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Understanding Central Bank Profitability[1]

Abstract: Since the increases of policy interest rates in the years 2022-2023, a number of central banks are suffering significant losses from the materialisation of interest rate risk. These losses erode the capital buffers and raise questions about the cost-efficiency of monetary policy. This warrants a closer look at the topic of central bank profitability. What drives central bank profits? What is the problem with central bank losses exactly? And what possibilities do central banks have to influence their profits and manage public perception? In this paper we revisit these questions for central banks in general, with a particular focus on the Eurosystem and De Nederlandsche Bank.

Although central bank losses can be an accepted consequence of necessary monetary policy (risks), they are regrettable as they constitute public money that could have been otherwise used for public purposes such as education and healthcare. But even low (positive) profits are undesirable. In general, central bank profits contribute to maintaining a strong balance sheet and support financial independence from the government. A central bank should preferably generate sufficient income over time to grow its capital in line with

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GDP (Gross Domestic Product). Here, we use the concept of "capital" in a broad sense, i.e. shareholder capital and provisions, acting as risk buffer. This risk buffer should develop in line with GDP as that is roughly proportional to the underlying latent risks of the central bank from the economy and the banking sector.

Central bank profits are mainly driven by the monetary policy interest rates – which have little room for including "efficiency" considerations. However, central banks should understand the outlook of their profits under different (interest rate) scenarios. This is also important for Eurosystem national central banks and the ECB which are exposed to the financial consequences of the ECB's monetary policy decisions via income and cost sharing arrangements. Some of the balance sheet items allow for profitability considerations to be included in their management. The central bank's own investment portfolio is the most prominent example. With the significant losses of a number of central banks, it may be wise to consider profitability more explicitly in the central bank policies. This paper attempts to offer input on that question.

Keywords: capital, capital management, profitability, return-on-equity, central banks, risk management, portfolio management, RAROC

JEL Code: D24, E50, E58, G11, G17, G28, G31, G32, G35

1. Introduction

Central banks are generally profitable but this is often taken for granted. Traditionally, central banks earn a good income from seigniorage, driven by the issuance of banknotes, which they invest in low-risk interest-paying assets (like government bonds). In times when interest rates are well above zero, this provides a significant income with very little risk. Perhaps for this reason, central bankers traditionally worry little about their annual income, and this is often considered a convenient by-product of the monetary policy implementation.

The past 10 years have shown that central bank profitability is not a given. Many central banks have seen annual profits decline as (policy) interest rates have decreased to zero or below. Large quantitative easing programmes (QE) initially supported profitability to some extent but also locked in low yields on the QE holdings for a long period. And over recent years, a number of central banks have suffered significant losses, and expect more in the years to come, following the large increases in policy interest rates. This is driven by the materialisation of interest rate risk, i.e. costs of liabilities (created with the QE purchases) rising above incomes of the respective QE assets. The multibillion losses for a number of central banks have already generated significant public attention (Bell, Chui, Gomes, Moser-Boehm, and Pierres Tejada, 2023; Belhocine, Vir Bhatia, and Frie, 2023; Nordström and Vredin, 2022; and DNB, 2022).

In this paper, the topic of central bank profitability is revisited. What drives central bank profits? What is the problem with central bank losses exactly? And what possibilities do central banks have to influence their profits and manage public perception? The paper offers concepts to understand the profitability of a central bank and influence it in relation to the core task of monetary policy implementation. The insights apply to standalone central banks as well as Eurosystem national central banks (NCBs). The topic of *influencing* central bank profits has received little attention in central banking literature but may become more prominent going forward.

Central bank profitability has been studied in relation to central bank financial strength. Central bank financial strength is the topic of a series of papers initiated by Stella (1997, 2002) with a later overview by Archer and Moser-Boehm (2013). There are also more theoretical studies that attempt to estimate the aggregate value of future seigniorage (Ize, 2005; Buiter, 2008). Early reports on the possibility of central bank losses resulting from interest rate risk are from Carpenter, Ihrig, Klee, Quinn, and Boote (2015) and in DNB's 2015 annual report (DNB, 2015). In recent years, there have been many reports of (expected) central bank losses due to the materialisation of interest rate risk (Bell et al., 2023; Belhocine et al., 2023; Gebauer, Pool, and Schumacher, 2024). The measures discussed are typically corrective (ex post), ranging from maintaining a steady course until profitability returns (ignoring), to capital injections from the government. This study is an amended version of Wessels (2024) and contributes by providing ideas to understand and influence central bank profitability proactively.

2. Why central bank profits matter

Before continuing, it is important to elaborate why the topic is relevant in the first place. It is sometimes argued that central bank profits, and by extension central bank losses and resulting capital positions, are of little relevance – usually to calm down public concerns (Carstens, 2023). However, although central bank losses can be an accepted consequence of necessary monetary policy (risks), they are regrettable as they constitute public money that could have been otherwise used in the government budgets for public purposes such as education and healthcare.

Also, over the years consensus has emerged that financial strength supports the central bank's effectiveness in the execution of its policy mandate (Stella, 1997,

2002; Archer and Moser-Boehm, 2013). Here financial strength means a sound balance sheet with sufficient capital (shareholder equity and provisions) (see also ECB, 2025c). The capital base is the primary buffer against the central bank's financial risks. Like commercial banks, central banks are exposed to financial risks such as credit risk and market risk from their exposures to their commercial bank counterparties (monetary credit), asset holdings (quantitative easing, QE) and gold. Unlike commercial banks, central banks cannot go bankrupt as a result of low capital levels. For central banks, capital is auxiliary – in addition to the appropriate legal and institutional arrangements – in maintaining credibility to the financial markets and independence from the government. See Wessels and Broeders (2022a, 2022b and 2023) for further background, and Broeders, Bonetti, and Houben (editors, 2025) for a recent overview of work on central bank capital.

For a central bank, the annual profit is usually the main source of capital growth. In order to keep capital on appropriate levels, it has to grow over time in line with financial risks. For central banks, financial risks consist of both calculable risks and the non-calculable, latent risks. These 'latent risks' are financial risks due to *contingent* policy measures which the central bank may have to deploy on the basis of its mandate, but which are unknown as yet. Examples of such contingent policy measures are a future QE programme or a future lender of last resort programme (LOLR) for a commercial bank. These latent risks develop roughly in line with macroeconomic variables, such as GDP, over a longer period of time (Wessels and Broeders, 2022a, 2022b, 2023).

In order to allow capital to grow over time in line with GDP, the central bank profits have to be high enough. In years with positive results, part of the annual profits can be retained to ensure capital growth in line with GDP, while the rest can be paid as dividend to the shareholder. As capital only has an auxiliary role in supporting effectiveness, temporary capital levels below the target level are not problematic. Following years of losses and capital erosion, the capital should be able to grow back to the target level. As it is important to remain financially independent from the government, this should preferably be achieved from the central bank's own profits, by retaining what is necessary. An important prerequisite is that the central bank has the autonomy to decide how to use its profits, not being restricted by the government as shareholder demanding dividend. Also, capital injections from the government are in principle undesirable as they could raise questions about the standalone effectiveness of the central bank.

Apart from the relevance of profits for capital, a central bank is generally also concerned about public perception as a matter of credibility. Central bank policy measures contribute to economic growth and financial stability, and these impacts outweigh the costs or losses incurred by the central bank. Specifically, the recent Eurosystem QE programmes have contributed to lower borrowing costs for the governments (Eser, Lemke, Nyholm, Radde, and Vladu, 2019; and DNB, 2022a) that should more than make up for the costs and losses (those incurred and those still to come). Still, years with central bank losses may attract bad publicity with the suspicion of inefficient management or even carelessness. And this may also lead to scrutiny towards the central bank (policy) measures that caused the losses, thereby eroding its credibility. In a recent study, Goncharov, Ioannidou, and Schmalz (2023) show that central banks are concerned with public perception of reporting annual profits (or losses).

Conversely, good profitability has the additional benefit that it contributes to a positive perception of the central bank among the general public. Unlike most government authorities, central banks earn their own money from the services they provide to the economy and the financial sector, contributing positively to the public finances (usually). Regrettably, this usually goes unnoticed by the general public.

Generally, central bank objectives do not include profitability. A central bank that would have prominent profitability objectives may be tempted to focus on profits at the expense of price stability or financial stability. Therefore, central bank profits should only be taken into consideration insofar as the policy mandate allows (not interfering with the policy objectives), and to the extent that they contribute to a (rather modest) medium-term growth of capital in line with GDP.

3. What are central bank profits

It may seem like a trivial issue, but in the case of central banks, there are various perspectives on what constitutes the annual profit. Here we discuss three perspectives. The first and most straightforward simply takes the annual result from the income statement (P&L) as reported in the annual report.

The second perspective is a broader definition of the annual profit and includes the change in the General Risk Provision (GRP) in a given year. Many central banks (e.g. those in the Eurosystem) have the possibility to build a GRP that is under the full control of the central bank. As long as such a GRP can absorb a

broad range of expected and unexpected losses, it serves as de facto capital. Such a GRP is an accounting construct that is generally not available to commercial banks. Additions to and withdrawals from the GRP are made before establishing the annual profit and are decided by the central bank. The annual profit itself is under the control of the shareholder, typically the government, who decides what part the central bank can retain (adding to shareholder equity) and what part is distributed as dividend. Therefore, the use of a GRP increases financial independence from the government.

The third perspective includes the changes in the so-called revaluation reserves (RRs), in addition to the changes in the GRP. These RRs are accounts which keep track of valuation gains linked to a specific instrument (like a government bond or FX instrument) or certain holdings (e.g. gold). When the price of gold goes up, the unrealised valuation gains are added to the gold RR. When the gold price goes down, the valuation losses are taken from the RR. When the RR is completely depleted, any additional valuation losses are taken to the income statement, i.e. they are subtracted from annual profit. This reflects an asymmetry, induced by prudency considerations, whereby aggregate net valuation gains from price increases (of gold and relevant instruments) are retained in these RR accounts (as equity) in the balance sheet, while net valuation losses are taken directly in the P&L.

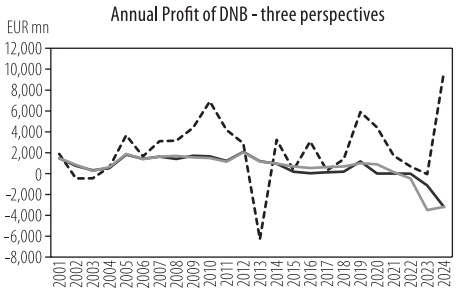
Due to many years of historical gold price increases, the RRs for gold in the Eurosystem are exceptionally large. In principle, these RRs are bits of shareholder equity which sit elsewhere on the balance sheet. As a result, changes in these RRs are (valuation) profits or losses not included in the official income statement. Only when the asset is sold or matures (for a bond instrument) the corresponding RR is released and taken to the P&L account where it ends up in the annual profit.

In figure 1, the annual profit of DNB is shown according to these three perspectives (DNB, 2001-2024):

1. Annual profit, as reported in the annual report (full black line), henceforth referred to as "annual report annual profit" or ARAP;
2. Annual profit PLUS changes in the GRP (full grey line), referred to as "provision-adjusted annual profit" or PAAP;
3. Annual profit PLUS changes in the GRP PLUS changes in the RRs (dashed black line), from hereon the "fully included annual profit" or FIAP.

Of these three profit metrics, the PAAP is the most relevant one for the central bank in understanding and influencing profitability. At the end of the financial year, the PAAP is the result of the central bank's policy decisions and other operations over the year. At that point, the central bank decides what part of the PAAP will be allocated to the GRP, or alternatively, what part of the GRP will be taken to the PAAP. The result of this is the ARAP. The FIAP includes the unrealised (valuation) gains and losses of gold and other assets. And although FIAP comes closest to the aggregate annual *economic profit*, it contains large valuation adjustments driven by price changes, which are beyond the control of the central bank.

Figure 1: ARAP (full black), PAAP (full grey) and FIAP (dashed black) for De Nederlandsche Bank (DNB) since 2001*



* Data taken from DNB annual reports (2001-2024). It can be seen that between 2015 and 2020 DNB has built up a GRP (grey line above the full black line) which was used to absorb losses in 2023 (grey line below the full black line). The dashed black line fluctuates more than the other two due to the gold price fluctuations.

The PAAP and the ARAP of DNB are quite closely aligned in most years. In the years 2015-2020 there was a gradual build-up of the GRP (ARAP below PAAP), with a large extraction from the GRP in 2023 due to the materialisation of interest rate risk (PAAP below ARAP). The FIAP of DNB over the last 24 years is more erratic than the other two. This is related to the sizes of the underlying equity items: at the end of 2024, the shareholder equity ("capital and reserves") of DNB stood at EUR 7.3 bn, the GRP ("provisions") at EUR 0.0 bn (approximately depleted), whereas the aggregate RRs ("revaluations accounts") amounted to EUR 49.3 bn.

If the use of RRs would not be allowed for central banks, these changes in gold prices (and other assets) would be incorporated directly into the PAAP (and possibly ARAP) increasing its volatility significantly. In years of high positive PAAPs, this could beg the question whether these unrealised (valuation) gains should be distributed to the government as dividend. In other years, large negative PAAPs could trigger a discussion about recapitalisation of the central bank by the government. In a way, the use of RRs prevents these debates by smoothening the PAAP and ARAP profiles over time.

4. Defining the ideal level of central bank profitability

The primary concern of a central bank relates to price stability and financial stability, and the central bank balance sheet is used primarily for this purpose. But even though the central bank profit is not the main focus of the central bank, it is useful to consider at what level it should ideally be, i.e. in order to maintain the financial strength to remain credible and independent from the government. A way to measure profitability is with the Return-on-Equity (RoE) metric, generically defined as follows:

$$RoE = \frac{net\ income}{capital} \tag{1}$$

Here, the net income is the bank's annual profit, after costs and losses. Depending on the perspective, this can be ARAP, PAAP or FIAP. The capital figure is the risk buffer corresponding to the relevant profit metric. For ARAP, the capital should be shareholder equity. For PAAP, the corresponding risk buffer is shareholder equity + GRP. For FIAP, the capital figure should be shareholder equity + GRP + revaluation reserves,

$$\begin{aligned} RoE\ (ARAP) &= \frac{ARAP}{Shareholder\ equity} \\ RoE\ (PAAP) &= \frac{PAAP}{Shareholder\ equity + GRP} \\ RoE\ (FIAP) &= \frac{FIAP}{Shareholder\ equity + GRP + RRs} \end{aligned} \tag{2}$$

For the remainder of this section, we focus on PAAP as the most relevant metric (see previous section). Assuming central bank capital is on an acceptable level, an appropriate target for the central bank RoE (PAAP) would be preferably higher than the average GDP growth over the medium term of 5-10 years:

$$Central\ bank\ RoE\ (PAAP)\ target > Average\ GDP\ growth \tag{3}$$

The reason is that central bank capital should grow over the years in line with average GDP. In a previous study (Wessels and Broeders, 2022a), we argued that capital needs to keep pace with the growth of the calculable and latent risks on the central bank balance sheet. This capital growth should preferably come from the central bank's own profits because capital injections from the government may affect its independence.

Here, an important assumption is that the central bank has the autonomy to decide what profits can be retained. Typically, this is the case for PAAP, i.e. additions to the GRP (taken from PAAP) or extractions from the GRP (added to PAAP) are under control of the central bank. This is usually not the case for ARAP where it is decided by the shareholder (usually the government) which part is paid out as dividend, and which part may be added to the shareholder equity. Still, some central banks are able to agree with the shareholder upfront which part of ARAP can be retained, and which part should be distributed as dividend.

As an example, if a country has an average (nominal) GDP growth of 3% over the last 10 years, the central bank would prefer a RoE at least that high. In case of an average, realised RoE (PAAP) of 4%, the central bank could retain 75% of the profits to ensure sufficient capital growth (shareholder equity and/or GRP). The other 1% (i.e. 25% of 4%) could be paid out as dividend to the government as shareholder. This contributes to a positive perception of the central bank by the public.

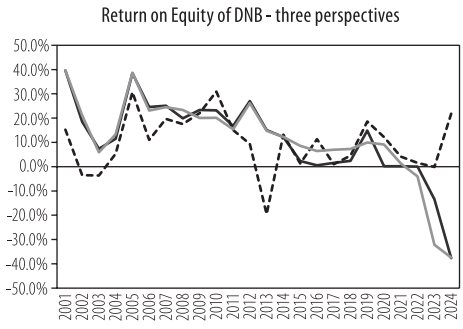
Also from an economic perspective, such a (minimum) RoE target would make sense, as central banks provide banking services to commercial banks that represent a certain value. Similar to what commercial banks do for their clients, central banks use their balance sheets to perform a number of economic functions such as credit, maturity and size transformation. In its capacity as 'bank for commercial banks', a central bank is exposed to many of the typical financial risks that commercial banks also face. Both have capital as a loss-absorbing buffer and both are leveraged. As these services represent value, it could be argued that the central bank should provide these services at fair prices to the main users – including an appropriate profit margin. Here, 'fair' means that these prices should be consistent with the prices the commercial banks would have had to pay to other service providers had these services not been provided by the central bank.

At the upper end, there is no necessary limit for the central bank RoE target. Years of large RoEs may be needed to compensate for years with low RoEs or even losses. However, one could argue that it would not be desirable to have central bank RoEs which structurally (over the medium term) exceed the RoEs of commercial banks significantly. As the central bank has a public task and its profits are paid (in part) from its services to commercial banks, a modest RoE target would seem appropriate. Therefore, a soft upper limit to the central bank RoE target could be around the lower end of the commercial bank RoE targets, e.g. 7-10% (Daniels, and Kamalodin, 2016; Freriks, Kakes, and Loman, 2021).

As a side note, the RoE (PAAP) can also be high when the central bank is highly leveraged. In such a situation, the amount of capital (as risk buffer) is low compared to the rest of the balance sheet (and the financial risks it represents). This could result in profits which are relatively high (on average) and volatile (over the years) compared to the capital figure. In that case, a higher capital figure could be justifiable to cover for the financial risks according to the appropriate confidence level (see Wessels and Broeders, 2022a).

It is also important to note that any RoE target for a central bank should have a medium-term horizon (e.g. 5–10 years). Profitability is not under control of the central bank and depends on the times and economic conditions. For central banks, there may be years when additional policy measures must be taken without additional profits (i.e. with low realised RoEs). In years of low inflation, for instance, QE measures can be deployed with the aim to reduce term spreads, at the cost of low (or even negative) profit margins. But in other years, higher profits can be possible (with higher RoEs) averaging into acceptable medium-term RoE realisations.

Figure 2: RoE of DNB since 2001 for ARAP (full black), PAAP (grey) and FIAP (dashed black)*



* Data taken from DNB annual reports (2001-2024)

In order to assess what RoEs are realistic, the case of DNB is analysed (DNB, 2001-2024). Figure 2 and table 1 show the realised RoEs of DNB according to the three perspectives described earlier. Table 1 shows both the full period (2001-2024) as well as three sub-periods, before QE (2001-2013), during QE (2014-2021) and after QE (2022-2024).

Table 1: Averages and standard deviation of the three RoEs of DNB since 2001*

RoE	ARAP (full black)		PAAP (grey)		FIAP (dashed black)	
	Average	Stdev	Average	Stdev	Average	Stdev
2001-2013	22.3%	9.0%	22.0%	9.0%	11.6%	13.7%
2014-2021	4.3%	5.4%	7.7%	3.0%	8.3%	6.0%
2022-2024	-17.0%	15.6%	-24.6%	14.7%	7.8%	10.0%
2001-2024	11.4%	16.3%	11.4%	17.3%	10.0%	11.4%

* Data taken from DNB annual reports (2001-2024)

The DNB RoEs over the full period 2001-2024 are quite good: averages are in all three cases (ARAP, PAAP and FIAP) above 10% although standard deviations are high. Regarding ARAP and PAAP, the years 2014-2021 are worse than those between 2001-2013 due to the low interest rates and large QE programmes. The recent years 2022-2024 are really bad due to the losses from the materialisation of interest rate risk. It can also be observed that FIAP is less sensitive over these QE periods. Although FIAP averages decrease over the three periods, this is less pronounced due to the dampening effect of gold price movements.

For the periods 2001-2013 and 2014-2022 the average DNB RoEs have been above average Dutch GDP growth (combined average 3.1% per year), but not for the last three years (average GDP growth of 8.3% per year), (CBS, 2025). For the coming years, the DNB RoEs for ARAP and PAAP will probably continue to be negative, due to the materialisation of interest rate risk (DNB, 2024). Perhaps the RoEs will settle on structurally lower levels, underlining the case for understanding and influencing central bank profitability (to the extent possible).

5. Understanding the drivers of central bank profitability

In the following sections, we will take a deeper look at the drivers of profitability and what a central bank can do. A central bank earns its profits from the differential between the returns on assets and the costs of liabilities, much like a commercial bank. When the returns exceed the costs, the central bank generates profit.

On a high level of abstraction, central bank assets are typically (A1) connected to the (policy) interest rates (e.g. monetary credit to commercial banks and the monetary bond portfolio), or (A2) not directly related to the domestic interest rates (e.g. gold and FX instruments). On the liability side, central banks have (L1) items which pay interest (e.g. deposits from commercial banks), and (L2) items without (explicit) funding costs (e.g. banknotes, RRs and capital) – see figure 3.

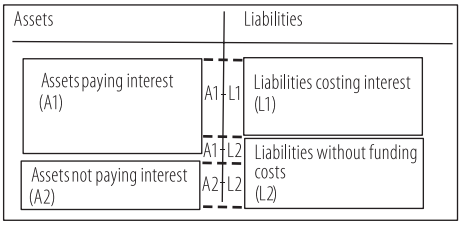
There are two observations that often hold and can be used to understand the drivers of profitability:

a) Gold (in A2) as asset is funded (largely) by RRs (in L2), and
b) Banknotes (in L2) are (significantly) larger than the rest of the (non-gold) A2 assets (i.e. FX etc. *without the gold*).

If this is the case, then L2 is larger than A2, and we can think of A2 being completely funded by L2. Following this line of reasoning, we can think of A1 being funded by L1 and (the remainder of) L2. Then it can be concluded that there are three main drivers of the central bank economic annual result (the FIAP):

1. The differential between (policy) interest rates on asset side and liability side (A1-L1),
2. The level of (policy) asset interest rates (vis-à-vis the zero-cost liabilities such as Banknotes, A1-L2), and
3. The absolute returns on Gold, FX instruments and possibly other instruments not linked to interest rates (A2-L2).

Figure 3: High-level split of the central bank balance sheet according to remuneration*



* As L2 is (usually) larger than A2, the central bank profitability can be split in the following three drivers: (1) A1-L1, (2) A1-L2 and (3) A2-L2.

For the PAAP (and ARAP), the first two drivers are typically the most relevant. The results from the third driver typically lead to changes to the RRs and the FIAP, e.g. appreciation of the gold price leads to a higher gold RR.

It is important for a central bank to understand the drivers of its profitability. In that respect, an Asset and Liability Management (ALM) model that captures the essential balance sheet dynamics is very useful. Such an ALM model can be used to project the balance sheet items and profitability into the future under different scenarios (Bakker, van der Hoorn, and Zwikker, 2011). Using a baseline future scenario (e.g. with neutral outlook, in line with market expectations of interest rates and economic indicators), the ALM model can produce an understanding of how the profitability develops under neutral circumstances. Changes to the baseline allow for testing the sensitivity of parameters and understanding of stressed scenarios and risks[2]. The ALM model can also be used to show the future impact of (possible) monetary policy decisions, e.g. a new QE programme, or a fast rise in policy interest rates (materialisation of interest rate risk).

[2] See e.g. Broeders, Loman, and van Toor (2019) for ways to design such scenarios.

A good understanding of the profitability drivers and the sensitivity allow for timely consideration of mitigating measures when profits decline and could become negative. In some cases there may be room to (slightly) improve profitability of some of the balance sheet items (see also next section). Also, the central bank can consider communicating about the risk of declining profitability to the public. DNB uses its ALM model to communicate profitability expectations to the government and public on (at least) an annual basis (Rijksoverheid, 2024). In a 2022 letter, after the start of the ECB hiking cycle, DNB informed the Minister of Finance of approximately EUR 9 bn in losses over the years to come, due to the (expected) materialisation of interest rate risk (DNB, 2022a). Pro-active communication raises awareness with external stakeholders and reduces the likelihood of public discontent when losses materialise.

6. Can central bank profits be influenced

As a policy-setting institution with a mandatory client base, a central bank can dictate the terms of its operations (including the profit margins) to the commercial banks in its jurisdiction. However, the primary mandate of a central bank relates to price stability and financial stability, and the central bank balance sheet should be used primarily for this purpose. Still there may be some room to include efficiency considerations in specific central bank activities at a lower priority. In this section we take stock of what balance sheet items can be influenced for the purpose of improving profitability.

To understand what can be done in respect of profitability we need to look at the purpose of each balance sheet item and whether there is room to include "efficiency" or "profitability" considerations. Roughly, we can distinguish between three categories:

1. Items that are not under control of the central bank, e.g. banknotes and revaluation reserves. For these items there is no room for steering.
2. Items that are used primarily for (monetary) policy implementation (the primary mandate), e.g. monetary credit, monetary bond portfolio. Here there is typically little room to include efficiency considerations, although risk management measures are usually deployed (e.g. good-quality collateral, minimum credit ratings).
3. Items that are not primarily used for (monetary) policy implementation, e.g. own investments, the FX portfolio and gold. Here there may be more room to include profitability considerations, often at the cost of taking more (financial) risk.

It should be emphasized that all three categories can (and usually do) contribute significantly to the central bank profit. The difference between the categories relates to the extent to which the central bank can include efficiency considerations in the management of the balance sheet items.

The category 1 balance sheet items are not under control of the central bank. For instance, banknotes are not remunerated and the value of banknotes in circulation is generally driven by public demand and cannot be steered by the central bank. Traditionally, seigniorage refers to the income from the issuance of banknotes and this has contributed well to central bank profits in the past. However, there is no guarantee that it will remain so. For instance, with the ongoing digitisation of payments, the use of banknotes may decline in the future – and the central bank profits along with it (although central-bank digital currencies could become a new source of profit). Similarly, revaluation reserves provide zero-cost funding for specific assets, but are also driven by the gains and losses of those specific assets. The only thing the central bank can do is analyse the contribution of these category 1 items to the profitability under various ALM scenarios going forward.

In category 2, items that are used primarily for (monetary) policy objectives, there is typically little room to include efficiency considerations. For example, for central banks, the key policy interest rates are driven by inflation and external (economic) conditions, and this will leave little room for other considerations. The same holds for the yields of asset purchases under a QE programme (which are likely in the neighbourhood of the policy rates). However, there may be certain parameters, possibly marginal from a monetary viewpoint, that can be used to some extent.

For example, the remuneration of minimum reserves (required deposits of commercial banks at the central bank) seems less prominent as a policy parameter. In fact, the Eurosystem has set the remuneration of these minimum required reserves to zero in 2023 (down from 4.5%, in one step) to "improve the efficiency of monetary policy by reducing the overall amount of interest that needs to be paid on reserves in order to implement the appropriate stance" (ECB, 2023). The impact of this adjustment is an increase in DNB's annual profits of approximately EUR 0.43 bn (based on a DNB share of 5.8% in the EUR 165 bn Eurosystem-wide amount at that time). This is a sizable amount compared to the historical profits of DNB (see figure 1). Other authors have suggested to significantly increase the sizes of bank's minimum reserves while keeping the zero remuneration to save taxpayer's money, e.g. Kwapil (2023).

Another example is the (upward) recalibration of the lending rates of the targeted long-term refinancing operations (TLTROs – monetary term credit) of the Eurosystem in November 2022 (ECB, 2022). This recalibration was necessary to improve the transmission of the increased policy rates to bank lending rates, but also helped to improve Eurosystem profitability. In fact, in a recent publication (ECB, 2025e), ECB staff argued what could be interpreted as a 'principle of profit efficiency': "Where two alternative instrument designs are judged to deliver the same effectiveness in terms of price stability, the preferred design should be the one that is more efficient including along the (projected) central bank income dimension." It is also suggested that "caution could be exercised in purchases of bonds whose yield is lower than the DFR owing to potential upfront losses and the fact that the potential for further yield compression is lower than when bond yields are high to start with."

These examples illustrate that the category 2 balance sheet items (although primarily used for policy implementation) may have some room to include efficiency considerations within the limits of the monetary stance.

Category 3 balance sheet items are not used in the day-to-day (monetary) policy implementation. Traditionally, central banks have significant amounts of excess funding (i.e. due to the banknotes in circulation) not needed for the implementation of monetary policy. Therefore, this excess funding can be used for "non-monetary assets". The central bank may have multiple objectives for these non-monetary assets which can include profitability. However, it should be noted that there is usually a risk-return trade-off, i.e. efforts to increase profitability typically imply taking more financial risk. Examples (not limitative) in category 3 are:

A. **Gold**. Gold is typically held by central banks as an anchor for extreme scenarios when trust in the currency is at risk. It is assumed to retain (or even increase) its value when many other assets decline. Appreciation of gold prices can contribute significantly to profitability (the FIAP). However, it may be unpractical for the central bank to include profitability considerations in managing the gold reserve as it is a risky asset class (from an investment point of view) and usually not actively managed (i.e. kept at strategic levels with little buying and selling).
B. **FX instruments**. FX instruments can be held for similar purposes as gold, i.e. protecting the currency, as they are assumed to retain real values in extreme (domestic) scenarios. A central bank can also hold FX instruments to provide liquidity support to the domestic banking sector in times of crises. Some central banks hold FX instruments as investments contributing to profitability.

C. **Own investments.** Many central banks hold investment portfolios with the specific objective of providing additional income for the central bank (supporting profitability, see e.g. ECB, 2025f). National central banks in the Eurosystem and the ECB have such investment portfolios which may also support other objectives such as (a) knowledge and monitoring (of financial markets and types of assets), (b) strategic operational relations (with market participants, which are useful in times of crisis, or when a new QE programme is set up) and (c) sustainability (e.g. contributing to climate goals). Increasing the (expected) profitability of the investment portfolio likely involves increasing the size and/ or taking more financial risks – a topic to which we will return in the next section.

D. **Non-monetary deposits**. On the liability side there may be room for profitability considerations as well. Many central banks have deposits from non-monetary institutions such as (national or regional) public institutions or foreign central banks. Remuneration of these non-monetary deposits could be different from monetary deposits. These non-monetary deposits support the (international) role and use of the currency, but can also contribute to the profitability of the central bank (when remuneration is below that of the monetary deposits), see e.g. ECB (2019).

Categorizing the balance sheet items into these three categories may not be unambiguous as it depends on the views of the central bank. For instance, the FX portfolio is placed in category 3 (not used for monetary policy implementation). However, some central banks may decide that FX instruments belong in category 2 as monetary policy instruments (and part of the primary mandate) or gold could be placed in category 1 (not under control of the central bank) as it is at strategic, long-term levels and should not be managed actively. The key message here is that for all balance sheet items the central bank could assess what are the main purposes and whether there is (some) room to include profitability as an additional (lower priority) objective.

7. Own investments of the central bank

If a central bank has an investment portfolio, this is where profitability considerations can have a prominent role. We use this section to elaborate on how profitability of the investment portfolio can be managed.

A central bank's investment portfolio has similarities with the portfolios of commercial banks which are managed by balancing (financial) risks and returns. Commercial banks often work with an "economic capital allocation" based on

the financial risks, and the Risk-adjusted Return on Capital (RAROC) metric (see Hull, 2018). The RAROC of *a specific portfolio* is calculated as the annual profit of that portfolio (income minus costs, minus losses) divided by the economic capital allocated to that portfolio ("capital allocation"). More risky investments (e.g. equities) obtain a higher capital allocation (but generally also have higher returns), while an investment with lower risk (e.g. a domestic government bond with short maturity) receives a lower capital allocation (and has a correspondingly lower return). Using an RAROC target, a commercial bank attempts to steer profitability of the various portfolios and activities to the desired level. If all portfolios and activities contribute in line with their RAROC targets, the overall bank-wide RoE target is also met.

A similar approach can be used for the investment portfolio of a central bank. We start by using the following portfolio identity:

$$I = C_I + D_I \tag{4}$$

whereby I is the size of the investment portfolio, C_I is the capital allocated to the investment portfolio (i.e. the economic capital allocation, funding a small part of the investments), and D_I is the amount of deposits (needed for funding the remainder, $I\text{-}C_I$, of the investments). This formula simply states that all money invested must be funded.

Formula (4) uses two assumptions: (1) All assets represent a certain amount of financial risk which must be covered by a part of the overall capital. Here, C_I is the part of the total capital C (being shareholder equity and GRP) that is allocated to the investment portfolio. As capital sits on the liability side, this allocated capital C_I then also serves as part of the funding of the investment portfolio. The size of economic capital C_I should be based on an objective calculation of risks (e.g. via a Value-at-Risk model or an Expected-Shortfall model) according to the relevant confidence level – see Wessels and Broeders (2022a).

The second assumption (2) is that the remainder of funding of the investment portfolio, i.e. $I\text{-}C_I$, is supplied by the commercial bank deposits, D_I. In essence, formula (4) defines the size of D_I as "marginal funding liability". The reason that commercial bank deposits (also: "monetary deposits") take this role as marginal funding liability is that these monetary deposits act as the "liquidity" for commercial banks. This liquidity is completely under control of the central bank, i.e. the central bank can decide when and how much is created (or erased). In the same way that these monetary deposits act as the *means of payment* or *currency* between commercial banks (for the transactions between them), they are also

involved in any balance sheet adjustment of the central bank. For example, if the central bank buys a security for the investment portfolio (from a commercial bank), it will create a commercial bank deposit (i.e. liquidity) on the liability side. If an investment is sold, a corresponding deposit (i.e. liquidity) is erased on the liability side.

Typically, central banks have significant room to increase or decrease these deposits (i.e. liquidity) within the monetary policy stance (see e.g. Bindseil, 2014). Within the Eurosystem; the NCB's investment portfolios are part of the so-called "net financial assets" limited in size by the ANFA agreement. The ECB website offers an explanation of how this room is limited in such a way that it does not interfere with monetary policy (ECB, 2025a).

As a next step, we observe that income and costs of the investment portfolio must be balanced:

$$r_I I = R_I\, C_I + r_D\, D_I + O_I \tag{5}$$

Formula (5) describes the percentage income r_I times the size I of the investment portfolio in terms of the return R_I on the allocated capital C_I, plus the costs of the allocated amount of deposits D_I from commercial banks at the central bank (costing the deposit rate r_D), and the allocated operational costs O_I. The costs O_I. are the direct costs of the investment operations plus the central bank overhead allocated to the investment portfolio.

Formula (5) is also an identity, as all income received must be conserved. Here the return on economic capital R_I is the residual quantity which is defined by formula (5). Rewriting (5) yields the well-known formula for the RAROC, if we assume that OI also includes any (expected) losses (see Hull, 2018):

$$R_I = \frac{r_I I - r_D D_I - O_I}{C_I} \tag{6}$$

Henceforth we will refer to R_I as the RAROC of the investment portfolio.

As the deposits from commercial banks are the "marginal funding liability", the deposit rate r_D acts as the central bank's "marginal funding rate". The marginal funding rate is the rate that the central bank must pay for additional funding when it obtains additional assets (increasing the length of its balance sheet). Vice versa, it is the funding rate it saves when it disposes assets (decreasing the balance sheet).

Formula (5) can be used to set profitability targets for the investment portfolio. For instance, if the central bank decides to set a RAROC target R_I^* for the economic capital allocation of the investment portfolio, this implies the following return target r_I^* for the investment activities:

$$r_I^* - r_D = (R_I^* - r_D)\frac{C_I}{I} + \frac{O_I}{I} \tag{7}$$

Here, the difference $r_I^* - r_D$ is the margin that should be earned in excess of the deposit rate r_D (as the marginal funding rate). Formula (7) is derived from (5) using $D_I = I - C_I$ and the asterisk indicates the target level instead of a realised quantity. If the investment portfolio realises the (average) return r_I^* (according to formula (7)), then it contributes a RAROC of R_I^* times the allocated economic capital CI to the central bank's annual profits. The RAROC target RI* for the economic capital allocation is sometimes called "RAROC Hurdle".

If this target return r_I^* cannot be realised, the best alternative may be to reduce the size of the investment portfolio. There may be times when the investment climate is unfavourable (e.g. with bond term yields below the deposit rate r_D during times of QE), and the target return seems not achievable. In such a situation, the central bank can sell investments and reduce the funding, i.e. erase some of the commercial bank deposits on the liability side. Depending on what other objectives the investment portfolio has (e.g. market presence, strategic operational relations), the central bank could work with a temporary smaller portfolio. However, when even a zero RAROC seems not achievable, the investment portfolio will be loss-making and the central bank should seriously consider if keeping it makes sense.

In a commercial bank setting, the size I of the investment portfolio is limited by the amount C_I of economic capital allocated. This is a hard limit as capital is scarce (by regulation) and risks must be contained. In a central bank setting this is not (necessarily) a hard limit as capital is only auxiliary in maintaining credibility and independence (see Wessels and Broeders, 2022a). Theoretically, a central bank could allow for a very large investment portfolio without having the appropriate amounts of capital to allocate, simply by creating large amounts of deposits D_I. However, in such a situation the large amounts of deposits could start interfering with monetary policy implementation – which is undesirable.

Therefore, in case of a central bank, it is necessary to set an upper limit to the size I of the investment portfolio directly, to contain the size of the corresponding deposits D_I. This is exactly what happens in the Eurosystem; the NCB's invest-

ment portfolios are part of the so-called "net financial assets" limited in size by the ANFA agreement (ECB, 2025a).

In the case of DNB and some other Eurosystem NCBs, the own investments have also been allocated a "risk budget", which represents the maximum amount of economic capital C_I the investments can consume. The risk budget is typically set to a strategic (multiyear) level that (a) represents a material part of the central bank's total risks (therefore contributing materially to the annual profits), but (b) does not dominate the whole balance sheet (overshadowing the monetary portfolios and the primary mandate).

The same formula (7) could be used to calculate desired return levels for other portfolios such as the FX portfolio (F), the monetary credit portfolio (M) and the monetary bond portfolio (QE), simply by exchanging the letter I for F, M or QE. Given that M and QE primarily serve a policy objective, formula (7) is not directly applicable *to set targets*. However, it may be *insightful* to calculate the desired return levels for the monetary portfolios M and QE given the amounts of economic capital they consume. In this way the central bank can assess to what extent the monetary portfolio profits are in line with the risks they entail.

Allocation of capital to asset portfolios is preferably done with a risk model (e.g. Value-at-Risk or Expected Shortfall) – see Wessels and Broeders (2022a). The risk model should estimate for each exposure the complete risk profile, including credit risk, interest rate risk and market risk. Such a model should use the desired risk quantile (e.g. 99 percentile) and differentiate between key characteristics of the assets, such as credit quality, market volatility and duration. Without a risk model it will be hard to allocate capital and use a RAROC target with formula (7). Risk models are common in a commercial bank environment, although not every central bank will have them yet.

In the case of DNB, the own investments stood at EUR 8.6 bn (including FX exposures, without IMF receivables) at the end of 2024 and contained exposures such as equities and high-yield bonds (DNB, 2024). Annual income was around EUR 0.45 bn. In the past, the portfolio was significantly larger, with predominantly government bonds (2015: EUR 27.2 bn, annual income: EUR 0.25 bn). Typical contributions of the DNB investment portfolio to the PAAP have been between 0 and EUR 0.5 bn over the years (DNB, 2001-2024).

8. Income and cost sharing within the Eurosystem

An important aspect of a Eurosystem NCB's profitability is that income and costs of part of the balance sheet are shared with the other Eurosystem NCBs. This has implications for the profitability of the individual Eurosystem NCBs. In this section we elaborate on the impact of these shared items on the NCB profits.

A schematic (high-level) overview of these NCB shared and non-shared balance sheet items is given in table 2. The shared items are mainly the ones which are important for the common monetary policy of the euro area, i.e. monetary credit (open market operations), the monetary bond portfolios (purchase programmes – with the exception of government bonds and other public sector instruments), banknotes and deposits from commercial banks (minimum reserves and excess reserves of monetary policy institutions). Also the intrasystem claims and liabilities are part of this exercise (see Kakes, Klaver, and Rollingswier, 2022; ECB, 2016; and ECB, 2025b; for background information). The exact mechanisms are well explained in recent papers by Cesaratto, Febrero, and Pantelopoulos (2024, 2025).

Items of which income and costs are not shared include gold, the FX portfolio, the investment portfolio and deposits from non-monetary policy institutions (such as public sector entities and non-Euro central banks). Obviously, equity items such as capital, provisions (e.g. GRP) and revaluation reserves belong to the shareholder of the NCB and are also not shared. The rules for (most of) these non-shared items are specified in the Agreement on Net Financial Assets (NFAs) (see ECB, 2025a). Some non-shared items are atypical, e.g. the monetary bond portfolio for government bonds (purchase programme for public sector instruments) is an important part of the monetary policy implementation and therefore not part of the NFAs. However, the results and costs are not shared (see Cesaratto et al. (2024, 2025). We will refer to the (official) NCB balance sheets, *before* the income and cost sharing, (as in table 2) as the *accounting* balance sheets. The virtual NCB balance sheet, *after* the income and cost sharing, which drives the annual profits (PAAP), will be referred to as the *economic* balance sheet. This is further explained below.

Table 2: Typical items on the accounting balance sheet of a national central bank (NCB) in the Eurosystem*

Income and costs	Assets	Liabilities
Shared	Monetary credit to commercial banks (Open Market Operations)	Banknotes in circulation
	Monetary bond portfolio (Purchase Programmes, except government bonds)	Deposits from commercial banks (Minimum Reserves of Monetary Policy Institutions)
		Deposits from commercial banks (Excess Reserves of Monetary Policy Institutions)
	Intrasystem claims (T2 transactions, allocation of banknotes)	Intrasystem liabilities (T2 transactions, allocation of banknotes)
Non-shared	Monetary bond portfolio (Purchase Programmes for government bonds)	***Deposits from other institutions (non-Monetary Policy Institutions***
	Gold	Revaluation reserves (RRs)
	FX portfolio	Capital, i.e. Shareholder equity (SE) and provisions (GRP)
	Investment portfolio	

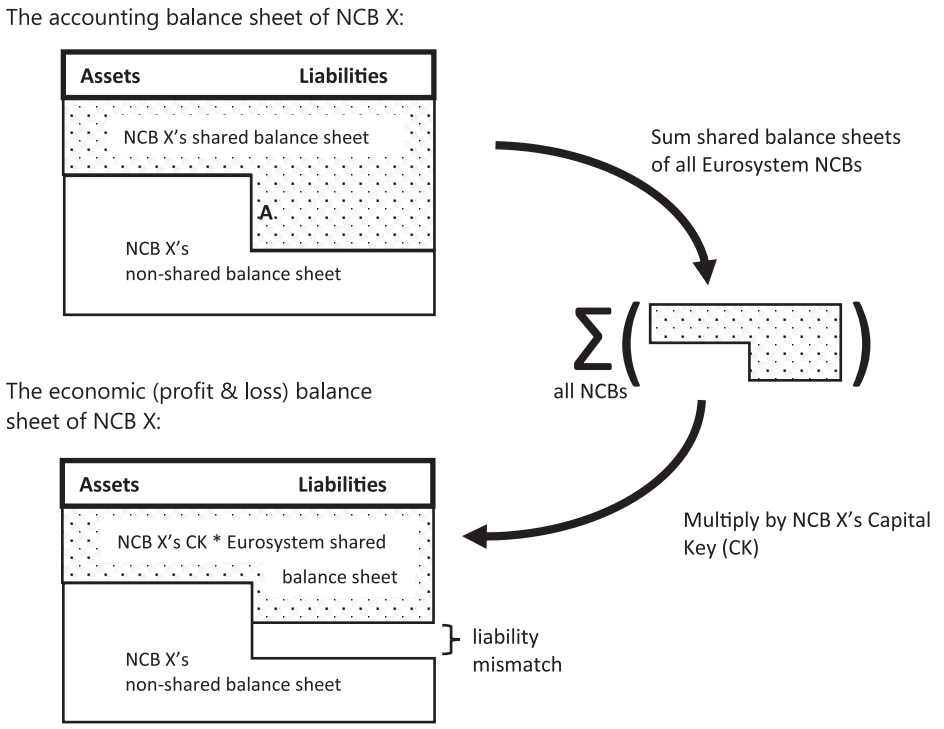
* For a number of items, income and costs are shared. For other items, they are for the own account of the NCB. The intrasystem claims and liabilities make up for the uneven distribution of deposits and banknotes in Europe. The non-shared items in bold and italic are under control of the NCB (part of the NFAs) and can (potentially) be used to influence profitability (cf. category 3 in section 6).

Another important task for Eurosystem NCBs is the Emergency Liquidity Assistance to monetary counterparties (ELA, the Eurosystem version of Lending of Last Resort, LOLR), which is a national task (for own risk and return) but requires approval from the Governing Council. As this is an exceptional exposure, it is not included in the table 2, but if it appears it would be included under the non-shared items, see ECB (2025d).

So, how does this income and cost sharing work? Effectively, the income of all shared assets and the costs of all shared liabilities across the Eurosystem NCBs (without the ECB) are pooled and distributed back to the NCBs according to their ECB Capital Key shares, see Cesaratto et al. (2024, 2025). For instance, if NCB X holds a monetary credit exposure (OMO) to a commercial bank in its jurisdiction, the income on that exposure is pooled by the ECB and NCB X receives a proportion equal to its Capital Key. The same would happen if NCB X experiences a loss on that exposure. The loss is then split over all NCBs where NCB X would suffer a proportion of the size of its Capital Key. And by the same mechanism NCB X also receives the Capital Key times the income on shared exposures and the costs of shared liabilities of other Eurosystem NCBs.

Effectively, this implies that – for the purpose of NCB X's profitability – we can allocate a proportion (the size of NCB X's Capital Key) of the shared balance sheets of all Eurosystem NCBs to NCB X. Simply put, sharing income (and losses) on an asset is effectively the same as (virtually) sharing the asset. In this way we can transform the regular "accounting balance sheet" (in the annual report) into an "economic balance sheet", i.e. the balance sheet that reflects the profitability. This is depicted schematically in figure 4.

Figure 4: Schematic representation of the process to transform the accounting balance sheet of a Eurosystem NCB into the economic (profit & loss) balance sheet*



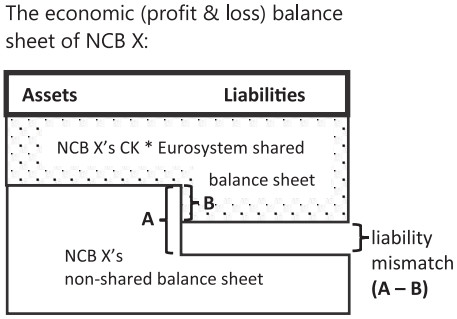
* This process results in a mismatch between the resulting shared balance sheet and the original non-shared balance sheet. For some NCBs this will be a liability mismatch (as depicted in the figure), but for others this will be an asset mismatch. This mismatch results in an extra balance sheet item remunerated at the reference rate (currently the DFR).

However, this is not the whole story. Combining the NCB X's non-shared balance sheet with a proportion of the aggregate Eurosystem shared balance sheet will lead to a mismatch, i.e. the resulting *economic* shared and non-shared assets will not completely add up to the size of the resulting *economic* shared and non-

shared liabilities. This mismatch can be on the liability side of NCB X ("liability mismatch" – as in the schematic example of figure 4), but also on the asset size (in which case it will be an "asset mismatch"). By construction, the sum of the asset mismatches and liability mismatches over all Eurosystem NCBs add up to zero (as all Eurosystem shared balance sheets and non-shared balance sheets add up on an aggregate level).

These asset mismatches and liability mismatches result in an additional income and costs (respectively) in the following way. In the Governing Council decision on the allocation of monetary income (ECB, 2016), it is stated that the 'reference rate' is used to the difference between the shared (or 'earmarkable') assets and the shared liabilities ('liability base') – this is depicted by the letter 'A' for NCB X in figures 4 and 5. Effectively, this implies that the non-shared balance sheet, which has the same difference 'A' (see figure 5), is also charged (or remunerated) with the reference rate. After the transformation exercise (going from the accounting balance sheet to the economic balance sheet), the difference 'B' (figure 5) between the resulting *economic* shared assets and the shared liabilities will be different from 'A'. The net effect is that the positive result (A – B) is the liability mismatch which costs the reference rate. If negative, this (A – B) appears as an asset mismatch on the asset side which is remunerated with the reference rate.

Figure 5: Explanation of the liability mismatch



The reference rate currently used by the Eurosystem is the Deposit Facility Rate (DFR) (see ECB, 2024). This means that NCB X, in figure 5, pays an additional (A – B) * DFR to the other NCBs in the Eurosystem. In summary, NCB X's annual profit (PAAP) would be sum (a) + (b) + (c):

a) Net result on [NCB X's Capital Key] * [aggregate Eurosystem shared balance sheet]
b) Net result on NCB X's non-shared balance sheet
c) The mismatch result (B – A) * DFR

All these three items can be positive as well as negative. In case of (c), we have used an income of (B – A) * DFR as the negative of the cost contribution: – (A – B) * DFR.

Until the end of 2024, the reference rate used was the Marginal Refinancing Rate (MRO). This gave rise to some peculiar effects which have now disappeared: (a) differences between NCBs in effective funding rates for non-shared assets, and (b) income effects for all NCBs resulting from investments or divestments of a single NCB in its non-shared portfolios (see the annex in Wessels, 2024). As the reference rate is now equal to the marginal funding rate of the Eurosystem NCBs (the DFR), this implies that the funding costs are simply transferred to these virtual exposures within the Eurosystem.

Although it may seem technical, the income effects due to these asset mismatches and liability mismatches can be material. There are no official figures to illustrate this effect, but we can look at a hypothetical example. At the end of 2024, the consolidated Eurosystem balance sheet stood at EUR 6.4 trillion. Historically, the Net Financial Assets (NFAs), which could be indicative of non-shared balance sheet differences, have often stood between 10-20% of the consolidated balance sheet (see ECB, 2025a). Let's assume that the difference between NCB's non-shared assets and non-shared liabilities (i.e. amount 'A' in figure 4), as percentage of the total NCB balance sheet, varies around 10% over NCBs. In such a case, the average difference (A-B) could be in the middle of the 10%, i.e. of the order of 5%. With a DFR of 2.0% (August 2025) this could result in a total amount of EUR 6.4 bn (= EUR 6.4 tn * 5% * 2.0%) of income and costs redistributed on the asset and liability mismatches. Taking a Capital Key of 5.9% (for DNB) that would correspond to an amount of EUR 0.38 bn, which is substantial compared to the typical annual profits (cf. figure 1). Again, we should emphasize that this example is purely hypothetical and intends to illustrate what could be the order of magnitude of the mismatch contribution vis-à-vis the annual profit (PAAP).

9. Conclusion

In this paper, it is argued that central bank annual profits contribute to credibility and maintaining financial independence from the government. We focus on the annual profit before provisions, i.e. the provision-adjusted annual profit (PAAP), over the annual report annual profit (ARAP) and the fully-included annual profit (FIAP). Ideally, the (average, medium-term) Return-on-Equity (RoE, for PAAP) for a central bank should be above the average GDP growth. In that case, the central bank would generate sufficient income to realise capital growth (by profit

retention or adding to provisions) in line with the growth of the underlying latent risks from the economy and the banking sector.

Central bank profits are not 'manageable' as they are for commercial banks. The primary mandate of a central bank relates to price stability and financial stability, and the contribution of policy measures to the economy outweighs the costs or losses incurred by the central bank. Therefore, the monetary policy interest rates – being the main drivers of the central bank profitability – leave little room to include "efficiency" considerations. Nevertheless, there are policy parameters that (at times) could allow for such efficiency considerations, e.g. the remuneration of minimum reserves is a recent example within the Eurosystem. Typically, a central bank aims for an "efficient" implementation of monetary policy, i.e. with limited risks and costs. Preferably, it could also earn a modest profit to allow for the appropriate capital growth.

The balance sheet items which are not primarily used for monetary policy implementation allow for including profitability considerations more explicitly. The central bank's own investment portfolio is the most prominent example. By allocating (part of the central bank's) *economic capital* to the investment portfolio, using a risk model, the central bank can establish what should be the target return (RAROC) for the investments. If these returns cannot be realized, it may be wise to sell (part of) the investments, reduce the funding and (when relevant) limit the losses.

Also, central banks should understand the outlook of their annual profits under different (interest rate) scenarios, e.g. by using an ALM model that captures the dynamics of the balance sheet. The insights can be used to communicate timely to stakeholders and the general public, e.g. in case of possible losses. Understanding the balance sheet under different scenarios is also important for Eurosystem national central banks (NCBs) which are exposed to financial consequences of the ECB's monetary policy decisions via income and cost sharing arrangements. The combination of the shared and non-shared NCB balance sheet items produces an asset or liability mismatch with a (possibly) material impact on the NCB's annual profit.

Given the significant losses of a number of central banks as a result of higher interest rates, it may be useful to consider profitability or efficiency more explicitly in the central bank policies. This paper offers input on that question by outlining how profitability considerations can be incorporated without compromising policy objectives.

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