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Theodore Humann, Kris Mitchener and Eric Monnet

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Centre for Economic Policy Research
33 Great Sutton Street, London EC1V 0DX, UK
Tel: +44 (0)20 7183 8801
www.cepr.org

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Abstract

Advanced-economy central banks are currently experiencing losses. To examine how rate-tightening cycles affect central bank finances, we study the financial statements of ten advanced-economy central banks during the 1970s and 1980s, the most notable and comparable policy environment to the present. We find that central bank profits actually increased in response to the anti-inflationary measures of the 1980s. We thus discuss how central bank profits depend on their policy instruments as well as their balance-sheet position when rate tightening begins, rather than on the tightening per se. Unlike today, central banks in the 1980s avoided losses because they did not remunerate bank reserves and their balance sheets did not carry the legacy of a decade of large asset purchases at low interest rates and long maturity. Our counterfactuals show that only a combination of these factors could have triggered losses in the 1980s: none of them is sufficient on its own. When losses emerged in the late 1970s, before the Volcker shock, they were due to foreign-exchange reserves depreciating. In these instances, when central banks carried them forward and did not rely on transfers from the government, there was no loss of central bank independence or their ability to fight inflation.

JEL Classification:

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Theodore Humann - theodore.humann@sciencespo.fr
Sciences Po Paris

Kris Mitchener - kmitchener@scu.edu
Santa Clara University, CAGE, CESifo & NBER and CEPR

Eric Monnet - eric.monnet@psemail.eu
Paris School of Economics & EHESS and CEPR

1. Introduction

Central banks have recently responded to the surge in inflation with restrictive policies. And since most central banks in advanced economies pay interest rates on bank reserves, the mismatch between a low return on assets and a rising cost of liabilities has triggered financial issues.[1] One might conclude from this situation that financial losses are inevitable when central banks increase their interest rates. Does history support this conjecture? And how did central banks manage losses in the past? To provide a new perspective on these issues, we examine advanced-economy central banks in the 1970s and 1980s to see how well they coped with a period characterized by the greatest volatility in exchange rates and interest rates since World War II. We are not aware of a previous comparative study on central bank finances during these two decades. The most recent and comprehensive analysis of central bank losses (Goncharov, Ioannidou, and Schmalz (2021)) uses data available in BankScope starting 1992.

Analyzing the detailed accounts of ten central banks from their annual reports, we highlight two findings. First, central-bank profits actually increased with the anti-inflationary measures of the 1980s. Rate-tightening cycles do not necessarily lead to central bank losses: the link between monetary policy and central-bank profits depends on the policy instruments used and on the initial balance-sheet conditions at the time the rate tightening begins. In contrast to today, advanced-economy central banks of the 1980s avoided losses because they did not remunerate bank reserves and their balance sheets did not carry the legacy of a decade of asset purchases at low interest rates and long maturity. Legacy matters because it affects the level of bank reserves held at the central bank and the remuneration of the central banks' assets. Our counterfactual simulations show that the remuneration of bank reserves would not have been sufficient to trigger losses in the 1980s. Only the combination of the three following factors is able to generate central bank losses in our counterfactual: (i) reserves remunerated at the lending rate; (ii) a large share of reserves in the central bank balance sheet; and (iii) assets with long maturity and low yields.

Second, we show that some central banks - in Switzerland and Germany - suffered losses in the 1970s, before the Volcker shock, due to a depreciation of their foreign-exchange reserves. These transitory losses were the consequence of an appreciation of the exchange rate, due to successive devaluations of the dollar and a more restrictive monetary policy than in the United States. They were carried forward and did not result in a transfer from the government. They did not lead to any significant change in monetary policy. There is no evidence that these losses threatened the independence of central banks and their ability to fight

[1] The Bank of England (BoE), which raised its main policy rate from 0.1% in end-2021 to 3.5% by the end of 2022, has reported losses on its bond-buying program of 11 billion pounds, which will be covered by a one time government transfer. In terms of how losses are covered, the case of the BoE appears exceptional since governments usually do not commit to recapitalizing central banks or transferring funds in such situations. For the first time in its history, the U.S. Federal Reserve (Fed) has also announced losses that are expected to grow over the next two years and reach USD 60bn in 2024 under the baseline scenario and USD 180bn under the extreme one. As a result, the Fed has been accumulating a "deferred asset" (an accounting measure that records the loss which will then be covered when the Fed returns to profitability), which totaled USD 18.8 billion by the end of 2022. See FEDS Note - Part 1 and Federal Reserve Board announces Reserve Bank income and expense data and transfers to the Treasury for 2022. Among others, the Bank of Canada has announced its first losses in its 87-year history and does not expect to make profits again before 2024-2025, while the Reserve Bank of Australia is running a negative-equity position of AUD 12.4bn. Securities accumulated over the years and depreciated by rate hikes expose central banks to latent (unrealized) losses only. As far as assets denominated in foreign currencies are concerned, these losses are not latent but actual when the exchange rate appreciates (Switzerland being the most prominent case).

inflation.

Recent central bank losses have triggered many questions and spurred strong uncertainty. As some economists had anticipated (e.g., Pradhan and Goodhart (2021)), central banks are now faced with significant challenges to their credibility. The financial press has stoked fears about the consequences of these losses, with headlines such as "Decade of central bank largesse haunts taxpayers as losses loom" or "Fallen heroes: Central banks face credibility crisis as losses pile up." They suggest that insolvency could endanger both the credibility of central bank actions and the state's budget.[2] Recent research has shown that central banks themselves indeed dislike reporting losses, in part because the latter generate political pressures and public responsiveness (Goncharov, Ioannidou, and Schmalz (2021)).[3] The political perception of these losses contrasts with the widely recognized perspective among economists that central bank finances are special and that losses and negative equity do not directly affect the ability of central banks to operate effectively as long as there is no attempt to use money creation to offset losses (Reis (2013), Archer and Moser-Boehm (2013)). A recent paper published by the Bank for International Settlements (Bell et al. (2023), p.6) argues that a central bank can "mitigate the risk of a misperception through effective communication to their stakeholders." To communicate effectively in the present environment, central banks need to understand why losses occur, how previous episodes of losses have been managed, and if they posed a threat to central bank credibility and independence.[4]

We thus contribute to the policy debates and academic literature on central bank losses by providing new data and the first investigation of central bank finances during the - otherwise well-known - Volcker shock (Goodfriend and King (2005)). We focus on the disinflationary policies of the 1980s because it is the most important prior example of a peacetime rate-tightening carried out by advanced-economy central banks. By contrast, inflation stabilization in the immediate post-war periods (in the 1920s and 1940s) was generally achieved through a combination of price controls and monetary reforms, at different speeds in different countries and without a sharp rise in nominal interest rates.

The Volcker shock could have triggered losses in many ways: higher interest rates may have decreased the demand for bank borrowing at the central bank, central banks may had been forced to sell assets at a depreciated price to implement their restrictive monetary policy, or could eventually have faced higher liability costs. Then why did central bank avoid losses? We perform counterfactuals to identify the factors that mattered most for a central banks' income statement, and consider how their finances in the 1980s would have looked like with today's central bank characteristics and policies. In particular, we simulate the return on assets if commercial bank reserves kept at the central bank had been remunerated.[5] We also run the same simulation assuming that the share of bank reserves in the balance sheet would have been as high

[2] "Decade of central bank largesse haunts taxpayers as losses loom," Francesco Canepa in Reuters, October 25, 2022 and "Fallen heroes: Central banks face credibility crisis as losses pile up." Johanna Treeck in Politico, December 1, 2022

[3] The idea that the credibility of central bank policy depends on the solvency of the institution has long roots in history and has received particular attention in Bagehot (1873), chp.VIII.

[4] Indeed, central bank losses could be connected to lending and cronyism, which would call into question the credibility of the central bank to act for the public good. See Mitchener and Monnet (2023) for a historical example.

[5] we rely on the standard metrics used by most of the empirical literature on central bank finances (Leone (1994), Stella (1997), Klüh and Stella (2008),Archer and Moser-Boehm (2013)): the return on asset and the equity to asset ratio. Following Archer and Moser-Boehm (2013) we use a broad definition of equity, including not only capital but provisions and reserves.

as today. Interestingly, these counterfactual scenarios are insufficient to trigger losses for the central banks of the 1980s. The counterfactual that produces losses makes the *additional* assumption that, like today, the revenue derived from the holding of domestic securities is very low due to previous purchases of bonds made at negative or very low rates and long maturity. Consequently, our counterfactual shows that losses are transitory and are offset when assets purchased before the rate tightening mature and asset yields increase.

These counterfactuals shed light on the relationship between central bank losses and the unique situation of the 2020s. They also explain why concerns about central bank losses did not materialize in the 1980s and did not pose a challenge to the credibility and rationale of restrictive monetary policy. Our reconstruction of central bank accounts and counterfactual simulations contribute to the literature that aims to distinguish quantitatively between different potential causes of central bank financial losses (Hall and Reis (2015)). While a handful of papers have studied several central bank finance scenarios over the past decade, none of them have managed to anticipate the full impact of past asset purchases and reserve remuneration when interest rates rise (Carpenter et al. (2012), Schwarz et al. (2015), Bonis, Fiesthumel, and Noonan (2018)).

Our paper also contributes to the literature that has discussed, in theory and in practice, how central banks cope with financial losses. Several studies have documented central bank losses since the 1990s, but their primary focus has been on emerging markets (e.g., Leone (1994), Stella (1997), Dziobek and Dalton (2005), Stella and Lonnberg (2008), Sweidan (2011), Archer and Moser-Boehm (2013)). This has left the impression that there is no precedent for central bank losses in Europe and North America even though these are clearly at risk today.

Before the Volcker shock, during the 1970s, some advanced-economy central banks, in particular Germany and Switzerland, experienced negative profits because of losses on their foreign-exchange reserves when their domestic currencies appreciated relative to the U.S. dollar. Contrary to domestic assets, foreign assets are valued at market exchange rates. We study in detail the different mechanisms to account for losses in different central banks (in the French case for example, FX losses were automatically subtracted from the maximum of the Treasury credit line at the central bank). In Germany and Switzerland, losses were carried forward and this did not involve any major consequence on the independence of the central bank and the implementation of monetary policy. The FX losses of the 1970s were nevertheless followed by an increase in reserve funds and provisions in the next years, consistent with the evidence that central banks dislike reporting losses even if they can manage them (Goncharov, Ioannidou, and Schmalz (2021)).

So, there is clear historical evidence that central banks can continue to operate while recording losses on their balance sheets, at least if those losses are temporary. While the theoretical literature on central bank losses stresses the need for optimal dividend rules (Hall and Reis (2015), Reis (2015), Del Negro and Sims (2015)), empirical studies on central bank finances since the 1990s have highlighted several instances where central banks functioned with negative equity (Archer and Moser-Boehm (2013), Allen et al. (2020), Bell et al. (2023)). Our results are in line with these previous empirical studies as we show that Switzerland and Germany managed to cope with losses through accounting mechanisms in the 1970s, without the need of positive transfers from the government to its central bank (negative dividends). In our sample, France offers a contrasting case where there was an automatic transfer - activated in 1972 - of losses from the central bank

to the government. French FX losses due to exchange rate appreciation nevertheless remained negligible compared to the German and Swiss cases and the central bank's overall profit remained positive. The German and Swiss models did not deliver the worst macroeconomic outcomes, however. These two countries had among the very lowest inflation rates and greater central bank independence during the 1970s (Bordo and Orphanides (2013)). While no causal link can be established, it is nevertheless possible to conclude that, as far as losses due to foreign assets are concerned, central bank losses are not incompatible with central bank independence.[6]

2. Central bank losses: causes and management

Although central bank balance sheets are well-known, their profit and loss accounts remain more opaque. To fix ideas, Table 1 displays the standardized profit and loss account of a central bank. The main source of revenues is the interest from the security portfolio followed by the revenues from the lending operations to commercial banks. Central banks have diverse sources of expenditures unrelated to the remuneration of bank reserves and other special liabilities: premises, labor costs, etc. Operating profit is defined as the difference between operating revenues and expenditures before paying dividends or increasing equity (reserves, provisions, etc.). Once determined, central banks distribute their profit under pre-established rules which vary depending on their laws and shareholding structure (see Appendix E. for more details).[7] Undistributed profits are written on the liability side, reinforcing the equity position of the central bank. On average over 1970-1990, central banks in our sample transferred 69% of their operating profit to the Treasury, most of the remainder being retained to increase equity. Central banks with partial or fully private shareholding transferred very little profit to the Treasury (see Rossouw and Breytenbach (2011)). As Bartels, Eichengreen, and Mauro (2016), we do not observe that central banks with private shareholders were more profitable (see Appendix C.).

[6] Klüh and Stella (2008) first provided econometric evidence showing that central bank losses were associated with higher inflation. This relation is also identified by Perera, Ralston, and Wickramanayake (2013). Benecka et al. (2012) however shows that this link is not robust to different measures of losses and alternative econometric specifications.

[7] For instance, the Fed paid a 6% dividend to its private shareholders over its net income, and transferred the vast majority of this income to the Treasury as interests on Federal Reserve Notes (as well as franchise tax). The remainder is transferred to its surplus under sections 7 and 13b of its statutes.

Table 1: A simplified framework of profit and loss generation and distribution

Profit & Loss account			
Revenues		**Expenditures**	
Asset remuneration	Interests on securities	Liability remuneration	Reserve remuneration
	Revenues from lending operations		
	Revenues from the Treasury		Payments to the Treasury
	Other interests received		Other interests paid
Asset valuation gains	Profit on appreciated assets sold	Outright and valuation losses	Losses on depreciated assets sold
	FX valuation gains		FX valuation losses
Other revenues	Withdraws from provisions and depreciations	Other expenditures	Transfers to provisions and depreciations
	Revenues from specific services (transaction)		Administration, premises, taxes and currency fabrication
Overall profit			
If positive, transferred to:		**If negative*:**	
Reserve funds and other financial buffers		Covered using retained earnings, reserves and other financial buffers	
Dividends to eventual shareholders		Covered using capital	
Transfer to the Treasury		Transfer from the Treasury	
Retained profits		Carried forward as deferred asset	

** The actual bearing of the loss depends on the Law binding the CB and the Treasury as well as discretionary government decisions.*

In light of this accounting framework, central bank losses can occur for four main reasons. First, if securities held by the central bank are sold at a value inferior to the one they were bought. Second, losses can occur if the counterparty of the security or of an uncollaterized lending operation defaults. Third, if there is a revaluation of foreign exchange holdings, i.e. that the domestic currency appreciated against reserve currencies, this can lead to a loss. And finally, a lose can arise if the overall remuneration of the assets is inferior to the overall cost of liabilities. Other specific operations (recorded in "other assets") can

generate losses (investments in real estate, pensions, transfers, etc.) but they are unrelated to monetary policy operations and thus are not relevant to our analysis.

There are several ways to manage central bank losses, which depend on the its institutional framework and the size of the loss.[8] If losses are not immediately covered by a transfer from the Treasury (negative dividend), they are offset using provisions and reserve funds. If these funds are insufficient due to too large losses or due to their shrinkage in case of repeated losses, the central bank can cover them using its capital. If the central bank does not want to tap into draw down capital or if lacks capital, it can carry a loss forward on the asset side and cover it using future profits. Negative equity positions can thus happen without being critical. Should this position last, a recapitalization could be needed from the fiscal authority. Section 5 discusses more exotic ways that losses can be managed using alternative government transfers or accounting tricks.

3. Central bank finances in the 1980s

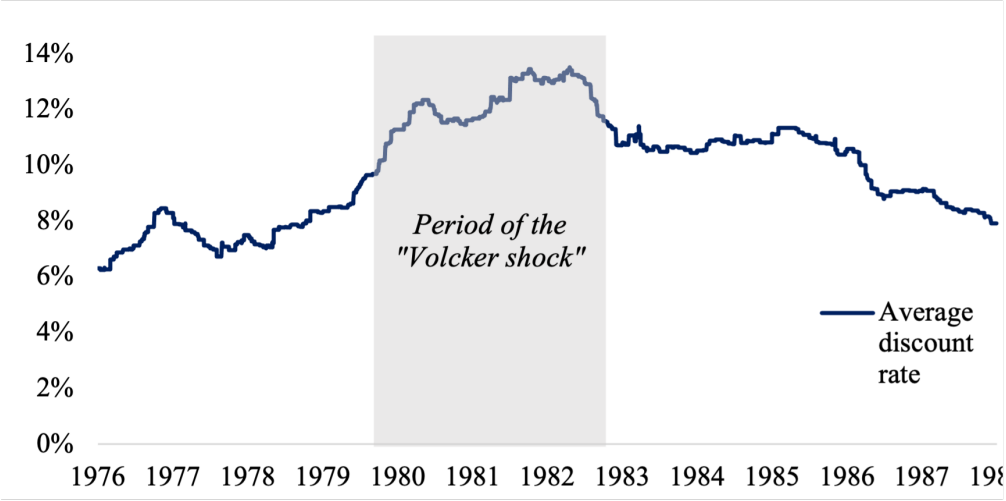
In late 1979, while inflation was reaching double digits, newly-appointed Fed Chairman Paul Volcker tightened monetary policy (1979-1982).[9] It triggered a global increase in market and central bank short-term rates (Goodfriend and King (2005)). Similar actions were taken in most advanced economies, with differences in magnitudes depending on inflation differentials and the exchange rate regime. By March 1980, the Fed funds rates had risen to 20%, a figure that was exceeded twice by the end of 1980 and the middle of 1981. M1 targets were set in the US, which determined a corresponding amount of non-borrowed reserves (see Bindseil (2004) pp. 29-30 for more details) and a target corridor for fed funds rates. In only a few years, U.S. inflation was contained to reach 6.1% at the end-1982 and 3.2% in end-1983. Figure 1 displays the global and simultaneous increase in the central bank policy rates in our 10 country sample.[10] Except in the U.S. where the fed funds rate were already targeted by the Federal Reserve, the discount rate was still the main policy rate of central banks in the 1980s, even when discount operations were negligible.

[8] As discussed by Archer and Moser-Boehm (2013), equity is not just capital but also includes undistributed profits, provisions, or other kinds of special reserve funds. Losses can either be carried forward on the asset side or reduce equity by decreasing the reserve funds, provisions, or even capital.

[9] The 11.3% U.S. inflation rate in 1979 was close to rates in Italy, the United Kingdom, and France, which had inflation rates of 14.8%, 13.4% and 10.6%, respectively. Other countries performed better, such as Switzerland, Germany, or the Netherlands, with inflation levels of 3.6%, 4.0%, and 4.2% respectively.

[10] While showing the value of the average discount rate over the sample, significant differences exist between countries. The lowest discount rates over 1979-1982 can be found at the Swiss National Bank (at 6%), while the highest was reached in Portugal (at around 25%).

Figure 1: The common evolution of the average discount rate



Source: FRED from IMF IFS, Annual Reports, National historical archives, Authors' calculations
The sample includes the U.S. Federal Reserve, the Bank of England, the Bank of France, the Deutsche Bundesbank, the Bank of Italy, De Nederlandsche Bank, the Swiss National Bank, the Reserve Bank of Australia, the National Bank of Belgium and the Bank of Portugal.

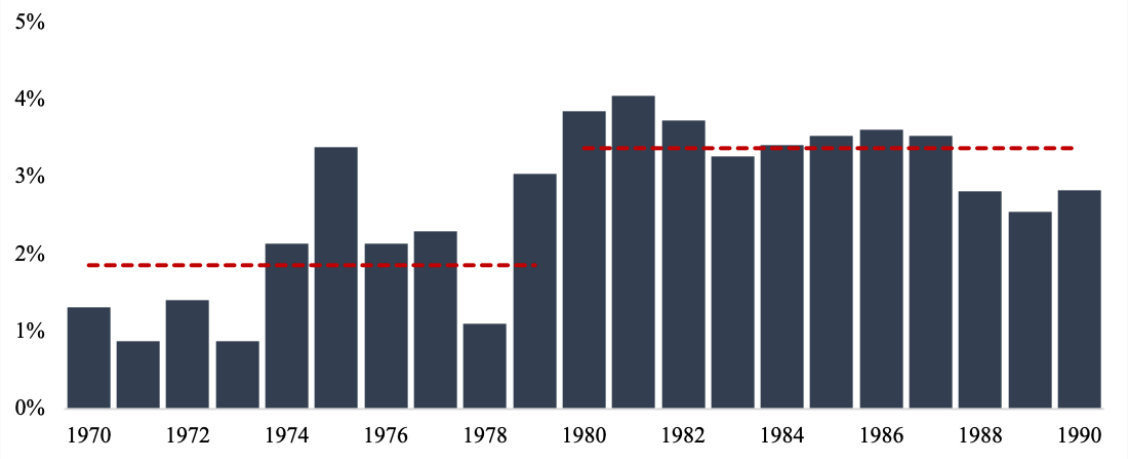
3.1. The rise in central bank's financial returns

Our study relies on the quantitative and qualitative analyses of the Annual Reports of ten central banks from 1970 to 1990. The sample includes the U.S. Federal Reserve, the Bank of England, the Bank of France, the Deutsche Bundesbank, the Bank of Italy, De Nederlandsche Bank, the Swiss National Bank, the Reserve Bank of Australia, the National Bank of Belgium and the Bank of Portugal. We collected, or sometimes reconstructed, detailed balance sheets and profit and loss (P&L) accounts. Comparing the financial statements of these ten central banks was a difficult task because of the considerable differences in central bank accounting frameworks, relationship with government treasuries, and the management of losses. A careful reading of the Annual Reports has been crucial in identifying and understanding the financial and accounting specificity of each central bank.[11]. Before being harmonized under the IMF IFRS rules for central banks in the 1990s (see Wytenburg (2021)), accounting standards differed significantly. The most recent and comprehensive analysis of central bank losses (Goncharov, Ioannidou, and Schmalz (2021)) uses data - already partly standardized - available in BankScope starting 1992. Following the literature (e.g., Leone (1994), Stella (1997) or Klüh and Stella (2008)) we rely on two financial indicators of central bank finances: the return on assets and the equity-to-assets ratio.

We do not find that central bank finances worsened following the Volcker shock. On the contrary, there was a sizable increase in profitability and financial buffers in the 1980s. The average return on central bank assets (ROA) increased from 1.9% in the 1970s to 3.4% in the 1980s (see Figure 2). Dashed red lines correspond to the average of the indicator over the two sub-periods (1970-1979 and 1980-1990).

[11]For example, not all central banks display FX losses and gains in the operating profit and some include transfers to reserve accounts in operating profit.

Figure 2: The evolution of the average return on assets, % of total assets



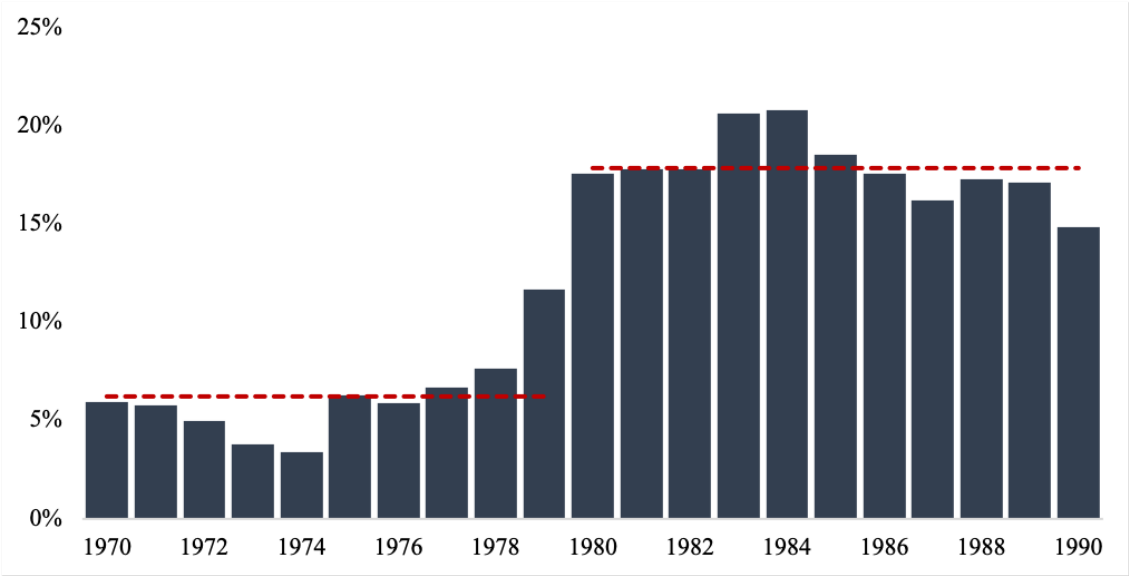
Note: averages over the ten central banks
Source: Annual Reports, Authors' calculations

The equity-to-asset ratio tells a similar story. Central banks experienced a strong increase in the equity ratio during the 1980s (see Figure 3). A broad definition of equity is used following Archer and Moser-Boehm (2013), which is similar to the IMF's definition of Other Items Net (OIN).[12] Equity thus includes more than capital, which alone only accounts for a small share of total assets compared to reserve funds or provisions.

The increase in the equity-to-asset ratio is significantly stronger than the one in the ROA, from 6.2% on average in the 1970s to 17.8% in the 1980s. These two indicators increased strongly starting 1979 and reached their peaks in 1982-1984, corresponding to the timeline of disinflation policies in advanced economies.

[12]They define equity in the following way: "Capital is only one component of equity, which also includes more active buffers such as reserves (built through retained earnings that are not distributed to shareholders as dividends), retained earnings (i.e. profits pending distribution or transfer to reserve), revaluation accounts (a special buffer tied to changes in the value of assets and liabilities in the books of the central bank), and general provisions against risks that are yet to be realized."

Figure 3: The evolution of the average equity to assets ratio, % of total assets

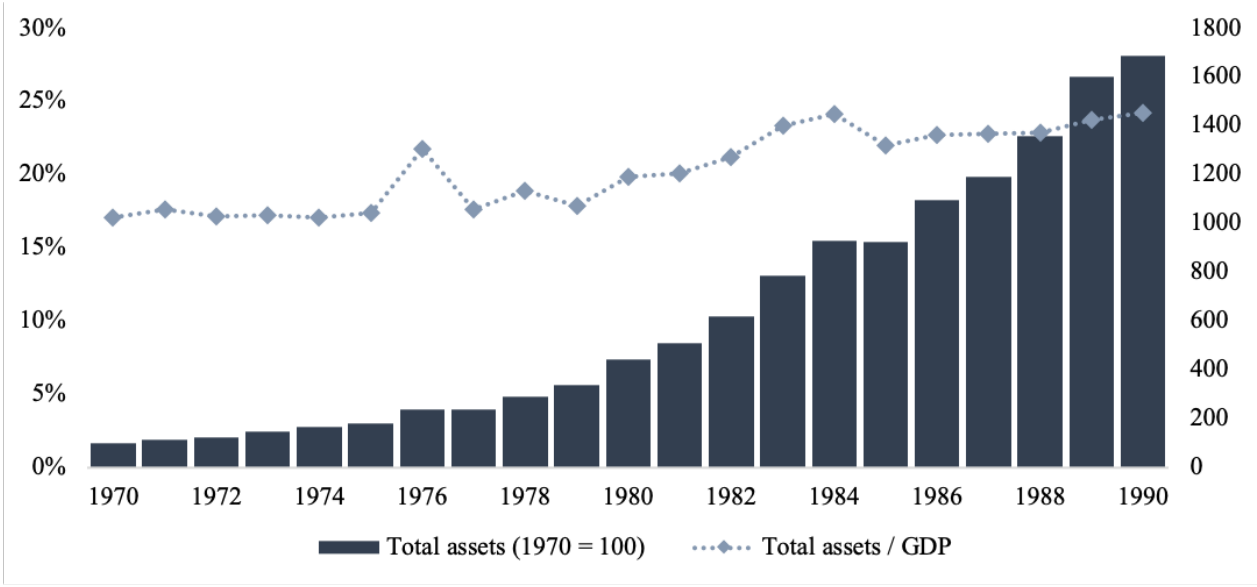


Note: averages over the ten central banks
Source: Annual Reports, Authors' calculations

Country-specific data on ROA and the equity ratio are given in Appendix A.. They show that there was no negative ROA in our sample in the 1980s, while some stronger losses and sometimes negative profits occurred in the 1970s (see Section 5). Appendix B. also displays the distribution of these profits and shows that, as in Goncharov, Ioannidou, and Schmalz (2021), central banks very rarely report a high return on asset.

These results are surprising in many ways. First, it is striking that the disinflation policies of the 1980s were carried out without a nominal decrease in central bank balance sheets (in any of the ten central banks). As Figure 4 shows, total assets increased in nominal terms over the whole period; they were multiplied by 16 between 1970 and 1990. The ratio of assets to nominal GDP remained quite stable over the period, near 20%, but it experienced a slowdown in the late 1980s. The economic slowdown that followed the disinflation shock was associated with an increase in the asset-to-GDP ratio. The 1984-1985 fall in the ratio is not only due to GDP growth but also to the decrease in central banks' total assets.

Figure 4: The evolution of CBs' balance sheet size in nominal terms and relative to GDP



Note: averages over the ten central banks
Source: Annual Reports, Authors' calculations

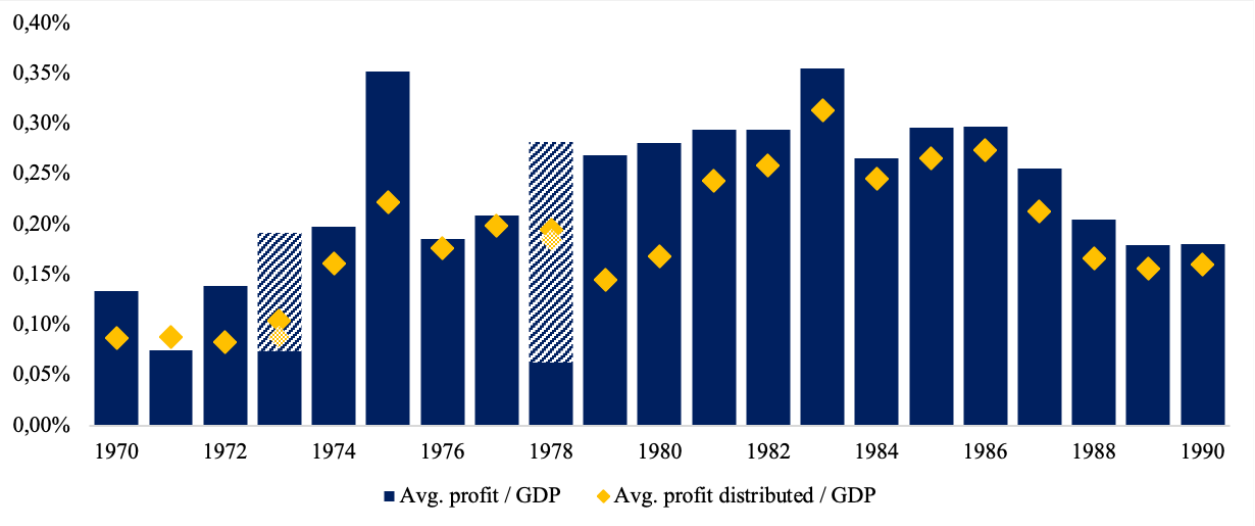
3.2. Higher transfers to governments

Figure 5 displays the evolution of both total central bank profits and the profits distributed to the government. Both series are scaled by GDP. As a share of GDP, central bank profits increased while their assets remained stable. While being a minor part of the government budget, central bank transfers to the government were non-negligible contributions to government finances. They increased from 0.15% of GDP on average in 1970-1979 to 0.22% in 1980-1990. Thus, the government budgets benefited from the disinflation policies of the 1980s, a fact that had been underappreciated in the historical literature. This also goes against the common assumption that seigniorage (government revenues from money creation) increases with inflation. As we will see later, positive transfers from central banks to governments were partly due to the fact that the financial cost of implementing the restrictive monetary policy was borne by commercial banks. Non-remunerated bank reserves were a tax on banks. Only the Italian central bank remunerated reserves held by banks.

The share of central bank profits distributed to the government is not constant. This is due to the specific national rules that govern the payment of dividends by central banks. In particular, these rules are asymmetric: dividends paid to the government are always positive and transfers from the government to the central bank are not allowed. For this reason, the years 1973 and 1978 display average ratios of profit distributed to total profits higher than one. It is due to the fact that the Bundesbank and the Swiss national bank experienced large losses in these two years (i.e. negative profits) but did not receive transfers from their government (see Section 5).[13]

[13]Central banks experiencing losses can still be subject to the payment of dividend to the government, which are generally of

Figure 5: The evolution of profit and profit distribution to the government, in % of GDP



Note: averages over the ten central banks
Source: Annual Reports, Authors' calculations

4. Why did central bank profits increase in the 1980s?

We first discuss why central banks did not make losses on their domestic and foreign assets in the 1980s - contrary to the 1970s - and why they had a stronger equity position than in the previous decade. We then explain the reasons why central banks could increase their revenues when they raised interest rates: they received a higher return on assets with zero liability costs (i.e. non remuneration of bank reserves). We explain why the net effect of higher lending rates and non-remunerated reserves on central bank profit is however not straightforward and depends on the response of banks to monetary policy implementation.

4.1. The absence of losses on securities

Central banks would not have been profitable if they had made losses on their asset portfolio in the 1980s. These losses did not happen for three reasons. First, at that time and still today, domestic securities purchased for monetary policy purposes are valued at book rather than market value.[14] Thus, latent losses on securities remain unrealized, as long as they are not sold or the counterparty does not default. Second, as we have explained previously, central banks did not reduce the size of their balance sheets when they increased interest rates. They did not sell bonds so losses remained unrealized when the price of government bonds

a much lower magnitude than the profit transferred, thus making these payments financially non-threatening. It is also to note that profit distribution rules can also change over time, with revisions in central banks' statutes, e.g., when the Bank of Portugal was nationalized in 1974, it granted the government a higher share of profits. Some other accounting features can explain these differences, for instance the carrying out over the year of the past year's undistributed profit.

[14]Securities acquired for non-monetary policy purposes, such as the ones invested by the central bank's pension fund, are considered at their market value. They were negligible amounts on balance sheets.

decreased. And no government defaulted in our sample. Third, there were no major losses on foreign exchange assets, contrary to the previous decade (see Section 5) because the main international reserve currency, the U.S. dollar, appreciated relative to other currencies. Thus, non-US central banks did not see the market value of their FX reserves decrease. Central banks do not take into account changes in the valuation of foreign reserves. As a result, they are exposed to exchange-rate risks. Revaluations of FX assets at market exchange rates generally occur once a year. They are justified by the fact that FX reserves are meant to be used on markets to stabilize the exchange rate and it is thus important to evaluate them at their market value.[15]

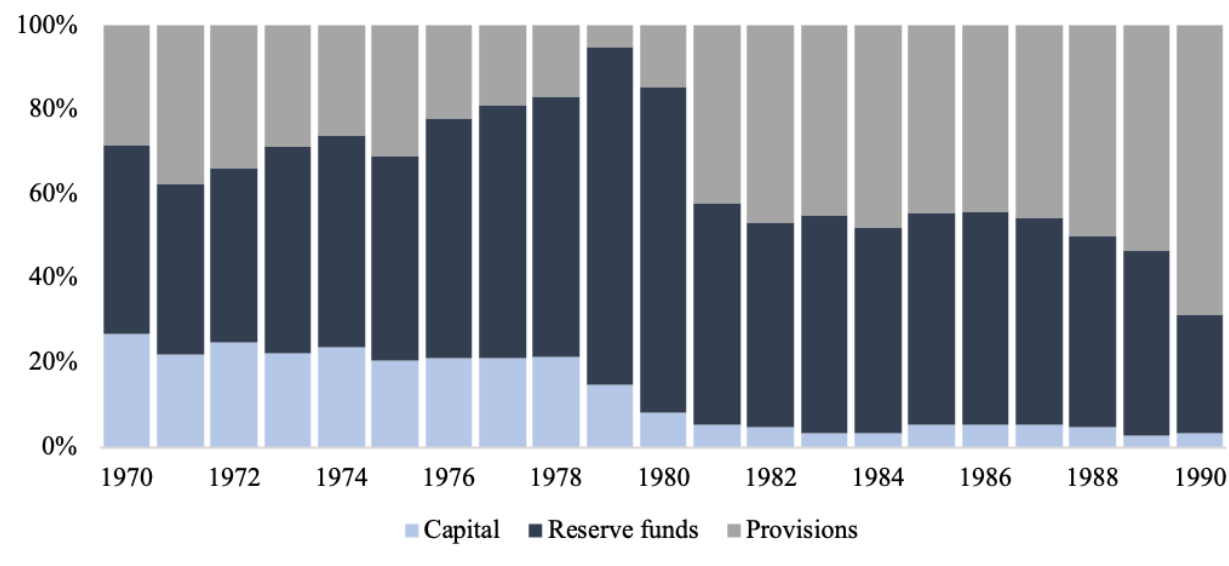
4.2. Better management and accounting practices

A minor factor that contributed to the financial strength of central banks in the 1980s was the development of more risk-averse accounting and financial practices. This translated into the development and even creation of (additional) reserve funds and provisionary accounts. The rise in the equity-to-asset ratio (larger than the one of the ROA) reflects this increase in financial buffers. While the share of capital to total liabilities remained steady, between 0.2% and 0.3% over the whole period, capital being mostly symbolic (at 0.29% of total assets on average, the share of reserves funds to total liabilities increased from 0.8% in the 1970s to 3.1% in the 1980s. Likewise, provision accounts to total liabilities rose from 0.3% in the 1970s to 2.9% in the 1980s.[16]). Figure 6 displays the breakdown of equity and its evolution.

[15] As far as we are aware, there is no theoretical justification for accounting foreign and domestic securities differently. FX reserves are accounted at market value since they are meant to be sold in FX markets to defend the exchange rate, whereas domestic securities are seldom sold by central banks once held. The specific accounting of domestic securities by central banks in practice reflects the ambiguity that, on one hand, a central bank is not a private firm with liability holders demanding transparency and threatening to run (Allen et al. (2020)) but, on the other hand, it seems that they are reluctant to report losses and negative equity and thus use accounting mechanisms to hide fluctuations in asset prices (Goncharov, Ioannidou, and Schmalz (2021)).

[16] Changes in the size of the capital account are rare and usually unrelated to financial distress.

Figure 6: The evolution of equity composition, % of total equity



Note: averages over the ten central banks
Source: Annual Reports, Authors' calculations

4.3. The net effect of higher interest rate on lending facilities

If the absence of losses on securities and the strengthening of equity can explain why the Volcker shock did not turn central bank finances into negative territory, it cannot explain why profits eventually increased. They increased because the return on assets rose during the tightening cycle: in other words, higher rates did not decrease central bank lending.

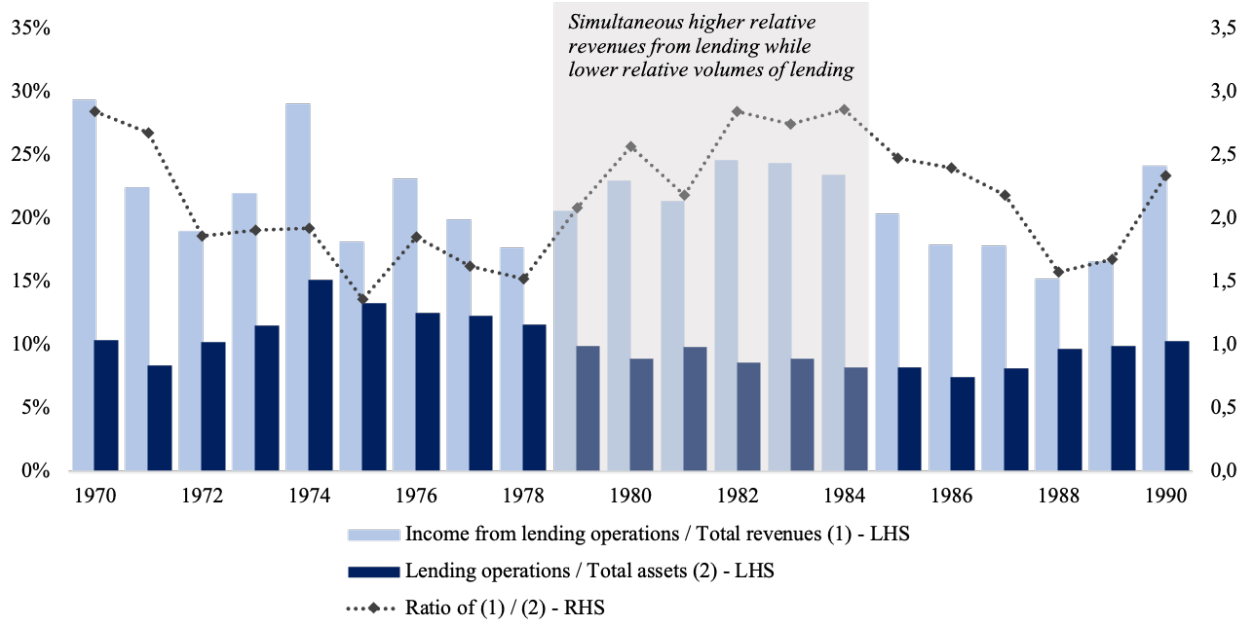
Determining the net effect of changes in the central bank policy rates on profits is not straightforward. Although there was always some commercial bank demand for borrowing at central banks, total central bank lending depends on the standing facility's (discount window's) elasticity of demand to these rates. While an increase in lending rates may negatively affect demand for liquidity, this demand also depends on interbank market conditions, the need to satisfy reserve requirements, and idiosyncratic liquidity needs of commercial banks. There is an minimum level (or very low elasticity from a certain point) of bank demand at the central bank because of the liquidity needs of banks.

With the exception of the Federal Reserve, lending operations represented a significant part of total assets of central banks in the 1970s and 1980s (see Section 6). These included advances on securities and discount loans to banks as well as other specific lending facilities to non-banks. Figure 7 shows the revenues of these activities are essential and on average roughly 20% of total operating revenues. The share of revenues from loans to total revenues significantly increased at the time of the Volcker shock before falling back to the 1970s levels in the late 1980s.

A low elasticity of commercial bank demand at the central bank lending facility is in fact not surprising, especially when central banks increase their obligatory reserves (Bindseil, Manzanares, and Weller (2004),

Monnet and Vari (2020)), as they did in the early 1980s (Borio (1997), Goodfriend and King (2005)). The combination of high interest rates, high reserve requirements (without interest rate paid on these reserves), and the important role of short-term loans for central bank monetary policy operations are thus crucial to explain the financial outcomes of the 1980s central bank policies.

Figure 7: Trends in lending operations and their profitability



Note: averages over the ten central banks
Source: Annual Reports, Authors' calculations

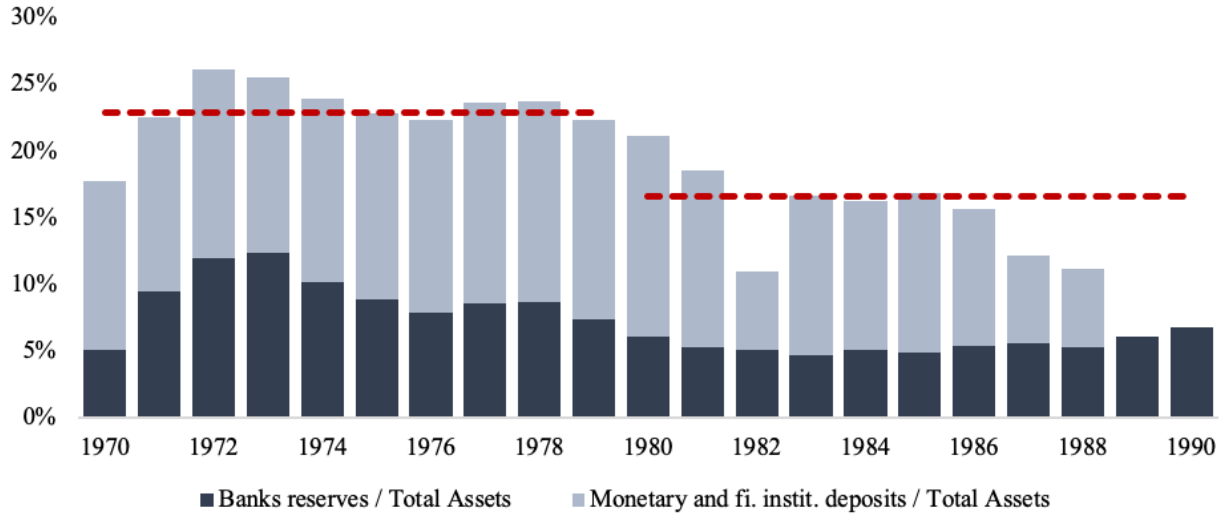
4.4. The ambiguous role of the tax reserve

Reserve requirements operate as a tax (Romer (1985), Bindseil (2004)), which can be computed as the product of total bank deposits, the reserve requirement coefficient, and the difference between market or lending rates and reserve remuneration rates. For most central banks from 1970 to 1990, the reserves held at the central bank - either required reserves or excess reserves - were not remunerated. The only exception was Italy.[17] Since the widespread use of paying interest on bank reserves only dates back to the early 2000s, central banks at the time of the Volcker shock focused on using reserve requirements as a key monetary tool. Monetary growth was monitored and targeted using reserve requirements as the main instrument and non-borrowed reserves as the main intermediate target (Bindseil, Manzanares, and Weller (2004), Goodfriend and King (2005)). Central banks increased required reserves but the share of bank reserves in their assets eventually decreased over the period because banks diminished their excess reserves (Figure 8). Excess

[17] Compulsory reserves were remunerated at a rate of 5.50% on average over the period, while excess reserves and 8-day reserves were remunerated at lower rates.

reserves had a high opportunity cost, both in nominal and real terms. Non-bank financial institutions - which were not subject to reserve requirements - also diminished their reserves significantly. The decrease of excess reserves worked at both the intensive and extensive margins. Feinman (1993) documents the attrition of excess reserves in the 1980s, despite the increase in reserve requirements. As reserve requirements only applied to commercial banks that were members of the Federal Reserve System, the increasing tax on reserves pushed some banks to revise their membership.

Figure 8: The evolution of reserves and monetary and fin. institutions deposits, % of total assets



Note: averages over the ten central banks
Source: Annual Reports, Authors' calculations

The reserve tax increased together with the short-term interest rates. At the same time, excess reserves declined because of the opportunity cost (the tax) of holding them. The first effect increases the central bank's profit, while the second decreases it. Understanding the impact on profit is even more complicated because of the difference between borrowed and non-borrowed reserves. Borrowed reserves are financed using the discount window and thus have a direct counterpart on the asset side and generate a stream of revenue, whereas the balance sheet counterparts (and their remuneration) of non-borrowed reserves are not as easy to locate.

Thus, because the total amount of bank reserves (and their share in central bank liabilities) eventually decreased during the 1980s rate-tightening cycle, the contribution of the non-remunerated reserves to the increase in central bank profits remains an empirical question and may have differed across central banks. The indirect effect of bank reserves on central bank revenues can only be assessed by taking into account the composition of assets. The counterfactual simulations in Section 6 will show that, although the absence of remuneration of banks reserves contributed to the rise in profits in the 1980s, it was not the only factor.

Before turning to counterfactual simulations that assess how the components listed above contributed to the increase in central bank profits, it is worth coming back to an important reason why central banks did not

experience losses during the 1980s: the absence of foreign exchange losses. In a historical perspective, this is an especially important point since it gave rise to the main differences in central bank finances in "advanced economies" between the 1970s and the 1980s. It also reveals that some central banks made significant losses in the 1970s, allowing us to examine how central banks managed their losses. We now turn our attention to this issue.

5. Losses on foreign exchange reserves in the 1970s

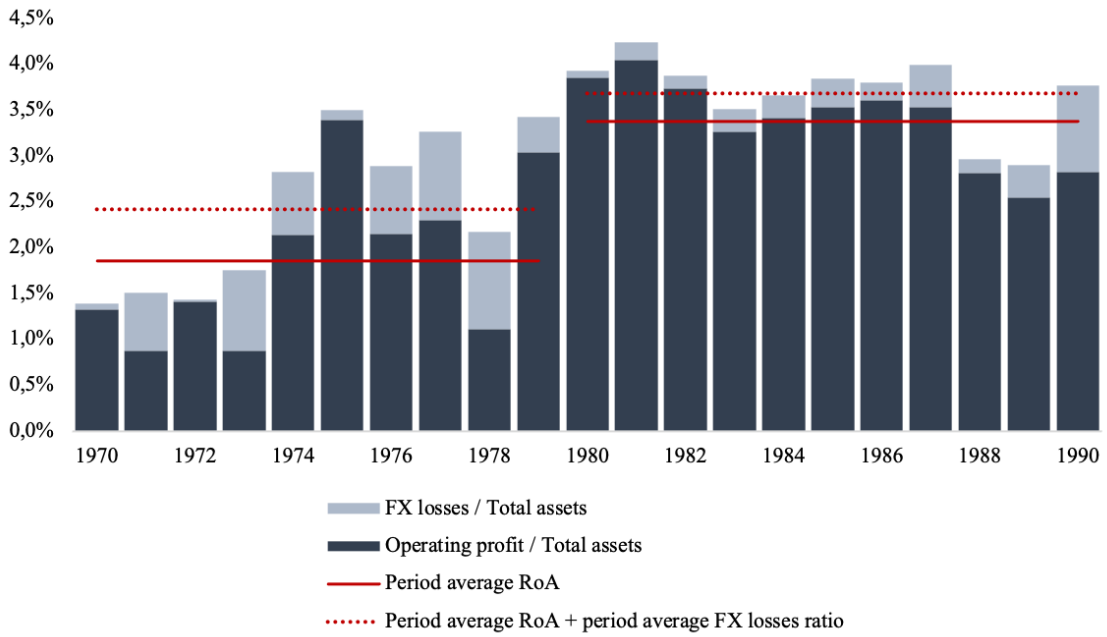
The Volcker shock had two effects on central bank finances outside the United States. First, it pushed other central banks to increase their interest rates, triggering a positive effect on the spread between their return on assets and the cost of their liabilities. Second, since rate-tightening in other countries did not follow the U.S. one-to-one – the Fed's monetary policy led to an appreciation of the U.S. dollar, which in turn had a positive valuation effect on the foreign assets held by non-US central banks.

By contrast, a fall in the value of the dollar in the 1970s resulted in negative valuation effects. After the suspension of the dollar's convertibility into gold in 1971, most currencies started to float against the dollar in 1973. Despite the dollar devaluing by 8% under the Smithsonian Agreement and the creation of bands that other G-10 countries' currencies could fluctuate, the dollar faced ongoing pressure and was devalued a second time in early 1973. This devaluation also generated losses on countries' international reserves, which where mostly composed of U.S. dollars at the time. In particular, the Deutsche Mark overvaluation created large foreign exchange losses at the Bundesbank.

5.1. Lower FX losses in the 1980s are not enough to explain higher profits

Figure 9 displays the historical ROA (dark blue bars) with the cost of FX losses (light blue bars). This reveals the operational profit without FX losses (the sum of the two blue bars). The straight red lines correspond to the period average period observed ROA and the dashed red lines to the average period ROA excluding FX losses. FX losses were much higher in the 1970s, relative to both total assets and total operating profit. There were still some FX losses in the 1980s because the U.S. dollar was not the only reserve currency and because it eventually depreciated in the second half of the 1980s. Yet, they were much smaller on average than during the previous decade. Figure 9 also reveals that smaller FX losses in the 1980s are not enough to explain the difference in ROA between the two decades. The dashed line in the 1980s is higher than the one in the 1970s. The more stable international monetary environment cannot explain alone the stronger central bank profitability of the 1980s.

Figure 9: The effect of FX losses on ROA differentials, % of total assets



Note: averages over the ten central banks
Source: Annual Reports, Authors' calculations

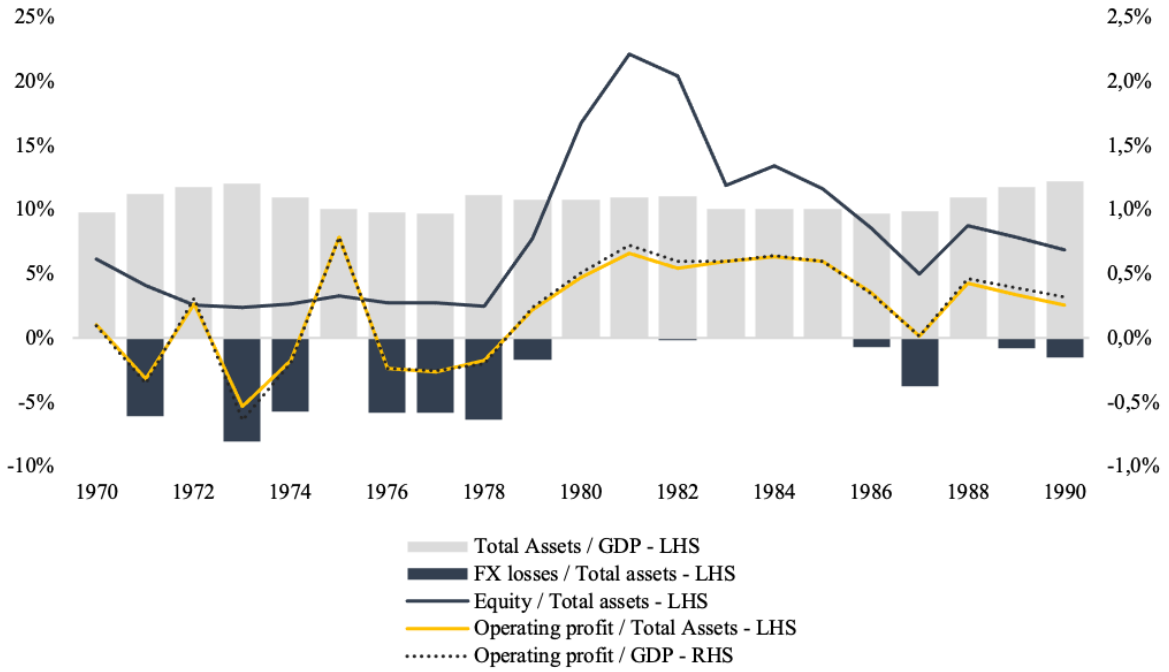
5.2. The management of central bank losses in the 1970s

We focus on the Deutsche Bundesbank, the Bank of France, and the Swiss National Bank which were the three central banks in our sample that experienced sizable FX losses in our sample in the 1970s (to a lesser extent in the French case). Greater details on the FX losses and their management in these three central banks are given in Appendix D..

The Bundesbank carried forward on its balance sheet the negative profits induced by the FX losses and covered them using future profits. In a very different framework, the Bank of France did not face negative profits following the FX losses, as these losses were related to France's Exchange Stabilization Funds, and were directly covered by the Treasury though a specific mechanism. The Treasury benefited from a credit line (perpetual loan) at the central bank, whose maximum was set by the Parliament (Monnet (2018), chp.5). Profits from the Exchange Stabilization Funds (managed by the Bank of France) were added to the maximum of the credit line while losses were subtracted from it.

The Bundesbank experienced several years of losses in the 1970s, which at their maximum in 1973, amounted to 5.3% of total assets (0.6% of the year's GDP) (see Figure 10). They are almost entirely due to FX losses that induced negative profits in 1971, 1973-74 and 1976-78. FX losses also occurred in 1986-90, without generating negative profits. The Bundesbank carried forward its losses from a year to another, covering them using future profits without fiscal support. The capital account was not used to cover the losses, and reserve funds had been immediately exhausted by the 1973 losses.

Figure 10: The Bundesbank's financial indicators



Source: Annual Reports, Authors' calculations

Turning to the Bank of France (BoF), the financial management and final bearing of its FX losses relate to the history and management of the Exchange Stabilization Funds (ESF). Like the United States and the United Kingdom, the Bank of France had created an Exchange Stabilization Funds (ESF) in the 1930s to isolate foreign exchange reserves from the balance sheet of the central bank and to provide automatic fiscal support in case of FX losses. The Fund was managed by the BoF but losses were borne by the Treasury (an arrangement similar to the one that still exists in the U.S. and U.K.). Thus, the BoF did not experience negative profits over the period and the losses only refer to the ones of the ESF.[18] Negative profits of the French ESF occurred following the devaluation of the dollar, which generated a net loss of F 1,569m of the ESF, in 1972. Had these losses been integrated into the profit and loss account of the BoF, the operating profit of the central bank would have remained positive in 1972 (it was equal to F 2,035m).

In 1978, the Swiss National Bank (SNB) experienced a sudden negative profit of CHF 2.6bn, corresponding to 5.6% of total assets, due to a large increase in currency amortization amounting to 9.6% of total assets. The SNB was facing strong upward pressure on the Swiss Franc and had to resort to large monetary interventions to prevent a too-strong appreciation of its currency against the U.S. dollar. Similar to the Bundesbank, this loss was carried forward over the next two years and cleared using future profits of the next two years. It then led to the systematic registering of larger provisions for FX risks and valuation changes in the profit and

[18]The July 5^{th}, 1972 Law properly established the convention between the Treasury and the BoF, stating that the Treasury shall cover the overall net loss of the French ESF. Should such losses occur, the Treasury would compensate the BoF through the issuance of zero-interest rate Treasury bonds with a 15-year maturity.

loss account in order to better account for these fluctuations. Despite this loss in 1978, the SNB resorted to its provisions in order to pay, in accordance with its statuses, a fixed dividend payment to its shareholders (regional governments) and to transfer a fixed amount to the "Caisse" (Treasury) of the Federal State. This transfer (CHF 5m) was negligible, representing only 0.01% of total assets. More details on the 1970s FX losses and their management can be found in Appendix D..

6. Counterfactual simulations: How could the central banks of the 1980s have experienced losses?

Would central banks of the 1980s experience losses if their monetary policy tools and balance sheets had resembled those of the 2020s? To answer these questions, we build counterfactual simulations based on financial accounting scenarios. This standard approach allows to simulate whether changes in central bank instruments or the composition of the balance sheet, holding everything else equal, could have generated losses – the key question of interest.[19]

We run the following counterfactual simulations. We first take the size of bank reserves as given (i.e., as it appeared in historical balance sheets) and simulate how an increase in the interest rate paid on reserves affected central bank profits. Second, we simulate an increase in the share of bank reserves in the total balance sheet of the central bank (taking the volume of other assets as given). Third, we examine the importance of the legacy of the balance sheet, that is the maturity of the assets held. We focus on ROA rather than the equity-to-asset ratio as the ROA displays less inertia and is thus more likely to become negative; however, conclusions do not differ if we consider the equity-to-asset ratio.

6.1. A counterfactual of ROA in the 1980s with positive reserve remuneration rates

One of the main differences between the 1980s and today is the absence of remuneration of bank reserves. First, we simulate the consequences on the ROA of a range of values for $\tau > 0$ (the remuneration rate of bank reserves). We plot the impact on the average central bank's ROA as well as on the Fed's ROA.[20] There were no excess reserves at the Fed in the 1980s. For other central banks, we charge all types of reserves with the same rate $\tau > 0$, in order to (i) provide a conservative scenario and (ii) in line with the current policies on the remuneration of bank reserves.[21]

[19] We follow the literature on central bank profit and losses (e.g., Carpenter et al. (2012), Schwarz et al. (2015), Bonis, Fiesthumel, and Noonan (2018)) and focus on a financial modeling strategy rather than taking a general equilibrium approach. Building a general equilibrium model would require very strong assumptions in the absence of a proper calibration strategy to estimate the response functions of the various balance sheet components. General equilibrium frameworks are useful for exploring the macro implications of changes in financial strength, but less well suited for studying how the existence of multiple instruments of central banks affect their overall financial position.

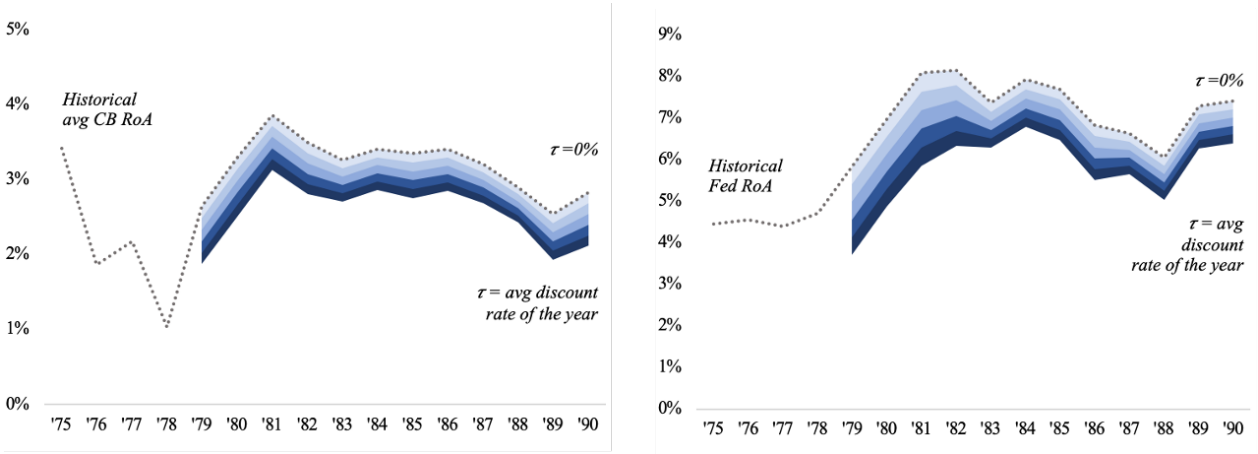
[20] The average central banks' ROA is simply the average ROA over the ten central banks of the sample

[21] In particular, the Fed decided to change its differentiated reserve remuneration policy on June 2021. The interest rates on required and excess reserves have been replaced by the single interest on reserve balances (IORB) rate. See here. The Rate on Reserve Balances (IORB rate) applied by the Fed is 4.4% in December 2022

The counterfactual simulation starts in 1979, the year of the Volcker shock. The actual historical scenario thus corresponds to the case with $\tau = 0$ and is represented in dashed lines in the charts. We only display the change in ROA for reasonable values of τ, by quintiles, from 0% to the actual average discount rate of each year. The financial consequences of a positive rate are linear and depend on the level of the rate and the ratio of bank reserves to total assets.[22].

The two charts show that, both on average and for the specific case of the U.S. Fed, a positive and realistic reserve remuneration rate would not have significantly pushed the ROA for central banks into negative territory. Values of τ up to the average discount rate would have reduced ROA only by 0.6 percentage points for the average CB (left panel) and 1.4 percentage points for the Fed (right panel) over 1979-1990 (see Figure 11). The consequences of a rise in τ on the profit of central banks are limited because of the linear relationship between τ and the ROA (i.e., the constant elasticity of the two) as well as the low ratio of bank reserves to total assets.

Figure 11: The consequences of positive RR remuneration rates in the Fed and avg CB ROAs



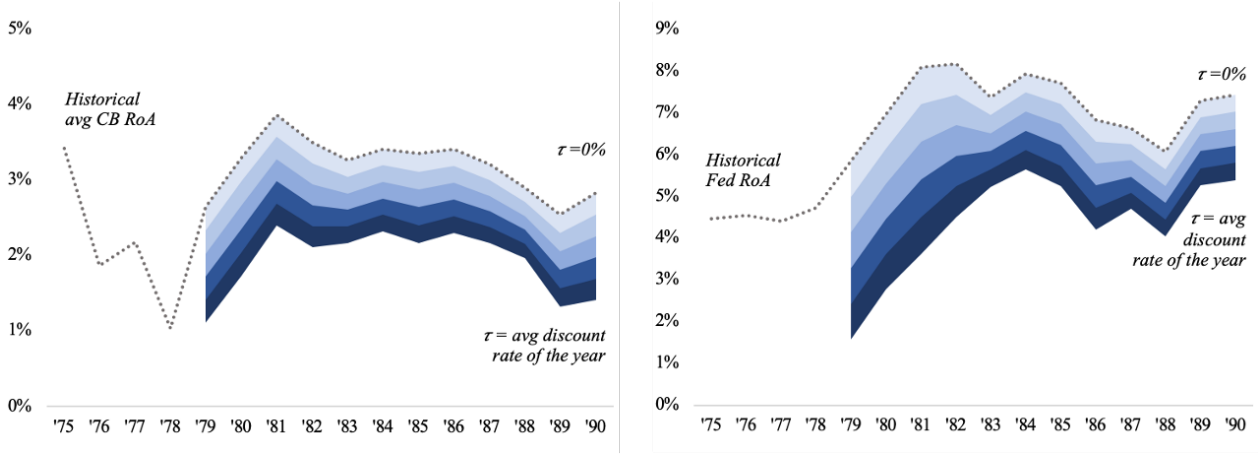
Source: Annual Reports, Authors' calculations

6.2. What would have happened with today's levels of bank reserves?

What would have happened to ROA if reserves were remunerated and their share in central bank assets be similar to today's values? While total bank reserves represented 16.0% of the Fed's balance sheet in 1980, they now account for a greater share of total assets. The 2021 Annual Report of the Fed indicates that total deposits held by depository institutions amounted to 41.6% of total assets. This is about twice as much as in the 1980s. We thus run the same counterfactuals as before (i.e. the same increases in the discount rates) with, in addition, doubling the share of reserves in the central bank balance sheets (keeping all things equal). It effectively doubles the decrease in ROA displayed in the previous chart.

[22]This ratio amounts to 13% on average for the Fed over the period 1980-1990, significantly higher than the average one over all central banks.

Figure 12: The consequences of doubled and remunerated RR in the Fed and avg. CB ROAs



Source: Annual Reports, Authors' calculations

Figure 12 shows that, while the increase in the relative size of reserves has sizable effects, it is not enough to generate negative ROA. Thus, profit would have remained positive even if banks in the 1980s had greatly increased their excess reserves after an increase in the interest rate on bank reserves (or if the share of bank reserves would have been initially very high). In other words, other factors would have been necessary to generate a negative ROA. Today, central banks not only have large remunerated bank reserves on their liabilities, they also hold assets with a long maturity that were issued in a very low nominal interest rate environment. For this reason, the initial ROA - before the rate-tightening cycle began - is much lower today than it was in the 1980s (dashed line in Figure 12).

6.3. The legacy of bond purchases at low rates and long maturity

Would the Volcker shock have created losses for central banks if it had occurred after a decade of purchases of securities at low rates and long maturities? Such a counterfactual is more difficult to perform in a comprehensive way because a starting point for the counterfactual requires precise information on the maturity and the price of securities held by central banks. Such information was seldom published at that time. Nevertheless, we know that the situation was very different from 2022. Securities were bought at a positive rate in the 1970s, with a nominal short-term rate usually exceeding 5% (see Figure 1). Most importantly, discount window lending was still the main operation of many central banks, which means that the maturity of the loans did not exceed 3 months. Table 2 below shows the share of discount window lending and other short-term loans in the total of domestic assets of the central banks in our sample over the period 1970-1990. The U.S. Federal Reserve stands out as an exception. Indeed, this central bank had started earlier than others in utilizing open market operations earlier than other central banks, and as a result, discount window operations and advances on securities were already a minor part of its operations in the 1970s. In other central banks, short-term loans (either discount loans or advances on securities) were still the main operations of central banks. The maximum maturity of these loans was 3 months, but actual operations were often less

than three months (though central banks did not report the average maturity of these loans). Hence, the Fed was more likely to suffer from the financial weight of bonds purchased at a lower rate when it decided to raise interest rates. The Fed is also the only central bank that published the average maturity of the bonds purchased in its annual report. For these two reasons, we focus on the Federal Reserve to perform the last counterfactual where we simulate the effect of a securities portfolio with similar characteristics as today: low rate and long maturity.[23].

Table 2: The differences of the Fed's operations

Variable	Units	U.S. Federal Reserve	Other central banks
Discount, loans and advances	% of total assets	1.0%	10.6%
Government securities	% of total assets	78.0%	14.0%

Source: Annual Reports, Authors' calculations

The Fed's government bond portfolio had an average maturity equal to 3.3 years (estimated from the 1979 Annual Report). That contrasts with the longer maturity of 6.2 years in 2021, nearly twice that of 1979. The share of commercial bank reserves in total assets stood at 20.8% in 1979 versus 47.8% as of end-2021. In contrast to the present situation, because domestic bonds had been purchased at a positive high nominal rate, they generated substantial revenue. The ratio of total income from government securities to the total outstanding value of government securities or what we call the "implicit rate of interest on government securities" depends on both the maturity of the bonds and the interest rates at which they were purchased. It is a way to capture the legacy of the balance sheet. The implicit rate of interest on government securities increased from 6.6% in 1977 to 10%-11% in 1979-1984, and compares to a much lower 1.6% in 2021.

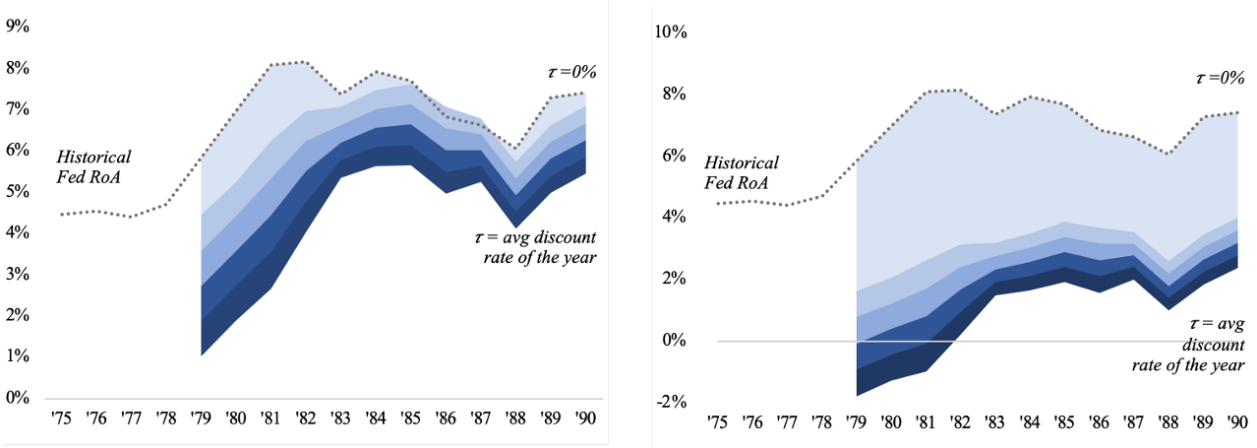
In addition to the two counterfactual changes performed previously (increasing both the remuneration of bank reserves and their share in the balance sheet), we run two new counterfactuals, this time thus only on the Fed. We increase the maturity of the portfolio, making the unrealistic hypothesis that it does not affect the actual and implicit interest rate on government securities (left panel). This is done by lagging the government portfolio income streams over the previous period to generate greater inertia and reproduce the stronger maturity mismatch currently weakening financial institutions. In the second panel, we also decrease the implicit interest rate on government securities held, that is we decrease by half the revenues derived from previous and current asset purchases (consistent with its 2022 value). In this last scenario we can generate a three-year loss, starting at -1.8% of total assets. The loss is transitory, since the interest rate on assets purchased increases when bills are renewed at maturity.

This last counterfactual shows that only the combination of the three following factors is able to generate central bank losses: i) reserves remunerated at the lending rate, ii) a large share of reserves in the central bank balance sheet and iii) assets with long maturity and low yields. None of these factors is sufficient on its

[23]The low interest rate on government is itself a consequence of the purchases of long-term bonds by the central bank.

own. This combination did not occur in the early 1980s but in 2022. It is the consequence of both the current choice of central bank instruments (interest rates on reserves) and the central bank's past policy (quantitative easing). Our counterfactual scenario also shows that central bank losses are transitory and disappear when asset yields rise.

Figure 13: The consequence on the Fed's ROA of doubled maturity and halved government bonds revenues



Source: Annual Reports, Authors' calculations

7. Conclusion

The rate-tightening cycle of 2022-23 has once again drawn attention to central bank finances. Some commentators have suggested that recent losses experienced by many advanced-economy central banks are a result of these disinflation policies and suggested that mounting losses may have important implications for central bank independence. However, understanding the reasons for their changing financial position requires a consideration of both balance-sheet dynamics and the operational tools central banks employ when conducting monetary policy.

To shed light on the relationship between disinflation policies and central bank finances, we revisit the Volcker shock of the 1980s and construct a consistent set of balance sheets and profit and loss statements for 10 advanced-economy central banks between 1970-1990. We show that central banks, in fact, made profits when policy rates rose dramatically in response to double-digit inflation. Central banks continued to lend to commercial banks throughout the rate tightening cycle and reaped higher profits as a result. Central banks of this earlier era differed in important ways from today's central banks. They did not pay interest on reserves, they imposed high reserve requirements on commercial banks, and they made profits from short-term lending. By contrast, and in the wake of the Global Financial Crisis, today's central banks entered the rate-tightening phase with bond portfolios that were long-dated and that were massively expanded in a low-interest rate policy environment. When combined with the widespread practice of paying interest on reserves, a large negative gap on the spread between assets and liabilities emerged.

In a series of counterfactuals, we demonstrate that remunerating bank reserves at today's levels would have been insufficient to generate losses on advanced-economy central banks during the rate tightening cycle of the early 1980s. To generate losses during the disinflation of the 1980s, it would have also been necessary to increase the average maturity of assets held by central banks as well as the size of their holdings in central bank portfolios. In other words, the policy legacy of the GFC is crucial for understanding the reasons for the losses today.

Finally, we also considered the 1970s – a decade when losses did emerge for three advanced-economy central banks. Losses, however, occurred for entirely different reasons. The dollar appreciated, leading to sizable Forex losses at the central banks of Germany, Switzerland, and France. But these were managed with little drama (by carrying them forward in the cases of Germany and Switzerland and through the use of an exchange-rate stabilization fund in France's case) and no loss of central bank independence.

In summary, while central-bank policies are once again generating losses, the experience of the 2020s seems distinctive in that the most prominent previous example of disinflation failed to do so.

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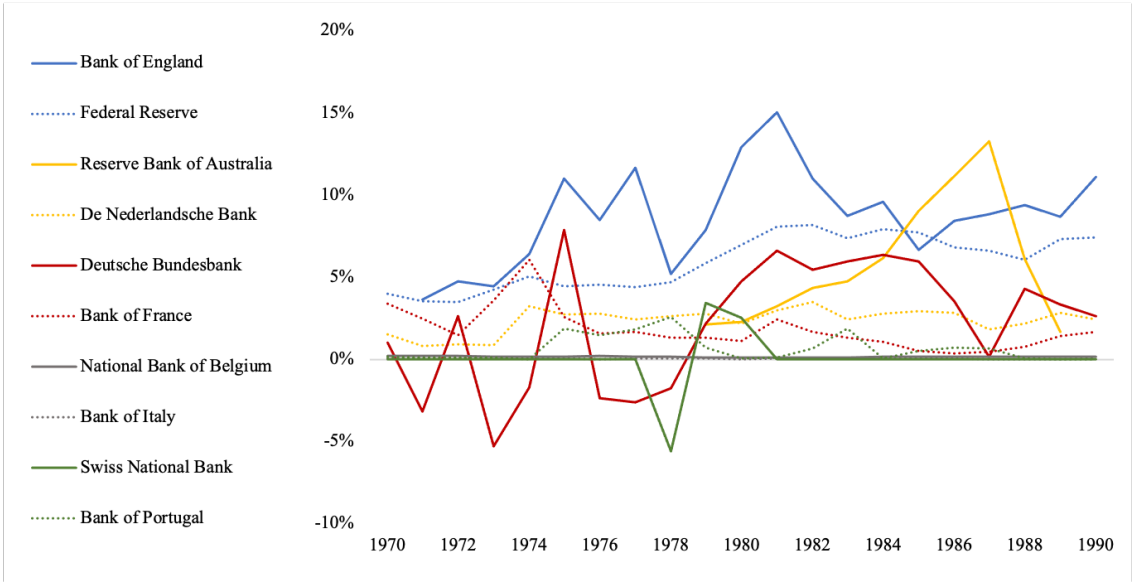
Appendix A. Key financial ratios for central banks

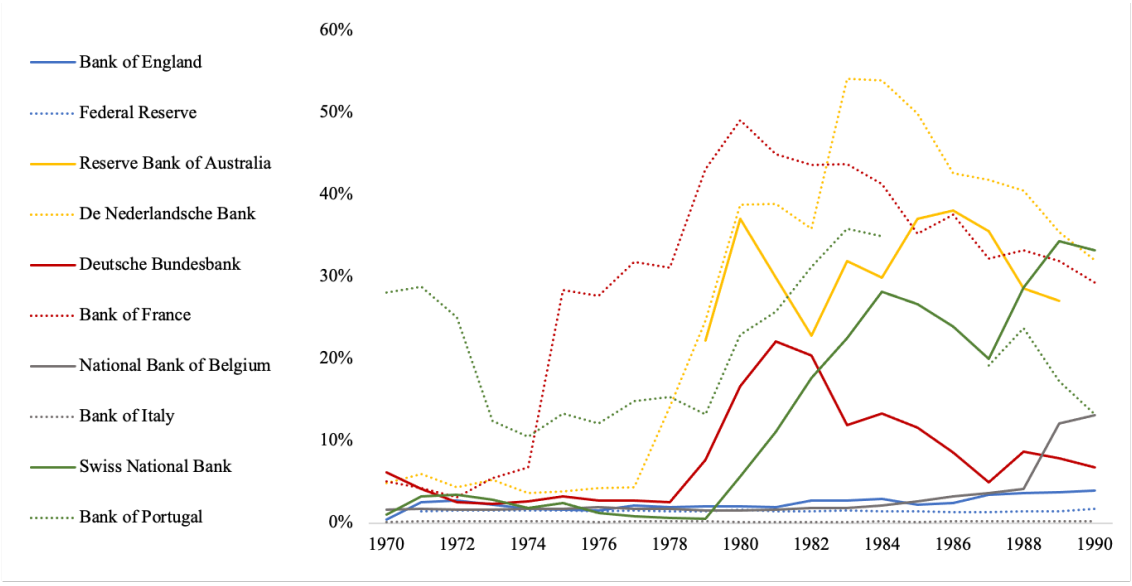
Figures A.1 and A.2 display the ROA and the equity-to-asset ratio for each central bank in the sample. They show that no central bank experienced financial problems in the early 1980s during the disinflation period.

Figure A.1: Country specific evolution of RoA



Source: Annual Reports, authors' calculations

Figure A.2: Country specific evolution of equity to total assets



Source: Annual Reports, authors' calculations

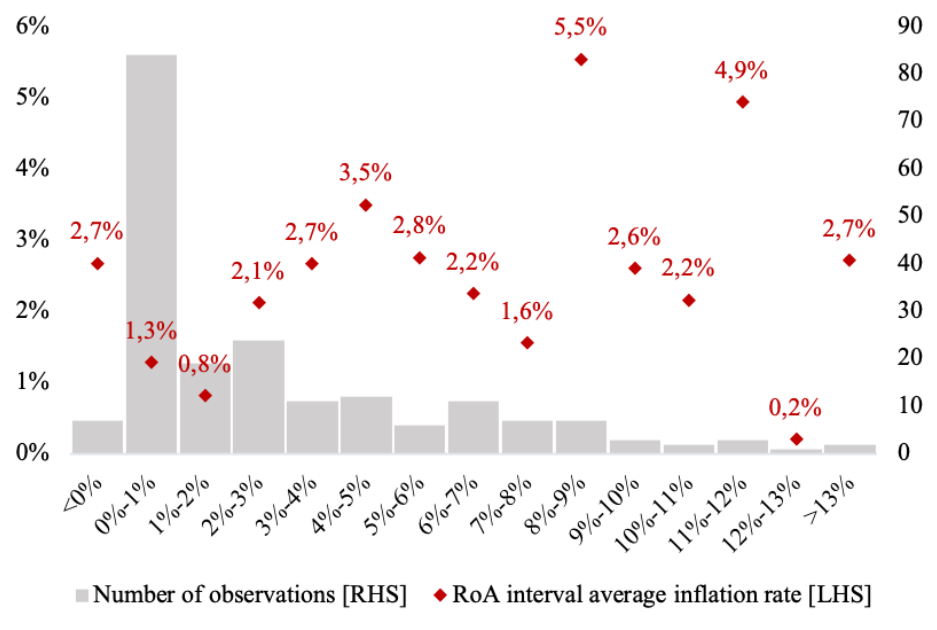
Appendix B. The distribution of central bank returns and the inflation rate

The relation between central bank finances and inflation has received significant attention in the literature, but mostly through the perspective of the potential causes of central bank losses on inflation. It has focused on developing economies during the 1990 and 2000s. This literature however suffers from omitted variable bias (Pinter (2017)) and from endogeneity: higher money creation can lead to both inflation and higher central bank profits in the short-term. Thus no definitive conclusion has been reached. Klüh and Stella (2008) and Perera, Ralston, and Wickramanayake (2013) provided econometric evidence of a relationship between lower central bank financial strength and higher inflation. This result was challenged by Benecka et al. (2012).

Our sample shows no evidence that central bank losses were associated with higher inflation rates. Figure B.1 below shows that a lower ROA is not correlated with higher inflation. Similar results are obtained when using the equity to total assets ratio as an alternative measure of financial strength.

Figure B.1 provides additional information on the distribution of the ROA. Based on our sample of 199 observations, the distribution of ROA interval is concentrated slightly above zero. This finding is in line with the results by Goncharov, Ioannidou, and Schmalz (2021) showing central banks' preferences for small positive profits. 42% of the observations are indeed located into the 0%-1% ROA interval, and 64% in the 0%-3% interval.

Figure B.1: Distribution of ROA and average inflation by ROA interval



Source: World Bank, Annual Reports, Authors' calculations

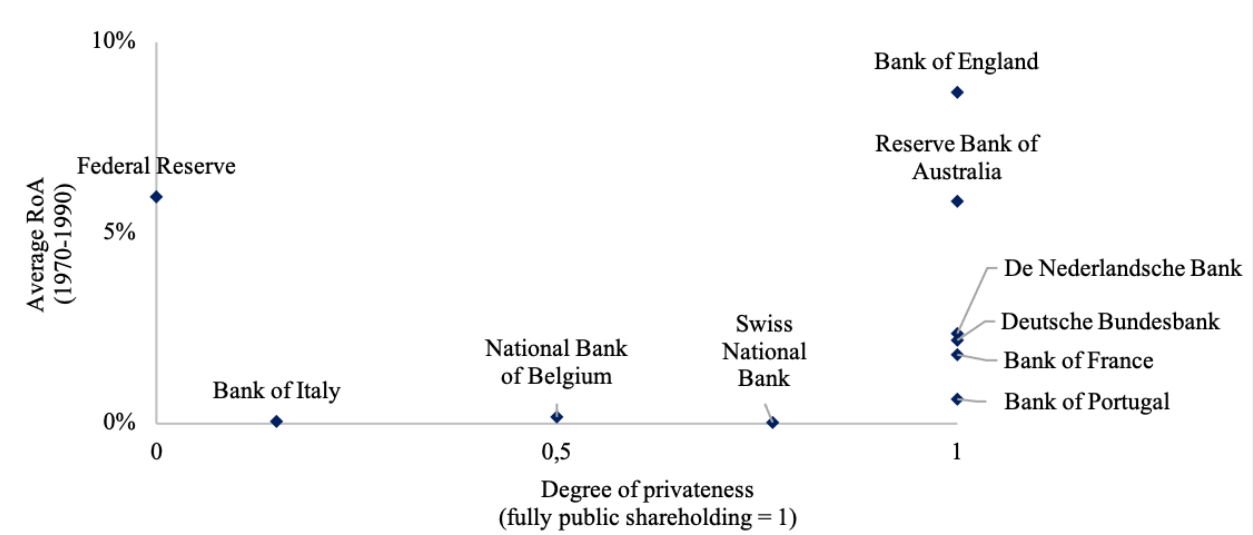
Appendix C. Ownership of central banks and profit

A handful of central banks still have private shareholders, but starting in the 1950s, no central bank in our sample is governed by private shareholders. Shareholders of central banks no longer appoint board members nor control monetary policy. From 1994-2014, Bartels, Eichengreen, and Mauro (2016) found no evidence that central banks with private shareholders publish higher profits or build more reserves.[24]

Figure C.1 shows the absence of a link between return on asset and shareholding structure in our sample. "Hybrid shareholding" means that the capital of the central bank is held by both private and public shareholders (Treasury, national or local institutions, monetary or financial public institutions).

[24]See also Rossouw (2014) for further discussions on private shareholding of central banks, which presents a typology and classification based on the different mechanisms as the voting rights and limitations, trading in shares or dividend payment rules. In 1974, they show that fourteen CBs had private shareholders, seven of which only having private shareholders.

Figure C.1: The absence of relation between ROA and shareholding structure

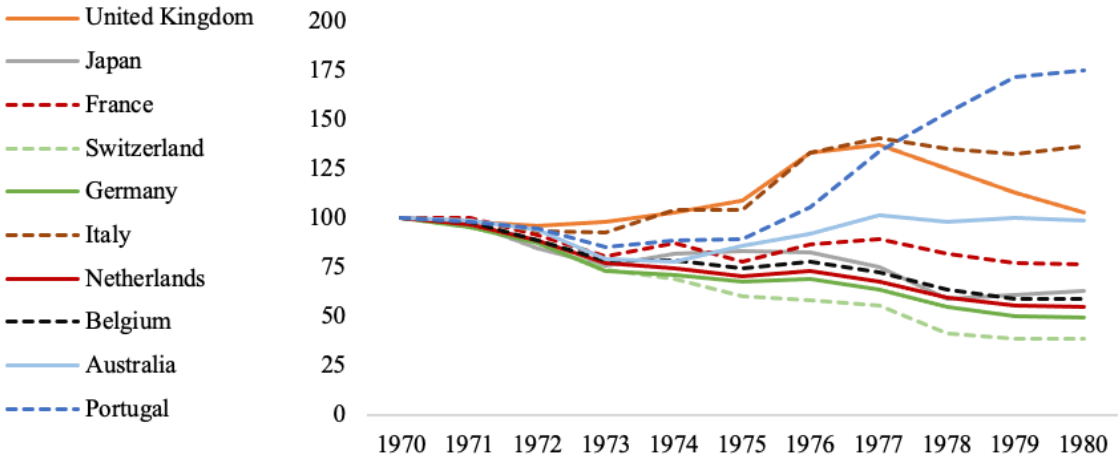


Source: Annual Reports, Authors' calculations

Appendix D. Managing FX losses in the 1970s

This section provides additional information on how foreign exchange losses were managed by three central banks (Germany, France, Switzerland) in the 1970s following the end of the dollar convertibility into gold in August 1971. The two devaluations of the dollar in December 1971 and March 1973 and the subsequent period of the floating US dollar depreciated the value of foreign exchange reserves for non-U.S. central banks (given its use as a reserve currency). Figure D.1 displays the appreciation of the different currencies with respect to the US dollar in our sample throughout the 1970s.

Figure D.1: Evolution of the bilateral exchange rates with the USD, 1970 = 100



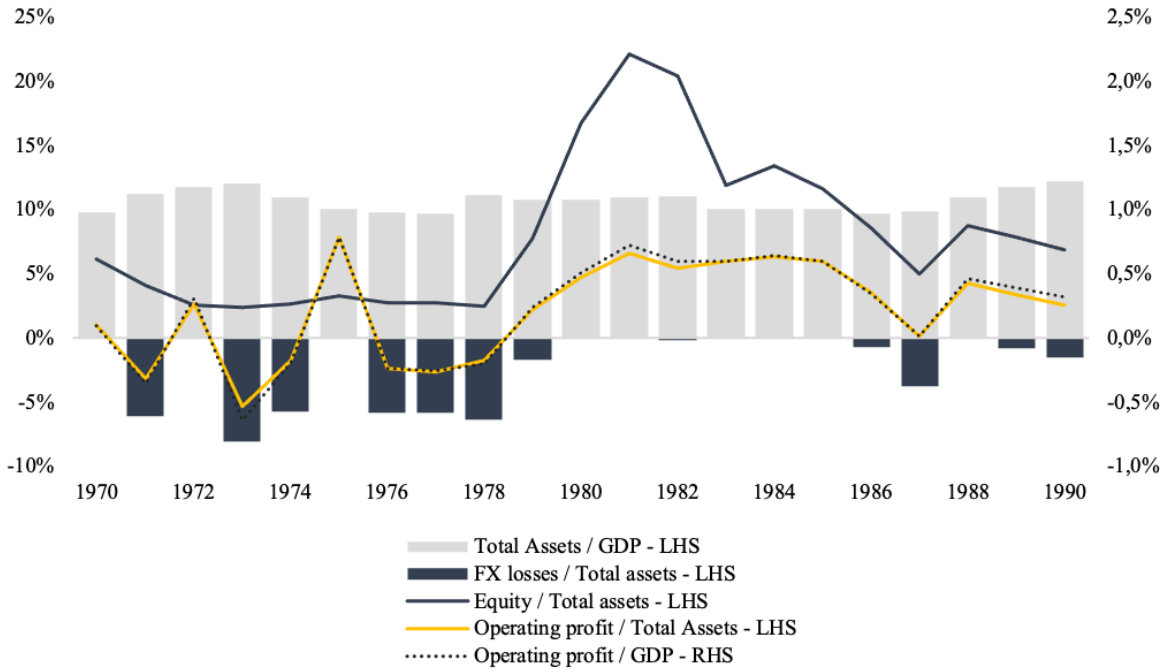
Source: Bank for International Settlements, authors' calculations

Central banks resorted to different accounting or institutional mechanisms to cover FX losses. For instance, the Bundesbank carried forward its negative profits and covered them using future profits. Under a different framework, the Bank of France did not face negative profits as FX losses were borne by France's Exchange Stabilization Fund and were thus directly covered by the Treasury through bond issuance to the Bank of France. These differences in loss management highlight the key importance of the accounting, financial and institutional framework to understand central bank losses (Goncharov et al. (2020)).

D.1 The management of FX losses at the Deutsche Bundesbank

The Bundesbank experienced in the 1970s several years of losses, which at their maximum amounted to 5.3% of total assets (0.6% of the year's GDP). They were almost entirely due to FX losses, which induced negative profits in 1971, 1973-74, 1976-78. These significant FX losses also occurred in 1986-90, though without generating negative profits.

Figure D.2: The Bundesbank's financial indicators



Source: Annual Reports, authors' calculations

The highest losses occurred in 1971 and 1973 and were caused by the two devaluations of the dollar. In 1971, the Bundesbank experienced a loss equal to 3.2% of its assets (DM 5.9bn). The 1971 losses at the Bundesbank were registered as expenses under the account "Compensatory amount required for new valuation of foreign currency assets and liabilities". New valuations followed the decision of the Federal Cabinet on the fixing of the central rates, which implied the revaluation of the FX assets and liabilities. Gold and SDRs were not revalued. [25]

In 1973, the Bundesbank faced the largest loss of the 1970-1990 period, at 5.3% of total assets, originating from the "Depreciation on monetary reserves and other FX positions" due to "the devaluation of the dollar in Feb 1973" (for DM 7.2bn) and "other monetary effects" (for DM 3.1bn). The dollar was left floating and Germany experienced massive capital inflows. This resulted in upward pressure on the DM and the decision to reevaluate twice the DM in the first half of 1973 (to align with the European snake).

The Bank's losses lowered to 1.7% of total assets in 1974, still fueled by the appreciation of the DM versus the dollar. Inflation stood notably lower in Germany than elsewhere.

After only a year of positive profit in 1975, the Bundesbank entered a three-year negative profits period. The effective exchange rate of the dollar was rather stabilized the DM continued to appreciate relative to all currencies, including the dollar. In 1976, losses amounted to 2.4% of assets. 1977 and 1978 generated further losses up to respectively 2.6% and 1.8% of assets.

[25] The valuation of gold in the balance sheets of the different CBs appeared to be subject to fewer valuation changes in the 1970s.

The Bundesbank carried forward its losses from an accounting exercise to another. Despite being quite sizable, the losses did not trigger fiscal support from the Federal government. After exhausting the limited reserve funds, losses were covered entirely with future profits. The Bundesbank thus did not use its capital account, which remained stable over the 1970s. The sum of the capital and reserve accounts (not counting provisions) was far from able to cover a single year of losses.

The absence of concern about the Bundesbank's negative profits in its Annual Reports can be seen as a sign of confidence in the potential fiscal support from the government in the eventuality of larger losses, a sign of accounting transparency and financial caution from the Bundesbank as well as the eventual absence of pressure from the government to appropriate the monetary income.

D.2 The Bank of France and Exchange Stabilization Fund

In France, as in the USA or the UK, foreign reserves were mostly held by a dedicated fund, rather than in the central bank balance sheet, but managed by the staff of the central bank. The central bank could lend to this fund and there was a complex mechanism linking the profit of this fund to the loan from the BoF to the Treasury. The financial management and final bearing of the FX losses at the Bank of France (BoF) thus relates to the management of the Exchange Stabilization Funds (ESF) - the Fonds de stablité des changes (FSC) similar to the Exchange Equalization Funds (EEF) in the UK.

In 1936, the State handed to the BoF the management of the country's ESF Profit and losses of the fund were still supported by the Treasury. The role of the FSC was suspended over 1939-1948, during the Second World War. A first clearing of the losses of the FSC was done in end-1948 to enable the re-introduction of the fund. Under a renewed framework, it was reformed so as to reduce the Treasury's exposure (which still had to make advances from fiscal funds for the operations) and cleared from past losses. It was decided that advances (i.e., loans) to the fund would have to be made by the BoF when the former needed additional ressources. The Treasury would thus only require to cover the end of year accounting position. The role of the FSC was more limited after the suspension of fixed parity after 1971, to the exception of the management of the fluctuation margins of the European "monetary snake".

In 1972, a Law was passed aiming to establish a proper management and covering of the FX losses of the Banque de France by the Treasury. This mechanism was used as soon as 1972 due to the devaluation of the dollar. The law of the 5th of July 1972 codified a previous agreement ("convention") between the Treasury and the BoF, and defined that the Treasury shall cover the overall net loss of the FSC. To do so, the BoF would subscribe to zero-interest rate Treasury bonds with a 15-year maturity and reimbursed over constant annuity. This implied a present value financial loss for the Treasury.

In the same year, the devaluation of the dollar led to a significant net loss of F 1,569m for the FSC. The BoF added zero-interest rate Treasury bonds to its balance sheet, for an amount equal to the net overall loss of the FSC. Note that the consequences of the dollar devaluation on FX reserves in France were much less important than in Germany because France had a weak currency since 1968 and thus a lower amount of reserves. Should these losses have been integrated in the profit and loss account of the BoF, they would

have not generated a negative operating profit, as it stood at circa F 2,035m.

D.3 The Swiss National Bank 1978 FX loss

In 1978, the Swiss National Bank (SNB) experienced a sudden negative profit of CHF 2.6bn, corresponding to 5.6% of total assets, due to the registering of a currency amortization amounting to 9.6% of total assets. The SNB was facing a strong upward pressure on the Swiss Franc against the US dollar and thus had to resort to large monetary intervention to prevent a too strong appreciation of its currency.

The loss on foreign reserves (called "amortization of the currency reserves" by the SNB) in 1978 reached CHF 4.4bn, following a loss of CHF 1.2bn in 1977. They account for the vast majority of expenditures and correspond to the sum of the net loss on FX operations over the exercise and the revaluation differential of the FX reserves under the end-of-year exchange rates. The result of the exercise was thus negative, despite the SNB covering part of the loss by using provisions.

This loss was carried forward over the next two years and cleared using future profits. By law, the SNB was required to pay a constant small positive profit target. This constant profit target aimed to distribute a constant and pre-determined value of the profit to the Federal State Caisse (CHF 5m per year at that time). In accordance with its statute, the SNB transferred a fixed dividend payment to its shareholders and a fixed amount to the Federal State Caisse. Yet, this total amount of CHF 5m represents only 0.01% of total assets. The SNB covered its FX losses through its provision accounts, rather than by developing large reserve funds. This loss was followed by the systematic registering of larger provisions for FX risks and valuation changes in the profit and loss account in order to better anticipate such fluctuations.

Appendix E. Laws on profit distribution and losses management

Central Bank	Laws on profit and losses (1)	Shareholding structure (1)	Profit distribution rule	Loss management mechanism
U.S. Federal Reserve	December 1913 Federal Reserve Act	Private (2)	Net profit to be distributed in the following order: - Private shareholders are entitled to a dividend of 6% of total capital paid-in - Remainder transfered to the U.S. government as a franchise tax (except one-hald of the earnings whihc must be transfered to a surplus fund until this fund amounts to 40% of the paid-in capital stock)	- It cannot be recapititalized by definition and member banks (shareholders) cannot born losses to a level higher than their capital held - Negative profits can carried forward as deferred asstes, and covered using future profits, while withholding transfers to the Treasury until purge of the deferred
Bank of France	December 1945 Law and July 1972 Law	Public	Net profit discretionarily distributed to: - the reserve fund - Provisions and employees funds - Dividend to the State (replacing the dividend to the private shareholders when nationalized)	- The losses of the Exhange Stabilisation Funds are covered by the government (1972 Law) - No special clause on losses management
Bank of England	1946 Bank of England Act	Public	- Payment to H.M. Treasury, twice a year, of a fixed but adjustable dividend - Additional transfer to the governement through taxation of the net profit - The remainder being retained by the Bank	- No special clause on losses management
Deutsche Bundesbank	July 26, 1957 Law concerning the Deutsche Bundesbank	Public	Net profit to be distributed in the following order: - The maximum between 20% of the profit or DM 20 Mns to the legal reserve, which can in return be used to cover losses - Up to 10% of the remaining net profit for other reserves, which total must not exceed original capital - DM 40 Mns (30 Mns after 1980) for the purchasing equalisation claims - The remaining is transfered to the Federation	- The legal reserve can be used to cover losses - No other legal disposition mentioned
Bank of Italy	1893 and 1936 Banking Laws	Private (3)	Net profit to be distributed in the following order: - To ordinary reserves (up to 20%) - To shareholders (up to a max. of 6% of the capital) - To special reserves and provisions (up to 20%) - The remainder being transfered to the Treasury	- The ordinary reserve shall be used to cover losses and No profit transfer shall be implemented until reconsitution of the reserve - No other legal disposition mentioned

Notes:

1. Acting Laws over the period considered (1970-1990)

2. Only the Regional Reserve Banks have a fully private shareholding, while the Federal Reserve Board is a public institution

3. The Bank of Italy's shareholding is composed of tradable shares owned both by public and private entities

Central Bank	Laws on profit and losses (1)	Shareholding structure (1)	Profit distribution rule	Loss management mechanism
De Nederlandsche Bank	1948 Bank Act	Public	Net profit to be distributed in the following order: - A discretionary amount to the special reserve - The remainder being transfered to the governement	N.A.
Swiss National Bank	October 1905 National Bank Act	Moslty public (2)	Net profit to be distributed in the following order: - To reserves (a 10% transfer capped at Fr 1Mn) - A 6% dividend (of capital) to shareholders - The remainder being transfered to the Federal Caisse	- Transfers to the Federal Caisse shall be halted if the benefit does not enablle them, to be reimbursed later by the Bank with interests - The reserve fund shall be used to cover losses, and then be re-filled to reach its maximum of 30% of capital paid-in - No other legal disposition mentioned
Reserve Bank of Australia	August 1945 Law and 1959 Reserve Bank Act	Public	Net profit from the different department of the RBA are transfered to: - Reserve Bank Reserve Fund - The Commonwealth of Australia - Rural Credits Funds	N.A.
National Bank of Belgium	1948 Bank Act	Half public (3)	Net profit to be distributed in the following order: - A first 6% dividend (of capital) to shareholders - A discretionary amount to the reserve fund - A second dividend of minimum 50% of the reserve fund transfer - The remainder being transfered to the governement	- No legal disposition mentioned - The State shall cover the exchange loosses of the Bank (Decree-Law of May 1944 from Aufricht (1967))
Bank of Portugal	1975 Organic Law	Public (start. 1974)	Net profit to be distributed in the following order (since 1974): - 5% for the reserve fund - 10% for the special reserve fund - 10% for the participation of the staff - The remainder being transfered to the governement	- No legal disposition mentioned in the 1975 Organic Law - The 1931 Charter of the BoP states that, if before its established 1991 dissolution date, the BoP faces losses which reduce capital by more than 75%, then the Bank shall be dossolved and liquidated (Aufricht 1967) - But the Charter also states that losses due to FX effects or fiscal acitivites of the CB shall be covered by the State (Aufricht 1967)

Notes:
1. Acting Laws over the period considered (1970-1990)
2. The Swiss National Bank's shares have been listed at the Swiss Exhange since 1907, and are moslty held by public entities
3. The Belge government owns half the Bank's capital and the remaining half is traded