).

[21] A third of the revenues from the CO_2 levy (but at most CHF 450 million) is currently earmarked for the funding of long-term CO_2 emission reduction measures in buildings. The remaining two-thirds are returned to the population and firms.

[22] The 2021 version of the Third CO_2 Act also proposed subsidiary limits of specific emissions (in CO_2 per square meter energy reference area) for existing and for new buildings. These limits would have entered into force if defined intermediate mitigation targets were missed in 2026/2027. The current proposal removes that provision.

reducing effect. Allowing the levy to rise beyond its current level would help counter that effect. Furthermore, emission reductions additional to what would be achieved through the Third CO_2 Act are needed to meet the 2040 target indicated in the Climate Protection Act. Increasing the levy to, e.g., CHF 210/tCO_2, as was envisaged in the previous proposal for a Third CO_2 Act, could help partially meet this need. It could be introduced from 2030 onward, with a view of ensuring that all efficient emission reduction options are implemented by households and firms. The impact on building emissions would be modest in the short-term (-0.5 Mt CO_2 by 2035) but could contribute substantially to decarbonization in the medium term as price elasticity increases. Additional fiscal revenues could reach CHF 0.54 bn annually(Figure 10), and GDP impacts would be small and transitory.

Figure 10. Estimated Revenues from a CHF 50/tCO2 on Road Transport Fuels



Source: CPAT.

27. A proposed ten-year program to upgrade heating and hot water installations may partially close this gap. This revision is introduced as a revision to the Energy Act as part of the Climate Protection Act and is in response to developments in the energy markets in 2022. This program is additional to the existing Buildings Program and is fully financed by the Confederation, up to a maximum of CHF 200 million per year. Furthermore, several cantons have introduced stricter regulations with regard to residential heating systems than those at the federal level. For instance, in Zurich, fossil fuel-fired boilers will have to be replaced by climate-neutral alternatives once they reached the end of their lifecycle.

Power Generation

28. Switzerland's power generation mix is almost entirely free of fossil fuels, which strengthens its position with regard to decarbonization through electrification (e.g., in road transport and industrial processes). In 2022, power generation in Switzerland was 61.5 percent hydro, 29 percent nuclear, 7.5 percent renewables and 2 percent fossil fuels (FOEN, 2022). Keeping GHG emissions of power generation low is essential to achieving economy-wide medium- and long-term decarbonization goals, as several sectors of the economy are expected to switch to or expand electricity-based technologies (e.g., electric vehicles in road transport, heat pumps in the heating sector). However, this has made Switzerland's economy-wide emission reductions more challenging than in other countries, as it cannot not rely on more easily implementable—and cheaper—emission reduction options in the power sector to achieve its near- and medium-term reduction objectives.

29. The projected growth in electricity demand, combined with the planned phase-out of nuclear power generation call for timely rollout of renewable power generation. Electricity consumption is projected to increase by 11 percent by 2050, compared to 2019 (Energy Perspectives

2050).[23] This represents a moderate but not negligible increase. Increased electricity demand will have to be met by newly-installed renewable (and non-dispatchable) generation capacity. As nuclear plants are progressively being decommissioned, no new ones will be built (under current legislation), and a substantial share of electricity is already produced from hydropower, the progressive phase out of nuclear power will have to be filled by technologies such as solar PV and wind energy.[24] In addition to domestic electricity production, imports will also be necessary up to 2050 to meet annual electricity demand.

30. A faster rollout of renewables would also provide energy security benefits. Following developments in the European energy markets in 2022, the authorities took preemptive measures to address energy security in the short term, but further efforts are needed to ensure a low-carbon and secure energy system in the medium and long term. Short-term measures targeted possible gas shortages due to Russia's war in Ukraine, as well as potential electricity shortages during winter peak hours. The authorities procured reserve generation capacity from hydro power plants (Hydropower Reserve Ordinance) and commissioned a reserve (gas) power plant as well as passed emergency measures, valid until 2025, to incentivize the development of utility-scale solar PV plants in Alpine areas and implemented them through modification of existing Ordinances (Energy Ordinance, Ordinance on the Promotion of Electricity Supply from Renewable Sources, Electricity Supply Ordinance). In the longer term, the authorities are aiming to further expand renewable energy capacity and strengthen security of electricity supply through the Federal Act on a Secure Electricity Supply from Renewable Energy Sources, currently under consideration in the National Council. The legislation contains several measures aiming at incentivizing the deployment of household (i.e., rooftop solar PV) and utility-scale renewable power generation. However, care needs to be taken to ensure concomitant expansion of the transmission network to integrate power generated by the additional generation capacity.

D. Conclusions and Summary of Policy Options

31. This paper discusses Switzerland's climate mitigation framework in light of its short- to medium-term (2030) as well as long-term (2040 and 2050) emission targets and laid out policy options for achieving them. The analysis in this paper leads to three concluding observations.

32. First, achieving emission reductions consistent with these targets requires a substantial increase in the pace of emission reductions, both in aggregate and at the sector level. At the aggregate level, Switzerland must, on average, reduce its emissions by 4.7 percent per year between 2021–2030. At the sectoral level, average annual reductions in emissions from road transport and buildings, for instance, must reach 3.8 percent and 6 percent, respectively, to align with long-term objectives.

[23] The bulk of increase in electricity demand will arise from electrification of road transport, while some substantial reductions will be achieved in industry and services.

[24] While potential to expand hydropower exists, it is currently exploited at 95% (Panos & Kannan, 2018; Schnerider & Vallet, 2019).

33. Second, with regard to 2030, Switzerland's achievement of its target hinges crucially on two factors. First, it is dependent on the reduction of emissions in Switzerland, for which policies and measures contained in the proposal for a revised CO_2 Act, currently debated in Parliament, are crucial. Second, it relies on successful emission reduction abroad. Thus, timely passage of the Third CO_2 Act is instrumental to placing Switzerland on course to achieving its 2030 target. But it also carries significant implications for emission reductions beyond 2030, as investment decisions made this decade are likely to affect emissions beyond then.

34. Third, the emission trajectory of some individual sectors implied by the proposed Third CO_2 Act of is not likely be sufficient to achieve their respective 2040 targets. Therefore, further measures, applying beyond 2030—but possibly before—could be considered. This paper introduced several policy options. In industry, a feebate mechanism could be introduced alongside negotiated reduction commitments. In road transport, a carbon content-based component in Switzerland's excise duty could further incentivize the shift to zero-emission vehicles or to other modes of transportation.

Appendix I. Mitigation Policies in Switzerland

Table A1. Switzerland: Summary of Climate Policy Instruments in Switzerland (in force as of 2023)

Sector	Instrument name	Description
Buildings (heating) and industry	CO_2 Levy on heating and process fuels	In January 2008, a tax on CO_2 emissions from stationary fuels, levied on heating and process fuels, came into force. The tax rate was initially CHF 12 per tCO_2 (equal to CHF 0.03 per liter of heating oil and CHF 0.025 per m^3 of natural gas). As permitted by the legislation in case of insufficient progress in emission reduction, the tax was increased in the following years. As of 2022, the tax had reached its maximum level, CHF 120. One third of the revenues are earmarked for the National Buildings Program; two-thirds are returned to the population and firms. Emitters participating in the ETS or who have entered negotiated emission reduction commitments are exempt.
Industry, Power, Aviation (2020)	Emissions Trading Scheme (ETS)	The Swiss ETS was introduced in 2008 (trial phase) and is compulsory since 2013. It initially covered large industrial emitters and, since 2020, power plants and domestic aviation. The Scheme is based on the cap-and-trade principle, enabling the cost-effective achievement of climate-protection targets. Large (total rated thermal input of > 20MW) companies are required to participate, medium-sized (total rated thermal input of >= MW) companies may voluntarily participate.
Industry	Roadmaps for businesses and sectors.	As part of the Climate Protection Act (Article 5), firms and sectors may design emission reduction roadmaps.
Road transport	CO_2 compensation for road fuel	Importers of fossil motor fuels (oil, diesel, natural gas and jet fuel) are required to partially compensate CO_2 emissions embedded in the fuels. This obligation applies to embedded emissions in excess of 1 kt of CO_2. The share of total embedded emissions for which compensation is required is currently 20 percent, rising to 23 percent in 2024. (It was 12 percent in 2021 and 17 percent in 2022). The current proposal for a Third CO_2 Act provides that this share would rise to 90 percent. This scheme is a successor of the "climate cent," introduced in 2008. For a brief overview of the history of climate policy development in the Swiss transport sector, see (Thalmann & Vielle, 2019).
Road transport	CO_2 Regulations for Vehicles	CO_2 emission targets for newly registered vehicles in line with regulations of the European Union. The target by 2020 for passenger cars (fleet average) has been set at 95 grams of CO2 per kilometer, for light commercial vehicles at 147 grams of CO2 per km.
Commercial road transport	Km-based and weight-based pricing for heavy duty vehicles	This charge, in force since 2001, applies to passenger and freight transport vehicles of more than 3.5 tonnes of gross weight. The level of the fee depends on a formula accounting for (i) kilometers travelled on Swiss, (ii) vehicle-specific maximum authorized weight, (iii) air pollutants. By design, the charge is targeted at local air pollution and road usage than greenhouse gas emissions.
Buildings	National Buildings refurbishment Program	This program, whose implementation is the responsibility of the cantons, aims to increase the refurbishment rate of buildings and to promote the use of renewable energies in the buildings sector. It is operational since 2010. This program is partly financed by earmarked revenues from the CO2 levy.
Buildings	Buildings codes of cantons	Building codes of cantons play an important role in reducing emissions from buildings and will continue to do so in future. The cantons are responsible for regulations in the buildings sector. Under the second and third CO_2 Acts they are required to define standards for the continuous reduction of CO_2 emissions in new and existing buildings (Article 9) (FOEN, 2022b).
Road Transport	Mineral Oil Tax and Surtax on Motor Fuels	Since 1996, Switzerland levies an excise tax on motor fuels. The applicable rate differs across types of mineral oil and is not based on their carbon content.

Source: (New Climate Institute, 2022), (Enerdata, 2023), (Federal Office for the Environment, 2022).
Note: this table contains an overview of the most significant emission reduction policies currently in force in Switzerland. For more details on these and information on terminated policies, see Switzerland's Fifth Biennial Report under the UNFCCC.

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