

# **An accounting-based model of seigniorage, and recent monetary developments**

Zbigniew Polański\*, Mikołaj Szadkowski#

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## **Abstract**

The aim of this paper is to identify the changes of seigniorage during 2003–2019 in a group of central banks. To achieve this we propose an accounting-based model of seigniorage creation and distribution. It is used to research the developments in seven monetary areas (i.e. of the euro area, Japan, Poland, Sweden, Switzerland, the UK and the US). We show that the post-2007 period differs substantially from the earlier one with respect to most variables of the model, which can be attributed above all to the implementation of unconventional monetary policies. Our estimates, based on a dataset compiled especially for the study, suggest that there was a break following the Great Financial Crisis as the share of seigniorage in central banks' profits declined noticeably. On the distribution side, we observed an increase in average central bank transfers to governments in all larger economies in 2008–2019. Central banks' finances in the three smaller economies (Poland, Sweden, Switzerland), however, markedly diverged from those of monetary authorities' in larger economies, particularly after 2007.

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\* SGH Warsaw School of Economics; e-mail: zpolansk@sgh.waw.pl.

# SGH Warsaw School of Economics; e-mail: mszadko@sgh.waw.pl.

## 1. Introduction

The goal of this article is to pinpoint the development of seigniorage, i.e. its creation and distribution, in modern central banks during the 2003–2019 period. We present both theoretical and empirical perspectives.

Most generally, seigniorage is income stemming from currency issuance. Thus, first, we seek to comprehend the nature of seigniorage in the context of the credit-based system in the world of developed financial markets. In the contemporary world of largely financially independent monetary authorities, seigniorage is simply part of their total net income, i.e. their financial results, or – central banks' profits. Accordingly, we construct an accounting-based model, which derives seigniorage from central banks' financial results. Then, second, we analyse monetary developments for seven major central banks, representing larger and smaller open economies: the Bank of England (BoE), the Bank of Japan (BoJ), the Eurosystem (which – for shortness – we often denote with the acronym “ECB”), the Federal Reserve System (Fed), Narodowy Bank Polski (NBP), the Swedish Riksbank (Riksbank) and the Swiss National Bank (SNB). These are largely independent central banks, although currently under political pressure in some countries, conducting during the period under review, inflation targeting (or quasi-IT) monetary policy strategies (Niedźwiedzińska 2022).

The choice of these institutions has also been motivated by their different experiences with unconventional policies. The study time span covers the final part of the “Great Moderation” and the crises' period since mid-2007, i.e. the Great Financial Crisis (GFC), the Great Recession, the European sovereign-debt crisis, followed by the so-called “secular stagnation” (Sieroń 2021). The 2020 Covid-19 pandemic, and the related recession, have clearly marked a new caesura in global economic developments, and although they undoubtedly must have had an impact on seigniorage and central banks' profits creation and distribution (Polański, Szadkowski 2020a), they belong in many respects to a new period of economic policy worldwide and – consequently – are not covered in this study.

The 2007 crisis resulted in the implementation in many economies of unconventional monetary instruments, i.e. above all quantitative easing, and zero and negative interest rate policies. We attempt to capture their impact on the creation and distribution of seigniorage. Based on a dataset produced by the authors, we find that a break occurred following the GFC, in which the share of seigniorage in overall central banks' financial results declined markedly. At the same time, on the distribution side, we observe an increase of average central banks' transfers to governments in all larger economies. The central bank's finances in the smaller countries (Poland, Sweden, Switzerland) visibly diverged, however, from those developments, particularly in the 2008–2019 period.

The discussion is organized in three main sections. In Section 2, we deal concisely with the notion of seigniorage and propose a model of central bank finances and seigniorage. In Section 3 some definitional, institutional and methodological remarks laying the ground for the empirical analyses are presented. In Section 4, we examine seigniorage creation and distribution, emphasizing two sub-periods: 2003–2007 and 2008–2019. The conclusions of our study are summarized in the final section. An appendix supplements additional data relevant for our discussion in Section 4.

It is also important to stress that the paper builds on our earlier work. Two publications should be particularly emphasized: Szadkowski (2019), and Polański and Szadkowski (2020b). Given the limited length of the paper, and the broad range of problems to be covered, we will refer to both publications where further arguments and analyses are offered.

## 2. Theoretical remarks

### 2.1. The concept of seigniorage and its complexity

Seigniorage is by no means a new concept. As a technique, it was already practiced in ancient and medieval times to mint new, additional coins from the same stock of precious metals. The term itself can be found as early as in Adam Smith's work, where he defined seigniorage as "duty paid upon the coinage" and stated that it can be "a small (...) revenue to the sovereign" (Smith 2007, p. 37, 39 and 561).<sup>1</sup>

In modern economic literature there are basically three main approaches to the term under discussion. The first one is known as "monetary seigniorage", the second one is "opportunity cost seigniorage", while the third can be labelled as "seigniorage from central bank's balance sheet" (Bodea, Sánchez-Santos 2020, p. 78). The first approach is linked to the work conducted by monetarists (see especially Bailey 1956; Cagan 1956), whereas the second is mainly associated with the name of Phelps and his 1973 paper (Phelps 1973). The third relevant approach is authored by several contemporary economists, some of whom are mentioned below.

All three approaches have certain limitations. In the case of monetary seigniorage its weaknesses stem above all from the fact that it assumes a pure fiat monetary circulation (Reich 2017, Chapter 3; White 1999, p. 143). Consequently, seigniorage is a change in the monetary base and refers to a stream of monetary resources generated by the difference between the nominal (face) value of paper money (including commercial banks' reserves) and its costs of production, which are treated as non-existent; this profit is then passively transferred by the central bank to the government (actually, under this concept, the central bank is part of "a government").

This quantity theory of money approach, reflecting in particular the nature of hyperinflationary developments,<sup>2</sup> was challenged by the above-mentioned work by Phelps, who emphasised the role of interest income in seigniorage creation. Under this approach, seigniorage is linked to the notion of money as a financial asset not bearing interest; thus, money-owners lose income which could be earned from investing it, hence the name "opportunity cost seigniorage". Clearly, this is an alternative approach to the previous one, although it can also be shown that under certain assumptions,<sup>3</sup> the monetarists' and Phelpsian concepts are equivalent. The latter is intellectually appealing, addressing the role of the interest rate, however, in an abstract way and difficult to convincingly apply empirically (what interest rate should be considered as opportunity cost, if there are various alternative financial assets to choose from?).

The third approach consists of a heterogeneous group of concepts attempting to take directly into account the fact that modern monetary regimes are credit-based systems (with more or less developed liquid financial markets, depending on the economy). The crucial issue when discussing modern seigniorage is that currently we live in a credit-based monetary regime, as already stressed by Wicksell (1898), in which it is the banking system that creates modern money. As observed by Reich

<sup>1</sup> We do not aim to discuss the concepts of seigniorage which emerged throughout the history of economic thought. For this see above all Reich (2017); also White (1999, Chapter 7). Szadkowski (2019, pp. 40–53) and Polański, Szadkowski (2020b, Section 2 and Appendix 1) discuss contemporary definitions of seigniorage.

<sup>2</sup> Hence, the monetary seigniorage concept is closely related to the notion of the "inflation tax", i.e. the decline in purchasing power of the monetary base and the reduction in the real value of public debt.

<sup>3</sup> I.e. a constant velocity of base money and the real interest rate equal to the real growth rate of an economy. See Bénassy-Quéré et al. (2019, p. 289) and discussion in Hochreiter, Rovelli (2002, pp. 394–395).

(2017, p. 6), however, in the contemporary monetary systems some remnants of the previous regimes remain, i.e. coins (from the commodity regime) and notes (from the fiat – or paper – regime). Thus, a modern monetary system is a mixed one, but ultimately its credit mechanism is the driving force behind its workings.

The central bank balance sheet approach to seigniorage tries to capture the fact that in a credit-based regime, seigniorage income derives from interest payments (Reich 2017, p. 26 and 80), i.e. it relates to the Phelpsian concept. This approach has been gradually recognized by economists who studied seigniorage (often in the context of central banks' financial results). The first concepts moving into this direction still stressed the idea of monetary seigniorage (e.g. Drazen 1985; Klein, Neumann 1990; Neumann 1992; Rovelli 1994), but the newer approaches (e.g. Vaez-Zadeh 1991; Fry 1992, 1993; Hochreiter, Rovelli 2002; Ize 2005; Sweidan 2011; Kjellberg, Vestin 2019, to name a few) increasingly emphasize the role of interest payments in the context of central bank operation, seigniorage creation included.

Our approach to seigniorage, presented in the next section, develops the central bank balance sheet perspective as we consider a central bank working in an environment (in fact being its integral part) of the credit system with developed financial markets.

## 2.2. An accounting-based model of seigniorage creation and distribution

We present now a model of the origination and allocation of seigniorage. Before getting into details of its algebraic incarnation, it is helpful to look first at its underlying logic as shown in a stylized graphical form in Figure 1.

Let us make three observations related to Figure 1.

First, we consider seigniorage as an outcome of the workings of central bank finances,<sup>4</sup> in particular, its monetary operations, while the financial result is an outcome of (almost) all central bank operations.

Second, consequently, seigniorage is fully booked in the central bank's financial result. It implies that we analyse central banks which are financially independent, i.e. there is no subsidized lending or – more broadly – there are no so-called “quasi-fiscal activities”.<sup>5</sup> Seigniorage, when the central bank is not financially independent, may thus “leak out” from the bank through other channels.<sup>6</sup>

Third, the origination of seigniorage is linked to cash in circulation (“base of seigniorage” in Figure 1), which is entirely issued by the central bank. Hence, we adopt a cash-based definition of seigniorage. This is above all because the existence of seigniorage results from the central bank monopoly on cash – a legal tender. More technically, seigniorage income is generated by non-remunerated central bank liabilities, which nowadays is cash (together with central bank capital).

<sup>4</sup> On the concept of central bank finances see more in Archer, Moser-Boehm (2013, Parts A and B).

<sup>5</sup> More formally, central bank financial independence is the state in which the central bank possesses an “adequate balance sheet structure and earnings generation capacity to efficiently perform its functions” (Martínez-Resano 2004, p. 8; see also Stella 2002), while generally “quasi-fiscal activities” encompass central banks' operations that could “be duplicated by specific budgetary measures in the form of an explicit tax, subsidy, or other direct expenditure” (Mackenzie, Stella 1996, p. 3, see also Appendix 1).

<sup>6</sup> For the European post-socialist countries' experience in this respect, before their EU accession, see Hochreiter, Rovelli, Winckler (1996), Hochreiter, Rovelli (2002), Cukrowski, Fischer (2003).

In many concepts of central bank seigniorage, commercial banks' reserves, including required ones, i.e. the total monetary base (M0), are also often treated as a base of seigniorage. There are, however, at least two reasons not to follow this approach. First, reserves are not defined in law as legal tender (see discussion in Bossu et al. 2020, p. 8). Second, reserves are nowadays usually remunerated at market rates, i.e. at a similar rate as central bank assets (in domestic currency), which means that interest earned and paid tends to cancel out (see also Polański, Szadkowski 2020b, pp. 10–12).

There are two additional issues that should be discussed: (1) in many countries (e.g. in the UK and the US) mints are separated from central banks (i.e. mints have their own balance sheets and income statements) and, thus, separately generate (and distribute) seigniorage; (2) as modern money is created by the banking system as a whole, there are economists<sup>7</sup> who argue that commercial banks also generate seigniorage. The first of these two potential objections is discussed in our further remarks (Section 3.2). As concerns the second objection, there is no doubt that private money (bank's deposits) creation is linked to bank profit; however, private money is not legal tender and, thus, is not compatible with the proposed approach.

The mathematical version of the model involves six equations. The first two present the mechanism of seigniorage creation, while the remaining four deal with its distribution.

The first one is the central bank financial result equation:

$$FR = S + OI \quad (1)$$

where:

$FR$  – financial result,

$S$  – seigniorage,

$OI$  – other central bank net income.

In our exposition, we give priority to the financial result, i.e. a plain outcome of transactions conducted by a central bank during a certain period of time, because it is an observable variable, computed and disclosed regularly by all central banks. Equation (1) states, as mentioned earlier, that seigniorage is embedded in the financial result of a central bank. In other words, we can present the financial result as composed of two elements, i.e. seigniorage and “the rest”, which we label “other central bank net income”. The latter is due to the activities of the central bank which are not directly linked to cash issuance, and can be defined as non-seigniorage central bank income reduced by costs unrelated to the cash-issue function. In light of Equation (1), seigniorage is registered as part of the financial result, but it must be estimated as it is an unobservable variable (similarly as the value of  $OI$ ).

The second formula is the central bank seigniorage creation equation proper:

$$S = IA - E \quad (2)$$

where the new symbols are:

$IA$  – income on all assets against central bank liabilities in the form of cash,

$E$  – expenses of a central bank resulting from cash issuance.

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<sup>7</sup> See e.g. Bossone (2021) and the review of the literature provided there.

In this perspective, seigniorage is simply net income stemming from the issue of cash – the legal tender of the jurisdiction in which the central bank operates. More precisely, it is the flow of income on central bank assets equivalent in value to its outstanding stock of cash less the flow of costs related to cash issuance.

Both Equations (1) and (2), and Figure 1, show that the central bank financial result and seigniorage are derived from the income on financial assets, which are above all different kinds of credit (debt) granted by the central bank (loans made to commercial banks and different types of bonds purchased). The credit nature of the essential part of central bank assets means that its income ultimately stems from interest payments on its credit activities. Alternatively stated, it also means that under the credit-based monetary regime both the central bank financial result and seigniorage are essentially of credit origin.

Estimating seigniorage allows for the evaluation of that part of central bank profit which results from its monopoly on cash creation. Thus, seigniorage is in principle a positive number. In practice, as we shall see, it can be incidentally negative, but central banks' financial results are relatively often negative, with potentially – if persistent – major disruptive macroeconomic effects for the broader economy due to the impact of central bank losses on the liquidity of the banking sector (more on this point in Section 4).

Let us turn now to seigniorage distribution. The equations describing the process are:

$$FR = \Delta K + TR \quad (3)$$

$$TR = pr \cdot FR \quad (4)$$

$$pr = \frac{TR}{FR} \quad (5)$$

$$FS = \frac{TR}{S} \quad (6)$$

where the new symbols are:

$\Delta K$  – amount transferred to central bank's capital (net equity),

$TR$  – amount transferred by the central bank to the government,

$pr$  – payment ratio,

$FS$  – fiscal seigniorage.

Once again we start with a central bank financial result formula. Equation (3) states that the financial result ( $FR$ ) is divided into an amount transferred to central bank capital ( $\Delta K$ ) and, usually a major part, an amount transferred ( $TR$ ) to the government (potentially also to other shareholders when the bank is a joint stock company; in practice, sometimes corporate taxes are levied on central banks too). In turn, transfers to the government can be presented (Equation 4) as a product of the financial result and a payment ratio ( $pr$ ), i.e. a number that tells what part of the central bank financial result is transferred to the owner(s). The level of the  $pr$  is the outcome of legal procedures and the political economy surrounding the process; Equation (5) provides its formal definition. The last Equation (6), refers to the so-called “fiscal seigniorage”, which defines it as “that part of seigniorage

which the central bank passes on to the government” (Klein, Neumann 1990, p. 210). In other words, the variable *FS* talks about the scale of appropriation of central bank seigniorage by the government, signalling again that the subject of central bank independence, especially its financial dimension, is of crucial importance for the whole process of seigniorage and financial result creation and distribution.

We analyse the development of the variables of the proposed model in the empirical part of the paper.

### 3. Some preliminary matters

Before we move to the empirical analysis, three more topics need to be elaborated: (1) the understanding of “unconventional policies” together with their short overview, (2) some additional aspects of the analysed central banks’ finances, and (3) seigniorage estimation technique.

#### 3.1. Unconventional policies: a glimpse

Unconventional (or “non-standard”) monetary policies are typically understood as based on one of the following central bank’s instruments (CGFS 2019, pp. 9–13):

- 1) central banks’ zero and negative nominal interest rate policies (ZIRP and NIRP, respectively), i.e. decisions resulting in policy rates reaching zero or negative nominal values;
- 2) expanded lending operations, i.e. credit easing schemes providing additional liquidity to commercial banks;
- 3) asset purchase or “quantitative easing” (QE) programmes, i.e. the acquisition (in principle on the secondary market) of financial assets, above all public debt, aiming at strong liquidity injections to the banking sector and the reduction of longer-term interest rates;
- 4) forward guidance, i.e. advanced (typically conditional) management of market expectations.

We take into account only the first three types of the above-mentioned tools. We exclude forward guidance on the ground that it has no direct impact on central banks’ balance sheets that could be statistically detected. On the other hand, the remaining instruments are in practice closely interrelated, since they have a direct effect on the market prices of the financial instruments (thus, their yields) and the size of central banks’ balances.

Unconventional instruments gained global importance in 2008 with the outbreak of the GFC. However, while ZIRP, and obviously NIRP, are basically without precedent in monetary history, QE-type and lending operations were implemented earlier (Allen 2012; Ferguson, Schaab, Schularick 2015). Japan, due to its long-lasting growth and deflation problems, introduced ZIRP in 1999 and started conducting QE in 2001 (Shirai 2018, p. 12 and 15). Below, we outline succinctly the issue of the three non-standard instruments, leaving relevant details for further discussion when indispensable (see Figures 2 and 3).

According to both figures, most of the seven central banks under scrutiny began unconventional policies in the autumn of 2008, after the collapse of the Lehman Brothers. However, the Fed (together with the ECB) introduced additional lending operations already in August 2007, when the first serious hints of the crisis became visible (i.e. the liquidity freeze). Later that year, the Fed started aggressively

cutting interest rates and in 2008 launched QE operations. The BoE, after lowering the Bank Rate since December 2007, followed with QE in March 2009 (albeit its balance sheet had already clearly expanded in 2006–2007).

These banks, however, were not the first to reach for unconventional measures. As already noted, the BoJ started non-standard policies much earlier – at the turn of the millennium. On top of other non-standard policies, in January 2016, the BoJ decided to move to NIRP policy, while its balance sheet continued to grow rapidly (exceeding 100 per cent of GDP in 2019).

The ECB gradually developed unconventional tools as well. It began to implement fully-fledged QE operations, however, only in March 2015; they were preceded by other attempts to increase liquidity in the euro financial markets (mostly via the expanded lending operations), which progressively increased the Eurosystem's balance sheet. The ECB also moved to ZIRP and NIRP, albeit in a rather complex way. Namely, in the course of the first half of the 2010s, its deposit rate de facto became “the relevant” policy rate (Brandão-Marques et al. 2021, p. 54), as it started to decisively influence EONIA, the interbank euro market rate – see panel B in Figure 3. Consequently, while the ECB lowered the main refinancing operations rate to zero only in 2016, its deposit rate together with EONIA had already been negative since mid-2014. The Riksbank followed in principle the ECB steps, but sometimes more aggressively, as shown by the fact that it temporarily introduced negative nominal deposit rates already in mid-2009; in 2015, it started QE operations and cut its main (and deposit) rate to negative nominal values.

Among the seven studied monetary authorities, the cases of the SNB and NBP are quite different. In the period under consideration, none of them conducted asset purchase programmes based on domestically issued assets, i.e. they formally did not implement QE-type operations. The SNB started its balance sheet expansion (topping the record 115 per cent of GDP in 2017–2019) as it purchased inflowing international capital (stemming from investors' perception of Switzerland as a “safe haven”), in order to prevent the franc's strong appreciation (i.e. the SNB conducted extensive foreign exchange interventions). Attempts to halt, or at least decelerate, the inflow of foreign capital also resulted in the SNB move to NIRP in early 2015, leading to a rate of -0.75 per cent, the lowest interest rate of central banks so far. As concerns NBP, with the exception of some minor attempts in 2008–2010, until March 2020 it did not use any of the three unconventional monetary policy tools. But from 2008, NBP's balance sheet in real terms also gradually increased, mostly as a result of the high inflow of EU funds to Poland.

None of the central banks conducting unconventional policies seriously attempted to halt them in the observation period, except the Fed (see Figures 2 and 3). The Fed began its “exit policies” in late 2014 by stopping further purchases of assets, while in December the following year it started raising interest rates, and in October 2017 it began reducing (nominally) the balance sheet. However, in July 2019 the Fed moved to cutting its interest rates and in September of that year began increasing the balance sheet again, albeit officially not returning to QE at that time (this happened only in 2020 with the spread of the Covid-19 pandemic).

### **3.2. Some other relevant aspects of the seven central banks' finances**

The discussed banks also differ considerably in other aspects pertinent to our research. These concern their finances, i.e. the composition of balance sheets and the structure of income (or “profit and

loss”) statements as well as the accounting framework (the so-called “accounting principles/policies”) underlying the computation of figures provided there.

Starting with the latter, it must be stressed that all the central banks studied follow to some extent a market-oriented approach to registering their operations and, consequently, favour the “mark-to-market” (“fair value”) accounting over the historical cost accounting when pricing some of their balance sheet items.

From the economic point of view, the complex issue of accounting principles can be boiled down to the following questions: (1) which balance sheet items should be valued at market prices on an ongoing basis?, and (2) how should such valuation (if conducted) be included in the income statement, or maybe included as part of equity? In practice, there are several approaches to these questions; and in the seven central banks, different accounting policies are implemented. Some banks follow the Eurosystem’s accounting standards (the Eurosystem banks, NBP and the Riksbank), the BoE implements the International Financial Reporting Standards (IFRS), while the remaining follow their own (or national) accounting rules.<sup>8</sup>

The banks’ finances also differ in other relevant aspects. The most important of them is probably the question of foreign exchange (FX) reserves, as they may have an important impact on the size of the central bank’s balance sheet, its profit and loss statement and, hence, the volatility of financial results (and often seigniorage). Due to historical developments, the BoE possesses almost negligible FX reserves in its balance sheet, while both the BoJ and the Fed maintain in their books only part of the nations’ (federal) FX reserves. In the cases of the remaining banks, total countries’ FX reserves are booked in their balance sheets.

The final subject touched upon here, although of minor impact in quantitative terms, is the issuance of coins. However, because the definition of seigniorage adopted in this paper is a cash-based one, we feel obliged to briefly address this question. In our group of central banks, some of them issue not only notes, but also coins; this is the case of NBP, the Riksbank and some of the Eurosystem’s national central banks (Cyprus, Estonia, Latvia, Lithuania and Slovakia), although the Eurosystem as a whole does not issue coins. As concerns the remaining central banks under study, they issue only notes and, consequently, coins are not present in the liabilities of their balance sheets (and likewise, coin production and distribution costs are also not considered in their financial result). Thus, in such cases, in our estimates of seigniorage, based on central banks’ documents, seigniorage resulting from coin issuance is obviously not taken into account.

At least these three issues from the area of central bank finances make far-reaching comparisons of the sizes of the seven central banks’ balance sheets (and related data, like the financial result) difficult. Hence, when assessing developments in Figure 2, we should rather stress their changes over time than aim at cross-bank comparisons.

### 3.3. Seigniorage estimates’ operationalization

When estimating seigniorage according to Equation (2), we consider the actual total income on the central bank’s assets, proportional to the cash stock issued, diminished by the cost of cash (or banknotes

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<sup>8</sup> For more, see Archer, Moser-Boehm (2013, pp. 27–33, 39–42 and Annex 1), and Polański, Szadkowski (2020b, Appendix 2).

only) production.<sup>9</sup> The main advantage of this approach is that it most comprehensively captures the impact of unconventional policies, while not overstating cash production costs. However, when no relevant information was available, overhead expenses were taken as an approximation to the cost of cash (banknote) production.

Estimates of seigniorage were carried out in four steps:

- 1) actual total income on all central bank assets was calculated;
- 2) the share of liabilities due to cash (banknotes) in circulation in the balance sheet total was determined;
- 3) the income from assets estimated in the first step was multiplied by the share of liabilities from the issuance of cash in the balance sheet, calculated in the second step;
- 4) the result obtained in the previous step was diminished by the expenses on cash production, leading to our estimate of seigniorage.<sup>10</sup>

The estimates were made for each central bank separately in each (financial) year. Let us also stress at this point that the ECB publishes its own profit figure, but does not publish the income statement for the whole Eurosystem. Consequently, we not only estimate seigniorage for the Eurosystem, but also compute its profit (financial result) and related variables.<sup>11</sup>

To allow for some inter-temporal and cross-country perspective, having in mind earlier caveats, the estimated values of seigniorage (and calculated related variables) are divided by the respective current values of GDP.<sup>12</sup>

#### **4. Empirical analysis of seigniorage and central banks' profit creation and distribution during the 2003–2019 period**

In this section, we identify the tendencies in the behaviour of the variables from our model (Equations 1–6 and their treatment in Sections 3.2 and 3.3), considering the impact of unconventional monetary policies on seigniorage and central banks' financial results. First, on their origination, subsequently – on their allocation.

<sup>9</sup> On other possible alternatives when applying Equation (2) see Szadkowski (2019) and Polański, Szadkowski (2020b).

<sup>10</sup> It must be noticed that both the BoE and the Riksbank estimate seigniorage similarly. The Riksbank has only published its estimates of seigniorage (in its annual reports) since 2008, while the BoE was requested to do it by the Parliament as early as 1928. The latter decision was easily implemented as under the 1844 Act, the BoE was divided into the Issue Department, covering banknote issuance activity, and the Banking Department, which encompassed “general banking business” activities (James 2020, p. 14). In this study, thus, seigniorage for the BoE is equal to the financial result of the Issue Department. As concerns the Riksbank, its estimates of seigniorage are based on the same premises as ours, with the exception that in our approach unrealized losses on price and FX valuation are treated as part of seigniorage, and costs on cash production include only banknotes and coins expenses (while the Riksbank takes into account all cash provision expenses). In 2021, NBP joined these two institutions in publishing estimates of seigniorage for 2019 and 2020 (NBP 2021, pp. 141–142).

<sup>11</sup> The Eurosystem's financial result was calculated as the sum of profits (and losses) of its National Central Banks (NCBs) and the ECB. The same refers to other variables (transfers to governments, expenses on cash issuance). The payment ratio for the Eurosystem was, for example, calculated as the sum of transfers made by all NCBs divided by the sum of financial results made by these banks.

<sup>12</sup> GDP values were downloaded from the European Commission's AMECO database. We neither report data nor provide estimates for Japan in 2003 based on the profit and loss account as the central bank did not publish it for that year in English on its website. The complete set of estimates and calculations can be provided on request. Data up to 2018 (as available in May 2020) can be found in Polański, Szadkowski (2020b, Appendix 3).

#### 4.1. The creation of seigniorage and central banks' profits

We start by examining estimates of seigniorage in the context of respective central banks' profits. Figure 4 provides an overview of their development during the period studied. It also displays the values of annual transfers to the government expressed as a percentage of GDP; however, we defer until the next section their analysis.

Based on the seven panels in Figure 4, and further analysis, we can formulate the following preliminary observations.

First, estimates of the annual seigniorage flow typically amounted to less than 0.4 per cent of GDP, which is roughly in-line with its earlier estimates in low inflation and interest rate countries;<sup>13</sup> to be more precise, the average for all our estimates was only 0.12 per cent of GDP with a standard deviation of 0.21 per cent of GDP. However, individual yearly estimates of seigniorage range from the top negative value of -0.67 per cent of GDP in the case of the SNB for 2010, to the top positive rate of 0.89 per cent of GDP, for the same institution for 2005. Negative values for seigniorage are not rare (11 cases out of 118) and, with the exception of the ECB in 2003, all are to be found in the central banks of the three smaller economies, with the seigniorage estimates for Riksbank being close to zero for a longer period of time (Figure 4, Panel F).

Second, typically, in our sample, financial results are positive and larger than seigniorage ( $FR > S$ ). In light of our theoretical remarks (Equation 1), this may sound as nothing surprising, but some earlier studies often reported a different result. For example, Fry (1993), Robinson, Stella (1993), Leone (1994), and Sweidan (2011) documented that many central banks from developing countries suffered losses during prolonged periods of time;<sup>14</sup> Fry (1992, 1993) also stressed that seigniorage was often larger than the financial result of a central bank, especially in less developed countries, mainly as a result of banks' large substandard assets.<sup>15</sup>

In a few cases in our sample, when seigniorage values were negative (or zero), the financial results (losses) for the same years were usually even larger ( $FR < S$ ). The reasons for this will be discussed in a moment when we turn to factors behind the origination of seigniorage; at this point let us only stress that this was the case of central banks of the three smaller economies. Only in this group did financial results become negative: twice in the case of NBP (2007 and 2017), three times in the case of the Riksbank (2003–2004 and 2013), and five times in the case of the SNB (2008, 2010, 2013, 2015 and 2018); or of zero value (four times in the case of NBP: 2008, 2013–2014 and 2018).

Third, as has been suggested by the above remarks, the central banks from the smaller economies are a somewhat distinct group as both their financial results and estimates of seigniorage tended to be much more volatile than was the case of monetary authorities in larger economies. Let us have a closer inspection of both groups of institutions then. See Table 1 consisting of three parts for different groups of banks.

<sup>13</sup> See for example Fry (1993), Gros (1989), Groeneveld, Visser (1997) or Rogoff (2016). See also Table 1A.3 in Polański, Szadkowski (2020b, p. 73).

<sup>14</sup> Goncharov, Ioannidou, Schmalz (2020:11) report that during the 1992–2014 period, 98 out of 155 central banks (i.e. 63 per cent) at least once registered losses, while the maximum number of loss observations per central bank was 18 years, the average being 2.8 years per bank. The empirical evidence of central banks' losses is also discussed in Archer, Moser-Boehm (2013, pp. 14–17).

<sup>15</sup> As suggested in Section 2.2, the situation  $S > FR$  most often takes place when central banks conduct so-called quasi-fiscal activities (for example, in the form of holdings of substandard assets or subsidized loans). See Stella (1997, p. 7) and further references therein.

Table 1 identifies the variables from Equation (1). Its part A suggests that all variables from this equation declined slightly in the second subperiod, although seigniorage (as part of GDP) remained virtually stable. This means that changes in the financial result and “other net income” almost compensated each other. Parts B and C show, however, diverging tendencies. In the larger economies, profits increased as a result of a large rise in the value of the “other net income” variable, which was accompanied by a small decline in seigniorage. In the case of the three smaller economies the situation was different. Financial results declined in the second subperiod due to the decline in “other net income”, while seigniorage somewhat increased.

This different development in both groups of banks is one of the leitmotifs of this section. However, importantly for our conclusions, a more disaggregated analysis shows that financial results (both measured as a percentage of GDP or in nominal terms, i.e. in domestic currencies) increased in the second subperiod in all the analysed central banks except the SNB.<sup>16</sup> As concerns seigniorage, there were four declines in this subperiod when measured in relation to GDP, and three when considered in nominal numbers. For more details see the Appendix.

Fourth, the developments described so far suggest that the relationship between the variables from Equation (1) changed, in particular after 2007. Table 2 shows this change from the perspective of the share of seigniorage in financial results for the seven monetary authorities individually.

Since 2008 we observe growing divergences between our estimates of seigniorage and the reported financial results, which translate into a diminishing share of seigniorage in central banks' profits. This pattern is visible in all the central banks under study except for NBP, as in the period under consideration it did not conduct unconventional policies (except forward guidance, which – as previously mentioned – we do not include in the analysis). Leaving aside this case, in all other central banks in the post-2007 period, the financial results tended to rise faster than seigniorage, leading to declining shares of seigniorage. The average decline in the share of seigniorage in central banks' profit was almost 10 p.p. However, these declines varied considerably: from the 7 p.p. reduction in the case of the BoJ to the case of the Fed, where the share of seigniorage declined by more than 50 p.p. And again these developments can be attributed to the use of non-standard tools: Japan started applying them very early, which resulted in a small decline in the share in the second subperiod, while the Fed went through three rounds of QE operations during 2008–2014, and thus recorded the largest decline in the discussed share. All in all, it can be said that a break occurred following the GFC, in which the share of seigniorage in overall income declined noticeably.

In order to explain these developments in more detail, we must analyse the factors influencing the size of seigniorage and central banks' profits more carefully. As suggested by Equations (1) and (2), and in light of the remarks made in Section 3.3, the following three main variables shaped the above tendencies: first, the total size of the balance sheet; second, the stock of cash and, third, the rate of return on central banks' assets.

In Figure 2, we observed strong increases in the balances after 2007, so that in some cases their values exceeded the country's GDP; in the instance of the Fed, in which the share of seigniorage in the financial result declined so visibly, its balance sheet expanded from 6.2 per cent of GDP in 2007

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<sup>16</sup> In the case of the BoE's financial results, the above statement additionally takes into account the “net indemnity due to HM Treasury” as the profit of the Bank of England Asset Purchase Facility Fund Ltd (BEAPFF); see the Appendix for further details. The impact of the activity of this subsidiary of the BoE will be discussed later in several contexts, but the following Table 2 still shows the financial result as reported by the Bank.

to almost 25 per cent of GDP in 2015. In short, the considerable expansion of central banks' balance sheets – except for NBP – led to the growth of the *OI* variable (from Equation 1), especially in the larger economies (see Table 1, Part B), making financial results much greater than the estimated seigniorage.

Cash has two aspects in seigniorage origination: (1) as its size (volume) and (2) as a ratio of the balance sheet. The volume of cash in circulation not only influences the costs related to its production and maintenance, i.e. central bank's expenses due to cash issuance (*E* from Equation 2), but above all it delineates the size of the bank's assets which generate seigniorage income (*IA* from Equation 2). This latter aspect is, however, more directly visible through the ratio of cash stock to the balance sheet total as well as to the monetary base. Figure 5 explores these different dimensions of cash for our sample of banks.

Perhaps somewhat surprisingly, given the development of electronic banking and the digital revolution in payments, Panel A in Figure 5 shows that in the vast majority of countries the volume of cash (as a percentage of GDP) increased after 2007. The only exception is Sweden where cash declined to below 1.5 per cent of GDP with a visible negative impact on the size of Riksbank's seigniorage (Panel F of Figure 4). In all other economies, the real demand for cash considerably increased, suggesting a broader tendency, whose explanation is outside the scope of this paper (see however: Jobst, Stix 2017; Shirai, Sugandi 2019; Ashworth, Goodhart 2020).

The cash-to-GDP perspective differs from the central banks' balance sheet perspective. As the two remaining panels in Figure 5 demonstrate, with the exception of NBP, the role of cash as part of the total central bank balance sheets and monetary base considerably declined after 2007. This tendency can be explained by the use of unconventional instruments, especially the ones directly resulting in additional liquidity (expanded lending operations and QE), leading to an increase in commercial banks' deposits with the central banks (reserves).

The strong decline of both ratios in panels B and C may suggest, with the exclusion of NBP, that cash developments tended to have a negative impact on the creation of seigniorage as related to the financial result, since they demarcated gradually smaller parts of the central banks' assets, allowing for the creation of seigniorage income.

To complete the above picture, let us now state that according to our calculations, the size of the central banks' expenses on the issue of cash (variable *E* from Equation 2), remained stable and of very minor importance as the yearly costs varied from the minimum of almost zero per cent of GDP (the Fed and the Riksbank) to the maximum of 0.05 per cent of GDP (the Eurosystem in most covered years). The variable *E* is, thus, of a negligible value in our macroeconomic picture, albeit in practice, on a micro level, usually of some relevance for the overall operating costs of a bank.

The development of the rate of return on central banks' assets is a much more complicated affair. Three factors are of crucial importance for shaping the level of the rate of return on assets owned by a central bank. These are: (1) central banks' interest rates policies, (2) the risk premia on assets purchased by the bank, and (3) the exchange rate fluctuations (including the price of gold). Before going further, however, let us first have an overview of the effective returns on individual central banks' assets in our sample (see Table 3).

Table 3 highlights the unusual situation of the three central banks from smaller economies: a sharp decline of the rate of return for the SNB and an increase in the rate of return on assets for NBP and the Riksbank, the only cases in our sample studied. The other four institutions form a more homogenous group, although the decline of the BoE's rate of return calls attention.

Let us commence with the smaller economies. One can justifiably expect that in their case the role of the exchange rate is more pronounced. This is more so as the currency structure of their central banks' assets is strongly biased in favour of investments denominated in foreign currencies. See Panel A of Figure 6.

Panel A of Figure 6 confirms that in the whole period studied these three central banks' balance sheets had open FX positions. What is more, their net FX exposures were of a long (i.e. positive) nature.<sup>17</sup> This implies that the depreciation of the domestic currency increases the value of assets expressed in the local currency, having potentially – i.e. depending on the accounting policies in place – a positive impact on the central bank's seigniorage and profits; of course, an appreciation of the domestic currency in this situation leads to a reverse process, i.e. declines in the central bank's financial results (leading even to losses). Thus, the direction of exchange rate changes becomes of crucial importance for central bank's financial situation.

After the start of the 2007 crisis, the Swiss franc tended to strongly appreciate, while the Polish zloty and Swedish krona tended to depreciate. Panels B, C and D of Figure 6 show these diverging trends for the mentioned currencies. Accordingly, the rate of return on these central banks' assets was strongly affected by the exchange rate trends and volatility. The depreciation of the Polish zloty and the Swedish krona after 2007 contributed to the average increase of return on NBP's<sup>18</sup> and the Riksbank's assets, while the case of the SNB was different. First of all, during the subperiod 2008–2019, the Swiss franc appreciated on average, which – along with the enormous growth of SNB's FX reserves – explains the diminishing yield on its assets. Secondly, due to SNB's accounting principles, its financial results are directly affected by the revaluation of its assets,<sup>19</sup> including gold price changes.<sup>20</sup> Hence, the lower pace of increase in the rate of return on the price of gold,<sup>21</sup> also contributed to the diminishing rate of return on the SNB's assets in the second subperiod. The implemented accounting policies, together with the volatility of the exchange rate, gold and other asset prices, largely explain the “wave” (or “sinusoidal”) pattern of the SNB's financial results and – although less visible because of the applied scale – of seigniorage developments in Panel G of Figure 4.

The central banks' policies leading to very low rates adversely impacted the income on assets of all the analysed central banks. The reductions of their interest rates, along with the QE operations, supported the decreasing yield of purchased debt securities by central banks. As suggested by economic theory and market practice, central banks' actions have a decisive influence on longer-term rates of public debt on the secondary market (Akram 2020; Akram, Li 2020; see also references provided there, and the discussion in Brandão-Marques et al. 2021, pp. 22–26). Consequently, the income on securities

<sup>17</sup> It was less pronounced in the case of the Riksbank, as it took, both in 2009 and 2012, foreign currency loans from the Swedish National Debt Office (Kjellberg, Vestin 2019, p. 14 and 20).

<sup>18</sup> Before the 2007 crisis, particularly since 2004 when Poland joined the EU, the Polish zloty appreciated strongly against foreign currencies. Consequently, the average yield on NBP's assets was negative in 2003–2007 (see Table 3).

<sup>19</sup> Note that, for example, under the Eurosystem's principles, unrealised FX and price gains do not affect the central bank's income statement, but are recognised as liabilities on the bank's balance sheet (i.e. registered as its net equity). In contrast, unrealised FX and price losses diminish the bank's financial result, similarly as realised FX and price losses.

<sup>20</sup> Other central banks under study (e.g. the BoJ, the Eurosystem, NBP and the Riksbank) also have important stocks of gold, but – because of the applied accounting policies – their valuation does not affect these banks' financial results. The BoJ presents its gold holdings at historical value, while the Eurosystem, NBP and the Riksbank, although they value gold at market prices, present unrealised gains in their capital (since gold was purchased at a low price, they always showed unrealised gains).

<sup>21</sup> While during the years 2003–2007, the gold price increased by more than 140 per cent (only in 2007, at the beginning of the crisis, the price soared by 32 per cent), in the following subperiod of 2008–2019, the gold price went up by slightly more than 80 per cent (calculations based on data provided by FRED Economic Data).

did not depart from the central banks' interest rates. In this context, let us recall that in 2016 the BoJ started yield curve control, i.e. a policy – among others – explicitly aimed at stabilizing the 10-year yield on the Japanese government bonds around zero per cent (Shirai 2018, Chapter 5; Shirai 2020, pp. 64–70 and 112).

In the case of the four larger economies, the principal reason for the deterioration of their monetary authorities' returns on assets was the declining central bank interest rate (see Figure 3), which was only partly mitigated by the growing risk premia on purchased debt securities (mainly corporate bonds). Thus, while in the case of the smaller economies the exchange rate risk was of crucial importance, in the larger economies interest rate and default risks were of key importance for shaping the rate of return on monetary authorities' assets.

Let us also note, however, that in the second subperiod studied, not all the central banks lowered their rates. In particular, as was mentioned at the end of Section 3.1, in the second half of the 2010s, the Fed made a serious effort to exit from QE and – above all – the ZIRP. The effects of this attempt are visible in Panel D of Figure 4. It shows that after 2014 the Fed's profits declined. Such a development was the direct effect of policy actions: interest rate increases raised instantaneously the Fed's financial costs resulting from its remunerated liabilities, while its income continued to be modest as a consequence of investments made in the post-2007 years when the rate of return on Treasury bonds was low as a result of ZIRP policies.

Even though all three central banks from the smaller economies cut interest rates after 2007, the impact of these actions on average yield on assets was not significant since they did not have large asset portfolios in domestic currencies (NBP and the SNB) or had only just started to increase them (the Riksbank essentially through its QE operations since 2015). Thus, in the latter instance, the decreasing Swedish reference rate also had a negative impact on the rate of return on its assets. As concerns NBP and the SNB, however, it was primarily the decline of foreign central banks' interest rates which had a negative impact on the average yield of their assets. In these cases, the domestic interest rates influenced only the liabilities of these two central banks as most of their assets were denominated in foreign currencies. Consequently, it was mainly the interest rates of the four larger economies which determined the yields on the Polish and Swiss central banks' assets.

The above logic on the impact of interest rate policies on public debt prices and returns also applies to private debt (mostly corporate bonds) with the caveat that in this case the role of the default risk and risk premium is much more pronounced (government bonds are traditionally considered as risk-free financial instruments). Since most of the institutions under discussion started purchasing private debt (and some of them equities) as part of their broader activities, not only QE, we ought to consider the fact that the rates of return on assets were also determined by the default risk on central banks' assets, i.e. the risk premium. However, we must stress that corporate bonds (and equities) purchase programmes were much smaller than QE programmes aimed at public debt purchases.<sup>22</sup>

Additionally, we have to make three more reservations here.

First, the BoE, unlike other central banks, has not purchased QE securities (public, private) on its own portfolio, but granted loans to its subsidiary created in 2009, i.e. the Bank of England Asset Purchase Facility Fund Ltd (BEAPFF), which has purchased debt securities (under the Asset

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<sup>22</sup> For example, in the case of the Eurosystem, at the end of 2019, the Public Sector Purchase Programme (PSPP) amounted to 45 per cent, while the Corporate Securities Purchase Programme (CSPP) amounted to only 4 per cent of its total assets. At the same time, the SNB's exposition against government instruments amounted to almost 68 per cent, while against corporations (including equities) it amounted to almost 27 per cent of FX investments.

Purchase Facility programme) on its own balance sheet. Accordingly, the increased balance sheet of the BoE resulted from loans made to the BEAPFF (on the asset side) and the simultaneous increase in commercial banks' reserves in the central bank (on the liability side); and both balance sheet items are remunerated at BoE's reference rate (Bank Rate). Although the BEAPFF is owned by the central bank and its profit is mostly passed on to the Treasury, its operations are wholly indemnified by the Treasury, i.e. it is a risk-transfer arrangement (Archer, Moser-Boehm 2013, p. 35). As a result, despite purchasing private debt, the BoE did not benefit from the risk premium.

Second, in the case of the Eurosystem, although it purchased mainly government securities, during the European sovereign debt crisis of the 2010s they included issues of the so-called "GIIPS" countries (Greece, Ireland, Italy, Portugal and Spain). These securities were rated well below German bonds (i.e. with higher yield), which means that the rate of return on these assets were positively influenced by the risk premia. See Figure 7, Panel A, showing the evolution of the spreads of 10-year European Treasury bonds.

During the period of May 2010-September 2012, bonds of the GIIPS countries were purchased under the ECB's Securities Markets Programme (SMP);<sup>23</sup> since 2015 they have been purchased as the ECB's QE operations under the PSPP (as Figure 7, Panel B shows and the note explains, only bonds of four GIIPS countries were purchased under this mechanism).

Third, the risk premium also positively affected the rate of return on the BoJ and the SNB assets since both institutions have pronounced equity portfolios (independently of investments in corporate bonds). Thus, they invested in equities with higher return and, thus, with higher risk. The BoJ purchased Japanese stocks (massively since 2013 in the form of purchases of exchange-traded funds) (Shirai 2020, pp. 79–93). In the instance of the SNB, part of its growing FX reserves were invested in shares (together with corporate bonds).

We should also be aware of the second side of the risk premia, i.e. once it materializes. When the issuer of the asset or borrower defaults, its owner/lender (i.e. a central bank) makes a loss. Clearly, after 2007 the quality of many central banks' assets declined, not only due to corporate paper and equity purchases, but also due to relaxed collateral standards, resulting in impaired investments. Monetary authorities do not provide extensive information on such incidences. However, for example, the Eurosystem's banks mentioned two cases concerning purchases under their corporate portfolio (Bank of Finland 2018, p. 75; Banco de España 2020, p. 34). On the other hand, the Fed also diminished its profit by either creating provisions for loan restructuring or recording unrealized valuation losses of its investments in special purpose vehicles (Fed 2010, p. 26 and 34; Fed 2012, p. 4 and 27–28).<sup>24</sup>

Last but not least, we ought to mention the impact of negative yields on central banks' returns. With the introduction of NIRP policies, negative yields became increasingly widespread (CGFS 2019, p. 17). In fact, it has been estimated that by 2019 sovereign and corporate debt trading at negative nominal interest rates was equivalent of about 20 per cent of world GDP (Borio 2019, pp. 1–2). Of course, below the zero threshold the situation changes, as central banks earn income on their liabilities (commercial banks pay for keeping reserves with a central bank), while they incur expenses on their assets (as they pay interest for lent funds).

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<sup>23</sup> At its height (2012) the size of the SMP portfolio was 7–8 per cent of total Eurosystem's assets.

<sup>24</sup> For an independent overview of investment policies followed by the Fed see, for example, Stella (2009), and Binder, Spindel (2017, pp. 210–214).

Table 4 provides a schematic and simplified overview of our discussion on the main forces behind the developments of seigniorage and financial results in the second subperiod as related to the developments in 2003–2007.

Table 4 presents the behaviour of variables discussed in the first two Equations (1 and 2) of our model, taking into account seigniorage estimates' operationalization issues (Section 3.3), in the seven central banks, comparing developments of 2008–2019 vis-à-vis 2003–2007. The behaviour marked by a “–” sign means that the variable's changes worked against seigniorage and financial results (or contributed less in the second subperiod); the “+” sign suggests that it worked in favour, i.e. it increased them more in the second subperiod. Of course, “0” means in this context no major change of impact of a variable.

Given all these factors and tendencies in seigniorage and financial results' developments, it seems reasonable to conclude this section with the following three statements. First, excluding Sweden, the increase in the real demand for cash (as visible in the cash-to-GDP ratio development since 2007) allowed for the maintenance of seigniorage as an important economic variable underlying central banks' profit formation. Second, central banks' profit creation and their tendency to increase in most banks, given the declining rates of return, was above all possible due to the strong growth of the size of almost all the balance sheets of the central banks under study. Third, and consequently, with the exception of NBP – a non-QE central bank at that time – the share of seigniorage in financial results declined in the post-2007 period.

## 4.2. The distribution of seigniorage and central banks' profits

We move now to the issue of the distribution of seigniorage, i.e. its allocation between different uses, analysed as before in the context of central banks' financial results. Contrary to the question of seigniorage creation, however, the literature on its distribution is rather silent, especially the theoretical one, as it typically presumes that the whole seigniorage is a revenue of the state budget, i.e. it is entirely transferred to the government. As could be seen in Figure 4, this is not exactly the case – the annual seigniorage flow usually differs from annual transfers to the government, and our model captures this phenomenon through the “fiscal seigniorage” variable (Equation 6).

In practice, seigniorage and central banks' profit distribution issue is a very delicate economic policy problem, and largely a political one. As Figure 1 and Equation (3) have shown, there is a conflict between the central bank's funds assigned to capital ( $\Delta K$ ) and remittances which increase state budget revenues ( $TR$ ). This trade-off is a very tricky one, as on the one hand, these transfers affect the government's proceeds, potentially impacting some of its outlays, or forcing it to increase taxes or issue additional debt, while on the other hand, there is no clear-cut case for the appropriate level of capital in a central bank.

As concerns the latter, the situation is obviously different from the one in a non-financial company, a commercial bank or another financial institution. In short: non-financial companies and non-bank financial institutions ultimately need capital for their current operations in order to remain credible to their business partners (creditors) as capital provides protection to the latter by reducing moral hazard of the company/institution in question; as concerns commercial banks, they create deposits (private money) by making loans and, consequently, their activities are subject to prudential regulations, among others minimum capital requirements.

This is evidently not the case of a central bank. In principle, from a purely technical point of view, a central bank with a proper (“strong”) balance sheet structure<sup>25</sup> and a generally acknowledged policy track record would be able to conduct its operations and achieve its policy targets even with zero – or in an extreme case, negative capital (Stella 1997, p. 8 and 12). This is possible because central banks create legal tender (cash) and other forms of domestic liquidity (funds on commercial bank and government accounts), i.e. central bank money, simply by making expenditures in domestic currency (Kruszewski, Szadkowski 2021, pp. 25–30). Technically speaking then, a central bank can continue operating with losses and without capital, and this situation may last as long as it does not interfere with its macroeconomic objectives, i.e. inflation control. Thus, the final limit for such a process is set by the stability of the economy, whose preservation is one of the key roles of modern central banks.

Under these circumstances one can only very generally claim that the appropriate level of central bank capital depends on the above-mentioned structure of its balance sheet, the bank’s reputation, and the macroeconomic situation. These factors ultimately influence the public perception of the central bank’s activity, i.e. the credibility underlying the conduct of monetary policy (Bindseil, Manzanares, Weller 2004; Dall’Orto Mas et al. 2020, p. 18). When searching for more precise guidelines, central bankers tend to state that in the case of a financially independent bank it “should maintain sufficient capital to absorb any losses arising from the discharge of its functions” (Sullivan 2005, p. 444) or that “a central bank’s equity must be sufficiently high to cover the risks in its balance sheet” (Jordan 2020). On the other hand, academics sometimes stress that ultimately it is the government which decides on the size of the transfer (Buiters 2021, p. 37), implying a limited degree of true central bank financial independence.

To recap: there are no straightforward factors shaping precisely the proper level of capital in a central bank, while the governments are typically in need of resources and are usually interested in larger remittances from the nation’s bank. Consequently, to make viable the process of distribution of a central bank’s profits, profit-sharing rules are established, determining the level of transfers, and shaping the payment ratio (see Equations 4 and 5 in our model). The latter, let us recall – the portion of central banks’ profit assigned to the government – is determined in practice in different ways. These may be legal acts, i.e. laws/statutes regulating the activities of central banks (e.g. as is the case of the Bundesbank and NBP), formal agreements between the central bank and the government as is the case of the BoJ as well as autonomous decisions of one or the other (as is the case of the National Bank of Slovakia).

In Figure 4 we have already shown central banks’ transfers to the government. It can be easily seen that over time they typically moved hand-in-hand with their financial results. Correlation coefficients for these two variables are very high in most cases, almost of the value of one for the central banks of the larger economies.<sup>26</sup> Analysing the payment ratio and fiscal seigniorage developments sheds additional light on the issue (see Figure 8).

Figure 8 suggests that central banks’ profit and seigniorage allocation is characterized by different patterns of payment ratios and fiscal seigniorage developments, but several outliers tend to distort them. Let us start with the latter.

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<sup>25</sup> For example, due to the dominance of safe assets and pronounced role of cash in its liabilities.

<sup>26</sup> More precisely, the correlation coefficients for the period 2003–2019 are of almost one for the BoJ, the Eurosystem and the Fed; 0.8 for the BoE and NBP; and much lower for the SNB (0.3) and the Riksbank (-0.2). As we shall see, these two latter banks extensively use transfer smoothing mechanisms.

The BoE's developments (Panel A) show two clear outliers: the first one in 2011, and the second one in 2019. The first is related to the operations of the Bank's Special Liquidity Scheme, which was in place in 2008–2012. During its operation, the Scheme generated a substantial surplus, which was finally transferred to the Treasury in April 2012.

BoE's 2019 outlier results from a rare event – clearly the only one in our sample – as it is due to a capital injection made by the Treasury to the Bank. Namely, in 2018, an agreement on the new capital framework between the Bank and the Treasury was reached (HM Treasury 2018), which changed capital principles starting the following year. As a result, in March 2019, the Bank was recapitalized by the government in order to increase the Bank's loss-absorbing capacity (BoE 2020, p. 119 and 121). Consequently, in 2019 the net transfer was of negative value, meaning that this year the Bank was the benefited institution.

It is worthwhile noting that in the case of the BoE, the payment ratio and fiscal seigniorage move very closely together (thus, outlier values refer to both of them), which is also exceptional. This is explained by the already mentioned fact that the UK's central bank is for accounting purposes divided into the Issue Department and the Banking Department; seigniorage is the profit of the former, while the Bank's financial result and the subsequent transfer are calculated as the sum of the Issue Department's surplus and (until 2018) half of the Banking Department's surplus (BoE 2019, p. 139 and 149). With the above-mentioned 2018 agreement on the new capital framework, however, this mechanism was changed, so that the portion of the Banking Department's payable profits to the Treasury is now determined by the level of loss-absorbing capital held by the Bank (BoE 2020, pp. 36–37).

Occasional transfers which resulted in payment ratios of above 100 per cent, i.e. central bank's remittances larger than annual profits, and increased fiscal seigniorage, took place not only in 2011 at the BoE, but also in some other monetary authorities. In particular, let us note the Fed's transfers in 2015 and 2018, well above its annual profit, which were due to additional remittances to the Treasury from its capital (more precisely – the Fed's Surplus Account).

The remaining, most notable outliers are the Eurosystem in 2003, the Riksbank in 2013, and the SNB in 2004. To avoid often technical deliberations, let us only say that in the case of the Eurosystem, the outlier resulted mainly from a loss recorded by the Banque de France and a one-time transfer made by the Central Bank of Ireland (the handover of pre-monetary union revaluation gains to the government). The Riksbank's 2013 situation of unusually high fiscal seigniorage and negative payment ratio can be explained by a low level of seigniorage and the loss that the Bank recorded mainly due to the appreciation of the krona; however, because of the transfer smoothing mechanism (to be discussed) it did make a remittance to the state budget. The 2004 SNB outlier is due to a one-off payment resulting from the sale of gold and its proceeds transferred to the Confederation and the cantons.

Figure 8 shows some different patterns in the performance of the two discussed variables over time. The BoE's payment ratio and fiscal seigniorage behaviour has already been addressed. Other patterns are visible in the remaining panels of Figure 8. The underlying factors shaping them were mostly discussed in the previous section when analysing seigniorage estimates and financial result developments; this is in particular true of the BoJ, the Eurosystem, and the Fed.

Now, let us concentrate on the central banks of the three smaller economies.

The Riksbank and the SNB panels (Panel Ga for the second institution) not only reflect the factors analysed earlier, but are also the outcome of the extensive transfer smoothing mechanisms in place

(although due to the outliers, in both cases the scale of the vertical axis results in almost flat lines around the zero value). These smoothing mechanisms, embedded in the finances of the two banks, led to a distorted relationship between their financial results and transfers to the government. For example, in the case of these institutions, from time-to-time, despite annual losses, they made transfers to the government.

The transfers to the government made by the Riksbank are based on a five-year moving average of the financial result; hence, there is no direct relation between its annual results and annual transfers. We can note, however, that due to the decline of seigniorage, fiscal seigniorage is rather high, especially since 2010, when Riksbank's seigniorage showed signs of vanishing (see Section 4.1).

In turn, the SNB transfer to the Confederation and the cantons is a mutually agreed (with the Swiss Federal Department) fixed amount, for a specified period of time, meaning that there is also no direct, mechanical relation between the size of the transfer and the recorded financial result in a given year. Therefore, the "wave" pattern observed in Figure 4 (panel G) for the financial result and seigniorage, turned into a "flat" one for the payment ratio and a less volatile fiscal seigniorage ratio (Figure 8, Panel Gb, which excludes the 2004 outlier to allow for a change of scale).

Panel E of Figure 8 shows another, highly different, pattern – this time for NBP. This is due to the fact that according to the law, since 2004 NBP transfers 95 per cent of its profit to the government. Thus, the payment ratio is either 95 per cent or – when there is no profit – zero per cent. Consequently, fiscal seigniorage also often reached a zero value (in the 17-year period studied, six times transfers were zero and – as a result – both ratios under consideration as well). Only in 2019 did a kind of smoothing mechanism become effective.<sup>27</sup>

But what is the impact of monetary developments after 2007 on the variables currently discussed? To answer this question let us examine more closely Tables 5 and 6.

As could be expected, Table 5 confirms that central banks typically remit a major part of their profits to the government; outliers are rare and occasional (the Riksbank in the first subperiod, the SNB in the second). The mean for the averages of payment ratios (the bottom line in the table) is very high for the whole sample, i.e. of more than 82 per cent, substantiating the high correlation coefficient between the financial results and transfers mentioned previously. This average increased over time: it became more than 9 p.p. higher in the second subperiod than in the first one.

However, it must be strongly stressed that when comparing the two subperiods, only in three central banks did the average payment ratio actually increase (BoJ, Fed, Riksbank), while in all the remaining ones it declined. In the cases of NBP and the SNB, this tendency can be explained by recalling that the payment ratio is the outcome of the distribution of central bank profit between capital retentions and remittances to the government; the increased share of retained earnings set for capital (including FX provision) can be explained as an effect of the increased FX risk in their portfolios (see Section 4.1). In the remaining two central banks the situation is different. In the case of the BoE, the impact of the Bank of England Asset Purchase Facility Fund (BEAPFF) discussed in the previous section is visible. For the Eurosystem, the effects of reserve funds, which were created and increased to absorb the financial risk related to growing assets, played a role.

Transfers are occasionally larger than central banks' profits: in each column of Table 5, covering different time periods, this is once the case. They were due to factors discussed in the context

<sup>27</sup> By the end of that year, new rules governing the central bank's creation of a provision against the FX risk of the zloty were established (NBP 2020, p. 142 and 146–147).

of the outlier values of the Eurosystem and the Riksbank. We have also already explained the instances of the Fed in 2015 and 2018 – its remittances to the Treasury almost fully exhausted the profit made in the second subperiod.

Let us now concentrate on fiscal seigniorage developments (see Table 6).

Table 6 shows indeed, as suggested by the traditional theoretical concepts, that in the longer run central banks tend to transfer all estimated seigniorage to the state budget. For the entire sample period, only NBP transferred less than the whole income from cash issuance, i.e. below 85 per cent of its seigniorage. This was mainly due to the fact, as said earlier, that as a result of the FX risk and rules governing the Bank's creation of a provision against this risk (until 2018), it did not make any transfers six times.

Actual remittances to the government larger than seigniorage support the observation from Section 4.1 that a large or sometimes even a major part of central banks' profits originate from other activities than cash issuance (the *OI* variable in Equation 1). What is more, transfers are made even when seigniorage is negative, as shown by the cases of the Eurosystem and the Riksbank in the first subperiod. This fact clearly confirms that central banks can make, and as a matter of fact actually made, remittances despite incurring a seigniorage loss.

The last column in Table 6 suggests that after 2007 fiscal seigniorage generally increased with the exception of two institutions: NBP and the SNB. This happened because of the aforesaid issue of FX risk and the need to increase capital. On the other hand, the dominating tendency of positive changes in fiscal seigniorage in the second subperiod is again consistent with the observation made in the previous section on the decreasing share of seigniorage in central banks' financial results.

Both these observations are not contradicted by the averages provided in the pre-bottom line of Table 6. The latter rather confirm the important role of the negative seigniorage in the case of the Eurosystem (2003) and the Riksbank (2003–2004), and of the very strong value of the SNB's average fiscal seigniorage in the first subperiod (due to the 2004 outlier transfer). If the three banks are taken out of the sample, the averages for the remaining four banks decline to values leading to a positive change, reported in the bottom line of Table 6.

Finally, to wrap up our analysis in this section, let us have a bird's-eye view of central bank transfers to the government. Scaling them with GDP provides information on the evolution of their actual size in a comparative perspective (see Table 7).

In the data provided by Table 7, the combined effect of all discussed factors is accounted for. And once again, we observe the familiar pattern: central banks from larger economies with small FX exposures differ from central banks from smaller economies with large FX exposures. As can be seen in the last column of the table, the average transfers to the government (as part of GDP) increased in all larger economies in the second subperiod, while they consistently decreased in all smaller ones in the same time-span. In the first group of banks, the case of the BoE is somewhat more complicated due to the existence of the already discussed BEAPFF risk transfer arrangement. However, after including its allocations to the government, there is no doubt that the BoE's overall remittances increased substantially. Thus, it seems plausible to state that as a result of the implementation of unconventional policies, transfers in real terms to the government increased in all the larger economies under consideration.

In this group two clear subgroups can be identified. On the one hand – the US and the UK, on the other – Japan and the euro area. In the first subgroup, transfers increased significantly in the second

subperiod, while in the second subgroup, the increase of transfers was definitely lower (i.e. well below the average for the four banks). How to explain these different developments?

When answering this question let us first note that all these four central banks conducted QE policies by purchasing locally denominated securities, mostly issued by their governments. Thus, in fact, the increased transfers in the second subperiod are largely a return of the governments' interest payments made to the central banks.<sup>28</sup> The size of these returns is in turn a function of the amount of public debt purchased and its rate of return, which is largely influenced by the central banks' interest rate policies (see Section 4.1). In this latter respect, the banks' policies differed. As could be seen in Figure 3, the BoE's and the Fed's rates remained above zero, generating substantial profits from public debt which were returned to the Treasuries. In the case of the remaining two institutions, their interest rates were reduced to zero and negative (in nominal term) values. Consequently, the public debt portfolios of the BoJ and the Eurosystem generated lower rates of return than in the case of the UK and the US banks. The interest payment factor explains why the change in transfers of the latter two central banks could be above the average change for the four banks, and was much lower in the case of the BoJ and the Eurosystem.

This is obviously not the case in the three smaller economies. Given the heterogeneity of their central banks, we must now adopt a more nuanced approach, although the common factor is their large net foreign reserves (Figure 6, Panel A).

Let us recall at this point that among these three central banks only the Riksbank was formally conducting QE operations in the period analysed, which means that it was purchasing public debt denominated in local currency. However, the central bank's gains from this title could not be large as the Riksbank had already started a policy of very low and negative rates in 2008–2009, while beginning rather small QE activity (see Figure 2), relatively late (in 2015). Furthermore, its net foreign reserves position declined only in 2013, while the krona's exchange rate faced occasional tendencies for appreciation. All these factors, resulted in declining transfers in the second subperiod.

From the perspective of the conduct of unconventional policies, the Polish case of a small decline in transfers can be linked to the fact that until 2020, NBP did not conduct such policies. On the other hand, its large net FX reserves and the volatile exchange rate of the zloty, as well as the central bank's profit distribution scheme, together with the rules governing the creation of a provision against the FX risk of the zloty (in place until 2018), were additional important factors shaping the final size of the transfers.

The extreme Swiss case is the most straightforward among the three smaller economies as the strong appreciation of the franc contributed – as extensively discussed – to the large decline in its profits and, consequently, its transfers. The SNB's capital needs, linked to its transfer smoothing mechanism, further causes a decline in transfers as part of the Swiss GDP.

All in all, leaving aside the question of the macroeconomic impact, it can be concluded that the governments of the larger economies clearly benefited from their central banks' unconventional policies as they enjoyed *de facto* a non-interest, long-term credit extended by their monetary authorities. The same, however, cannot be said of the two central banks from the smaller economies that conducted unconventional policies, and their respective Treasuries.

<sup>28</sup> Such a mechanism for the Fed and the US Treasury was already stressed by Neumann (1992, p. 36). On this point see also McKinsey (2015, p. 34) and Sławiński (2016, pp. 239–244).

## 5. Conclusions

In the theoretical part, after briefly discussing the concept of seigniorage, we introduced an accounting-based model of seigniorage, in which its creation and distribution is explicitly linked to central bank financial result formation. In our approach, assuming a modern credit-based monetary system with developed financial markets and a financially independent central bank, seigniorage – currently an unobservable variable – is a subset of central bank profits, i.e. an observable variable. Thus, while financial results are easily available from central bank records, seigniorage must be estimated.

In the empirical part, based on a dataset compiled by the authors, we estimated seigniorage and showed its evolution in the context of central banks' financial results for seven central banks, four from larger economies (the euro area, Japan, the UK and the US) and three from smaller ones (Poland, Sweden, Switzerland), during the period of 2003–2019. Our empirical analyses can be concluded in the following way.

First, on the creation side, we showed that the estimated seigniorage after 2007 continued (as part of GDP) to be roughly on the same level as in the subperiod 2003–2007, i.e. usually below 0.4 per cent of GDP. However, since 2008 central banks' profits expanded, leading to a break in the share of seigniorage in financial results in the second subperiod. Further analysis showed that the relative stability of seigniorage ought to be attributed to the increase in the real demand for cash in all the countries studied (except Sweden), while the average rate of return on assets decreased. The boost of central banks' profits must be linked to the expansion of unconventional policies, in particular QE-type instruments, that – with the exception of NBP, which was not implementing them at that time – dramatically increased the size of the banks' balance sheets.

Second, on the distribution side, we could observe that in the longer run seigniorage was entirely (or almost entirely – as in the case of NBP) transferred to the state budget. Usually, the average fiscal seigniorage ratio was above 100 per cent, with the tendency to increase in the second subperiod. This means that a major part of central banks' profits originate from activities other than the issue of cash, meaning also that other central bank net income played an important role, after 2007 increasingly reflecting the expansion of assets resulting from QE operations (again, NBP being a case apart as until 2020 it did not conduct QE). Consequently, in the four larger economies, a surge of average central banks' transfers to governments was observed, principally reflecting the return of their interest payments made earlier to central banks.

Third, a clearly different situation of the three central banks from the smaller economies, vis-à-vis the remaining four, was evident. This was visible in several aspects (such as large swings in financial results and the need for transfer smoothing mechanisms), and was due above all to large holdings of FX reserves in their assets, which resulted in long net FX exposures. As a consequence, in these three countries, average transfers to the government, measured as a percentage of GDP, were smaller after 2007 than in the preceding subperiod.

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## Appendix

Average financial results, seigniorage, and other income for central banks individually: 2003–2007 vs 2008–2019  
(in % of GDP and in local currencies)

Central bank	Part A. In % of GDP				Change in p.p. <sup>a</sup>
		2003–2019	2003–2007	2008–2019	
Bank of England	Financial result	0.07/0.59 <sup>b</sup>	0.13	0.05/0.78 <sup>b</sup>	-0.08/0.65 <sup>b</sup>
	Seigniorage	0.06	0.12	0.04	-0.08
	Other income	0.01/0.53 <sup>b</sup>	0.01	0.01/0.75 <sup>b</sup>	0.00/0.74 <sup>b</sup>
Bank of Japan	Financial result	0.14	0.12	0.14	0.02
	Seigniorage	0.08	0.10	0.08	-0.02
	Other income	0.06	0.03	0.07	0.04
Eurosystem	Financial result	0.18	0.10	0.21	0.11
	Seigniorage	0.12	0.12	0.13	0.01
	Other income	0.06	-0.02	0.09	0.11
Federal Reserve System	Financial result	0.37	0.21	0.44	0.23
	Seigniorage	0.20	0.21	0.19	-0.02
	Other income	0.18	0.00	0.25	0.25
Narodowy Bank Polski	Financial result	0.18	0.06	0.23	0.17
	Seigniorage	0.14	-0.13	0.25	0.38
	Other income	0.04	0.19	-0.02	-0.21
Swedish Riksbank	Financial result	0.11	0.01	0.15	0.14
	Seigniorage	0.03	0.02	0.03	0.01
	Other income	0.08	-0.02	0.12	0.14
Swiss National Bank	Financial result	1.21	1.77	0.98	-0.79
	Seigniorage	0.21	0.41	0.13	-0.28
	Other income	1.00	1.36	0.85	-0.51

Average financial results, seigniorage, and other income for central banks individually: 2003–2007 vs 2008–2019 (in % of GDP and in local currencies), cont'd

		<b>Part B. In local currencies (billion)</b>			
<b>Central bank</b>		<b>2003–2019</b>	<b>2003–2007</b>	<b>2008–2019</b>	<b>Change</b>
Bank of England	Financial result	1.2/11.0 <sup>b</sup>	1.8	0.9/14.9 <sup>b</sup>	-0.9/13.1 <sup>b</sup>
	Seigniorage	1.0	1.7	0.6	-1.1
	Other income	0.2/10.1 <sup>b</sup>	0.1	0.2/14.2 <sup>b</sup>	0.1/14.1 <sup>b</sup>
Bank of Japan	Financial result	734.3	654.0	761.1	107.1
	Seigniorage	428.4	519.4	398.1	-121.3
	Other income	305.9	134.6	363.0	228.4
Eurosystem	Financial result	18.2	8.5	22.2	13.7
	Seigniorage	12.0	10.4	12.6	2.2
	Other income	6.2	-1.9	9.6	11.5
Federal Reserve System	Financial result	62.0	28.1	76.1	48.0
	Seigniorage	31.7	27.5	33.5	6.0
	Other income	30.3	0.6	42.7	42.1
Narodowy Bank Polski	Financial result	2.8	0.0	4.0	4.0
	Seigniorage	2.5	-1.4	4.1	5.5
	Other income	0.3	1.4	-0.1	-1.5
Swedish Riksbank	Financial result	4.6	0.6	6.3	5.7
	Seigniorage	1.1	0.9	1.2	0.3
	Other income	3.5	-0.3	5.1	5.4
Swiss National Bank	Financial result	7.6	9.3	6.9	-2.4
	Seigniorage	1.3	2.2	0.9	-1.3
	Other income	6.3	7.1	6.0	-1.1

<sup>a</sup> Percentage points difference between the two subperiods (2008–2019 less 2003–2007).

<sup>b</sup> Numbers on the right side include the financial result (net indemnity due to HM Treasury) of the Bank of England Asset Purchase Facility Fund during 2009–2019.

Note: averages are arithmetic means.

Source: annual reports of central banks, AMECO database and own calculations.

Table 1

Average financial result, seigniorage, and other net income: 2003–2007 vs 2008–2019 (in % of GDP)

	<b>Part A. All seven central banks</b>			
	<b>2003–2019</b>	<b>2003–2007</b>	<b>2008–2019</b>	<b>Change in p.p.<sup>a</sup></b>
Financial result	0.3256	0.3495	0.3160	-0.0335
Seigniorage	0.1211	0.1220	0.1207	-0.0013
Other income	0.2045	0.2275	0.1952	-0.0323
	<b>Part B. Four central banks from larger economies</b>			
	<b>2003–2019</b>	<b>2003–2007</b>	<b>2008–2019</b>	<b>Change in p.p.<sup>a</sup></b>
Financial result	0.1922	0.1417	0.2121	0.0704
Seigniorage	0.1164	0.1380	0.1078	-0.0302
Other income	0.0758	0.0038	0.1043	0.1005
	<b>Part C. Three central banks from smaller economies</b>			
	<b>2003–2019</b>	<b>2003–2007</b>	<b>2008–2019</b>	<b>Change in p.p.<sup>a</sup></b>
Financial result	0.5010	0.6126	0.4544	-0.1582
Seigniorage	0.1273	0.1018	0.1380	0.0362
Other income	0.3737	0.5109	0.3165	-0.1944

<sup>a</sup> Percentage points difference between the two subperiods (2008–2019 less 2003–2007).

Note: averages are arithmetic means.

Source: annual reports of central banks, AMECO database and own calculations.

Table 2

Average share of seigniorage in financial result: 2003–2007 vs 2008–2019 (in %)

Central bank	2003–2019	2003–2007	2008–2019	Change in p.p. <sup>a</sup>
Bank of England	79.4	92.9	73.8	-19.1
Bank of Japan	73.1	78.4	71.3	-7.1
Eurosystem	74.6	103.6	62.5	-41.1
Federal Reserve System	61.5	97.8	46.4	-51.4
Narodowy Bank Polski	68.7	5.8	108.0	102.2
Swedish Riksbank	36.4	59.1	27.0	-32.1
Swiss National Bank	22.9	37.5	16.8	-20.7
Average <sup>b</sup>	59.5	67.9	58.0	-9.9

<sup>a</sup> Percentage points difference between the two subperiods (2008–2019 less 2003–2007).<sup>b</sup> Calculated as arithmetic mean.

Source: annual reports of central banks and own calculations.

Table 3

Average rate of return on assets of the central banks: 2003–2007 vs 2008–2019 (in %)

Central bank	2003–2019	2003–2007	2008–2019	Change in p.p. <sup>a</sup>
Bank of England	1.33	3.34	0.49	-2.85
Bank of Japan	0.58	0.77	0.51	-0.26
Eurosystem	2.10	2.54	1.91	-0.63
Federal Reserve System	3.12	3.78	2.84	-0.94
Narodowy Bank Polski	1.96	-1.77	3.52	5.29
Swedish Riksbank	1.28	0.95	1.41	0.46
Swiss National Bank	2.46	5.47	1.20	-4.27

<sup>a</sup> Percentage points difference between the two subperiods (2008–2019 less 2003–2007).

Note: the rate of return on assets is calculated as the actual total income earned by a central bank on assets for each year related to the average total assets (arithmetic mean of the balance at the beginning and at the end of a given year).

Source: as in Table 2.

Table 4

Summary of main factors shaping seigniorage and financial results' developments: 2008–2019 vs 2003–2007

	<b>BoE</b>	<b>BoJ</b>	<b>Eurosystem</b>	<b>Fed</b>	<b>NBP</b>	<b>Riksbank</b>	<b>SNB</b>
1. Size of balance sheet (BS)	+	+	+	+	0	+	+
2. Cash (C)							
2.1. Volume (C/GDP)	+	+	+	+	+	-	+
2.2. Ratios:							
2.2.1. C/BS	-	-	-	-	0	-	-
2.2.2. C/M0	-	-	-	-	0	-	-
3. Rate of return on central bank assets	-	-	-	-	+	+	-
3.1. Main policy interest rate	-	-	-	-	-	-	-
3.2. Risk premia	+	+	+	+	0	+	+
3.3. Impact of the exchange rate	0	0	0	0	+	+	-
3.3.1. Gold price	0	0	0	0	0	0	-

Note: "0" – no major change (neutral factor), "+" – increased impact (positive factor), "-" – decreased impact (negative factor).

Source: own elaboration based on the arguments provided.

Table 5

Average payment ratios: 2003–2007 vs 2008–2019 (in %)

Central bank	2003–2019	2003–2007	2008–2019	Change in p.p. <sup>a</sup>
Bank of England	92.9	97.1	91.2	-5.9
Bank of Japan	92.1	91.0	92.5	1.5
Eurosystem	86.8	105.2	79.1	-26.1
Federal Reserve System	95.6	89.3	98.2	8.9
Narodowy Bank Polski	61.5	76.0	55.4	-20.6
Swedish Riksbank	123.3	0.4	174.6	174.2
Swiss National Bank	23.7	71.3	3.9	-67.4
Average <sup>b</sup>	82.3	75.8	85.0	9.2

<sup>a</sup> Percentage points difference between the two subperiods (2008–2019 less 2003–2007).

<sup>b</sup> Calculated as arithmetic mean.

Note: (1) the payment ratio (pr) is calculated as the value of the central bank's transfers to the government related to the financial result of the central bank for each year (TR/FR); (2) for the NBP when FR = 0 (see Section 4.1), the payment ratio was assumed to be of zero value.

Source: central banks' annual reports and own calculations.

Table 6

Average fiscal seigniorage: 2003–2007 vs 2008–2019 (in %)

<b>Central bank</b>	<b>2003–2019</b>	<b>2003–2007</b>	<b>2008–2019</b>	<b>Change in p.p.<sup>a</sup></b>
Bank of England	116.5	104.4	121.5	17.1
Bank of Japan	167.0	116.8	183.7	66.9
Eurosystem	126.3	(44.2)	197.3	241.5
Federal Reserve System	187.5	91.3	227.5	136.2
Narodowy Bank Polski	84.4	116.0	71.3	-44.7
Swedish Riksbank	811.9	(67.4)	1 178.3	1 245.7
Swiss National Bank	850.5	2 872.7	7.9	-2 864.8
Average <sup>b</sup>				
– all banks	334.9	455.7	283.9	-171.8
– 4 banks <sup>c</sup>	138.9	107.1	151.0	43.9

<sup>a</sup> Percentage points difference between the two subperiods (2008–2019 less 2003–2007).

<sup>b</sup> Calculated as arithmetic mean.

<sup>c</sup> Excluding the Eurosystem, the Riksbank and the SNB.

Note: (1) fiscal seigniorage (FS) is calculated as the value of central bank transfers to the government related to seigniorage for each year (TR/S); (2) figures in parenthesis present situations when a central bank recorded negative seigniorage and at the same time made a transfer to the government (as it is in the first subperiod for the Eurosystem and the Riksbank).

Source: as in Table 5.

Table 7

Average transfers to the government: 2003–2007 vs 2008–2019 (in % of GDP)

Central bank	2003–2019	2003–2007	2008–2019	Change in p.p. <sup>a</sup>
Bank of England	0.07/0.38 <sup>b</sup>	0.13	0.05/0.48 <sup>b</sup>	-0.08/0.35 <sup>b</sup>
Bank of Japan	0.13	0.11	0.13	0.02
Eurosystem	0.15	0.09	0.17	0.08
Federal Reserve System	0.36	0.19	0.44	0.25
Narodowy Bank Polski	0.24	0.25	0.23	-0.02
Swedish Riksbank	0.14	0.18	0.12	-0.06
Swiss National Bank	0.59	1.34	0.28	-1.06
Average <sup>c</sup>				
– 4 banks from larger economies <sup>d</sup>	0.26	0.13	0.31	0.18
– 3 banks from smaller economies	0.32	0.59	0.21	-0.38

<sup>a</sup> Percentage points difference between the two subperiods (2008–2019 less 2003–2007).

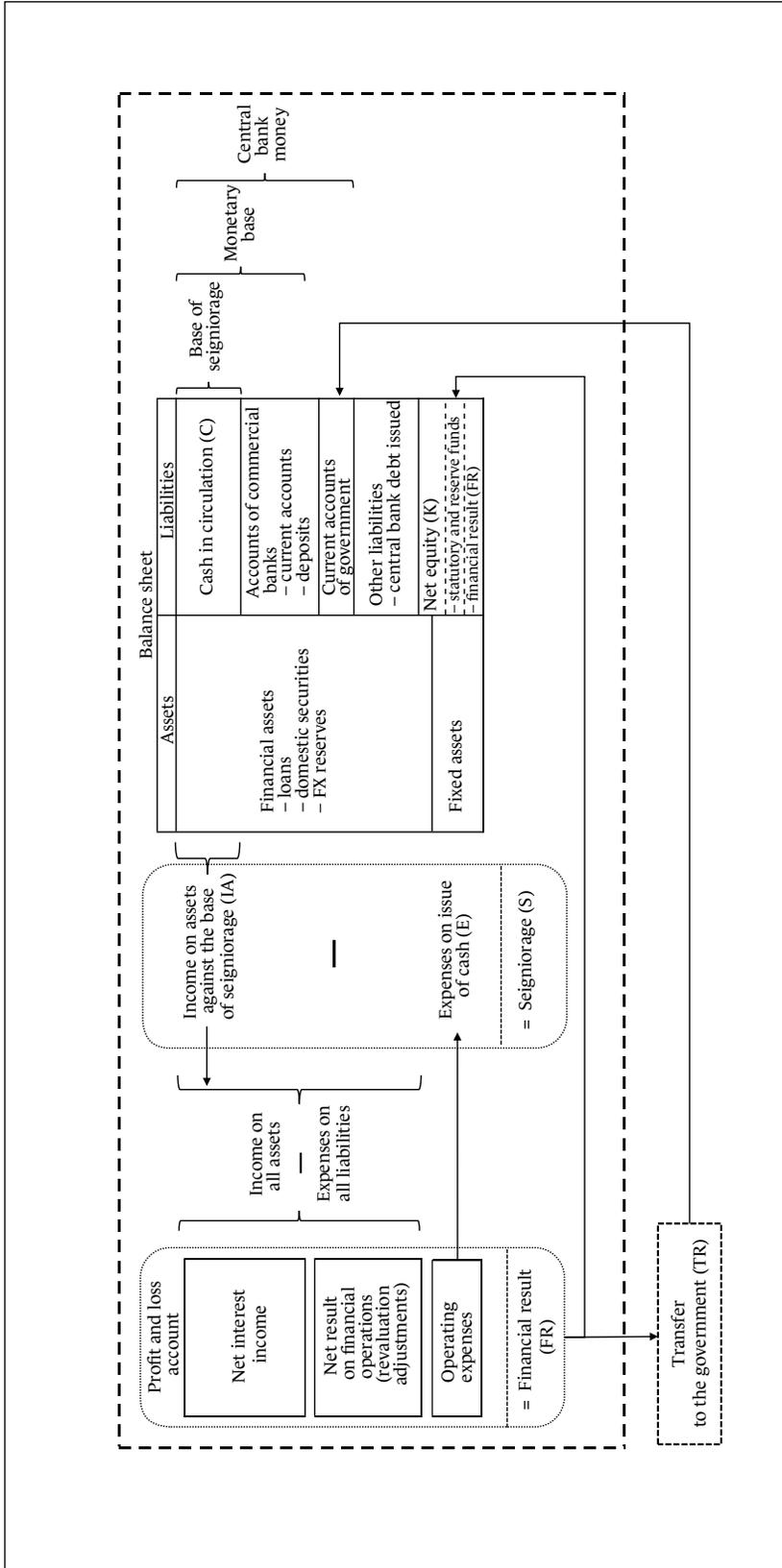
<sup>b</sup> Numbers on the right side include remittances by the BEAPFF to the government.

<sup>c</sup> Calculated as arithmetic mean.

<sup>d</sup> In the case of the BoE, the BEAPFF remittances to the government are included.

Source: central banks' respective annual reports and AMECO database.

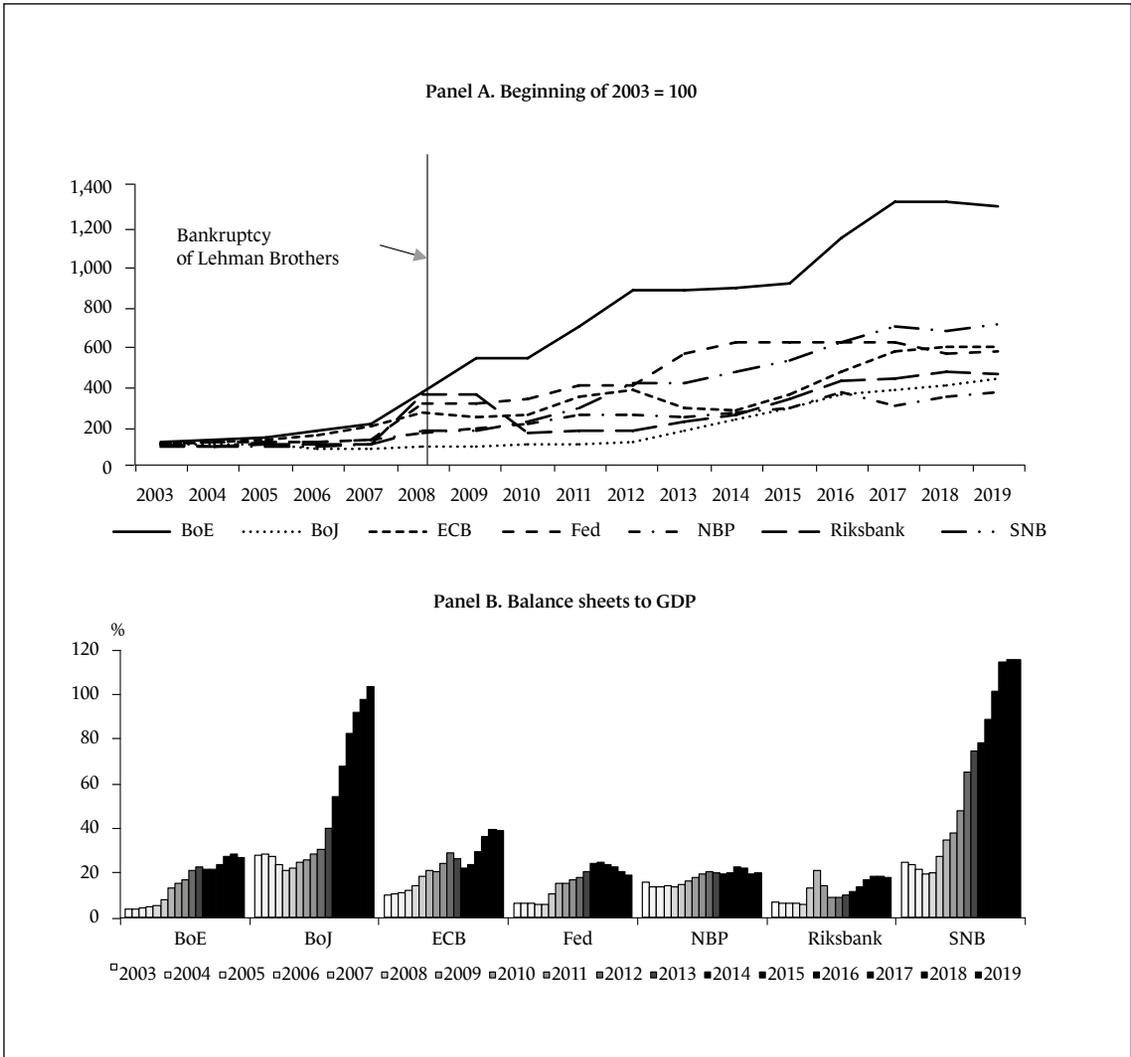
Figure 1  
Central bank finances and the creation and distribution of seigniorage and financial results



Source: own elaboration.

Figure 2

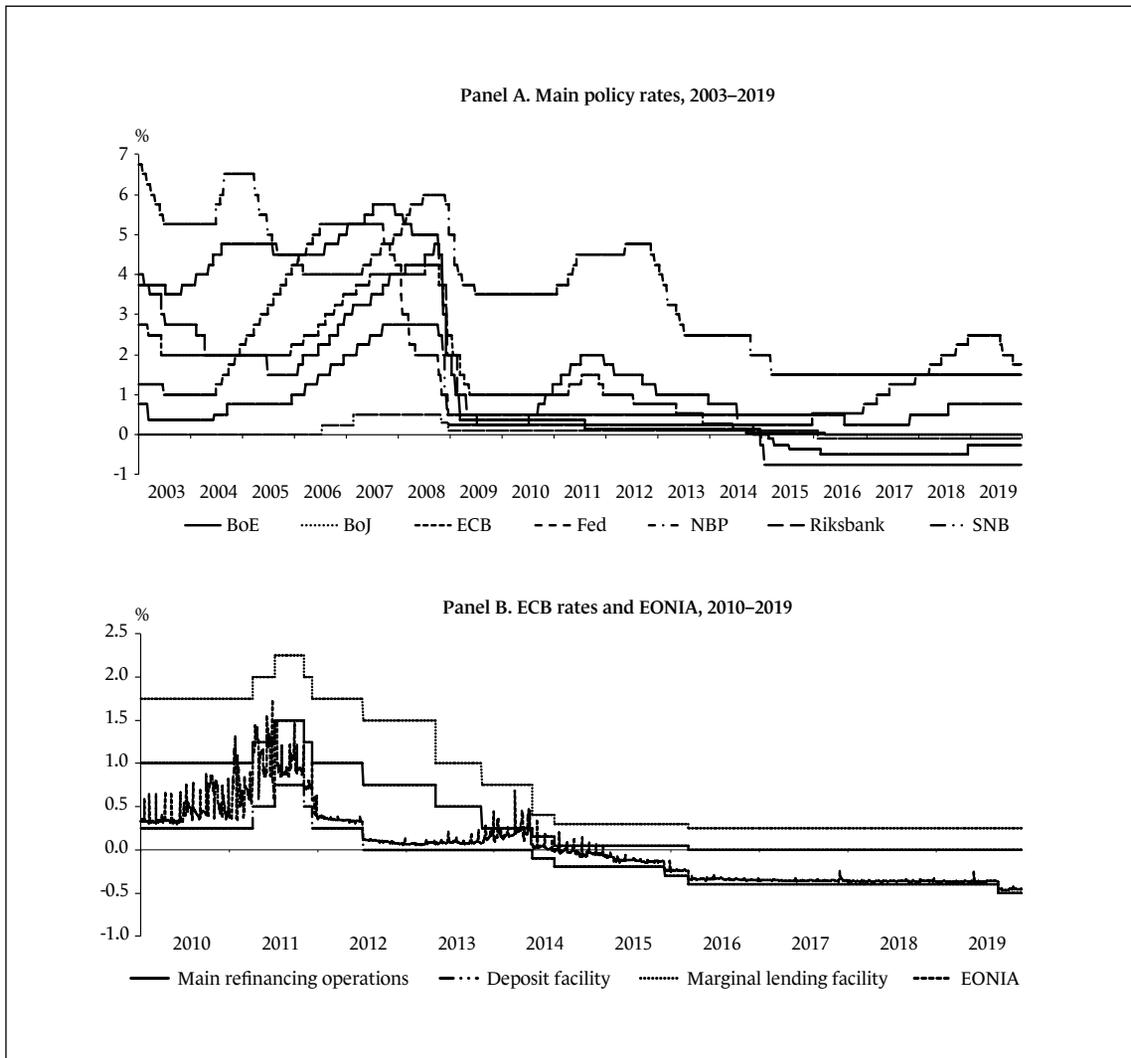
Central banks' balance sheets, 2003–2019



Note: Panel A – end of financial year data; Panel B – yearly arithmetic average values of balance sheets at the beginning and at the end of a given financial year.

Source: annual reports of the central banks and AMECO database.

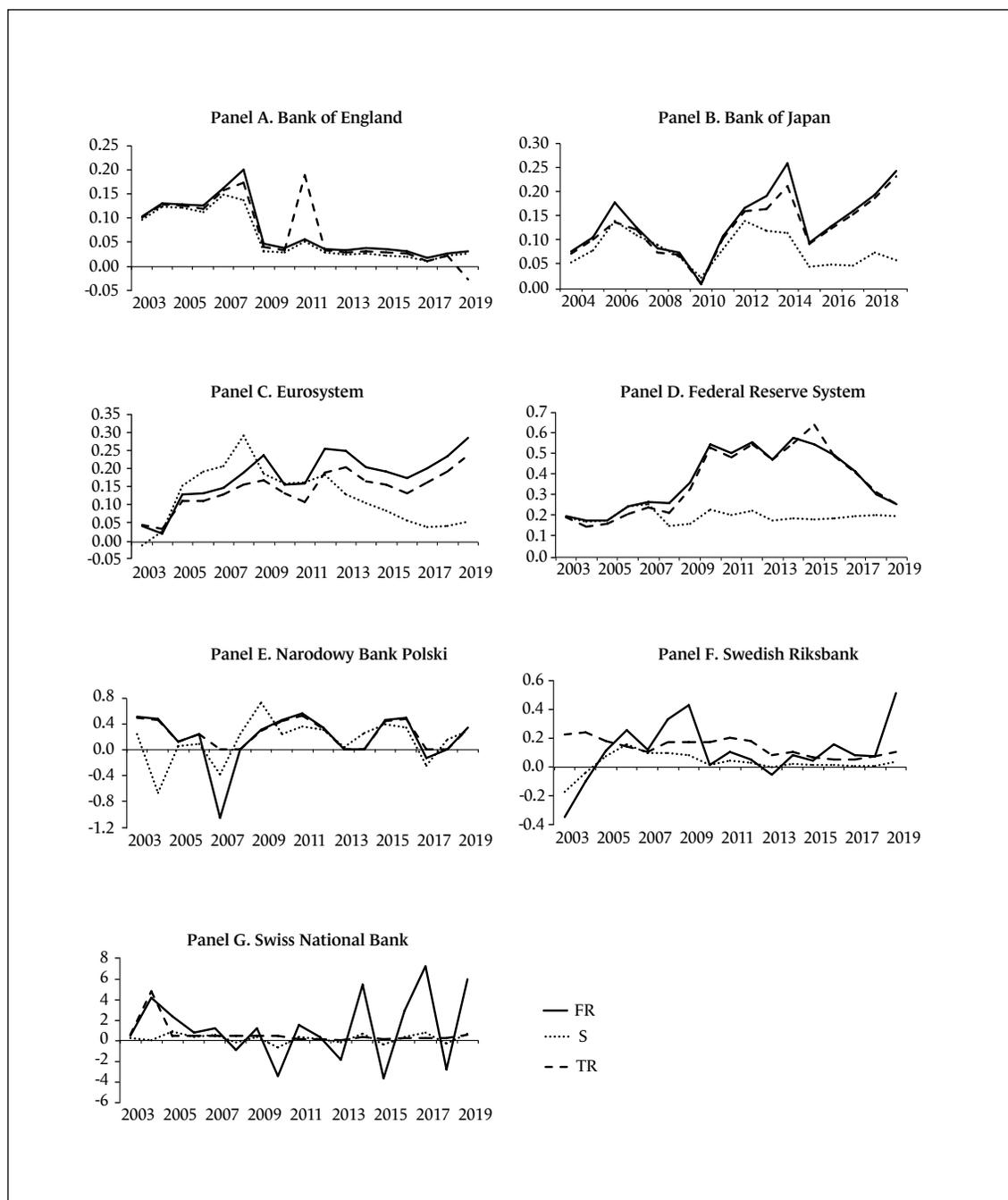
Figure 3  
Central banks' policy rates



Note: EONIA stands for Euro Overnight Index Average.

Source: central banks' websites.

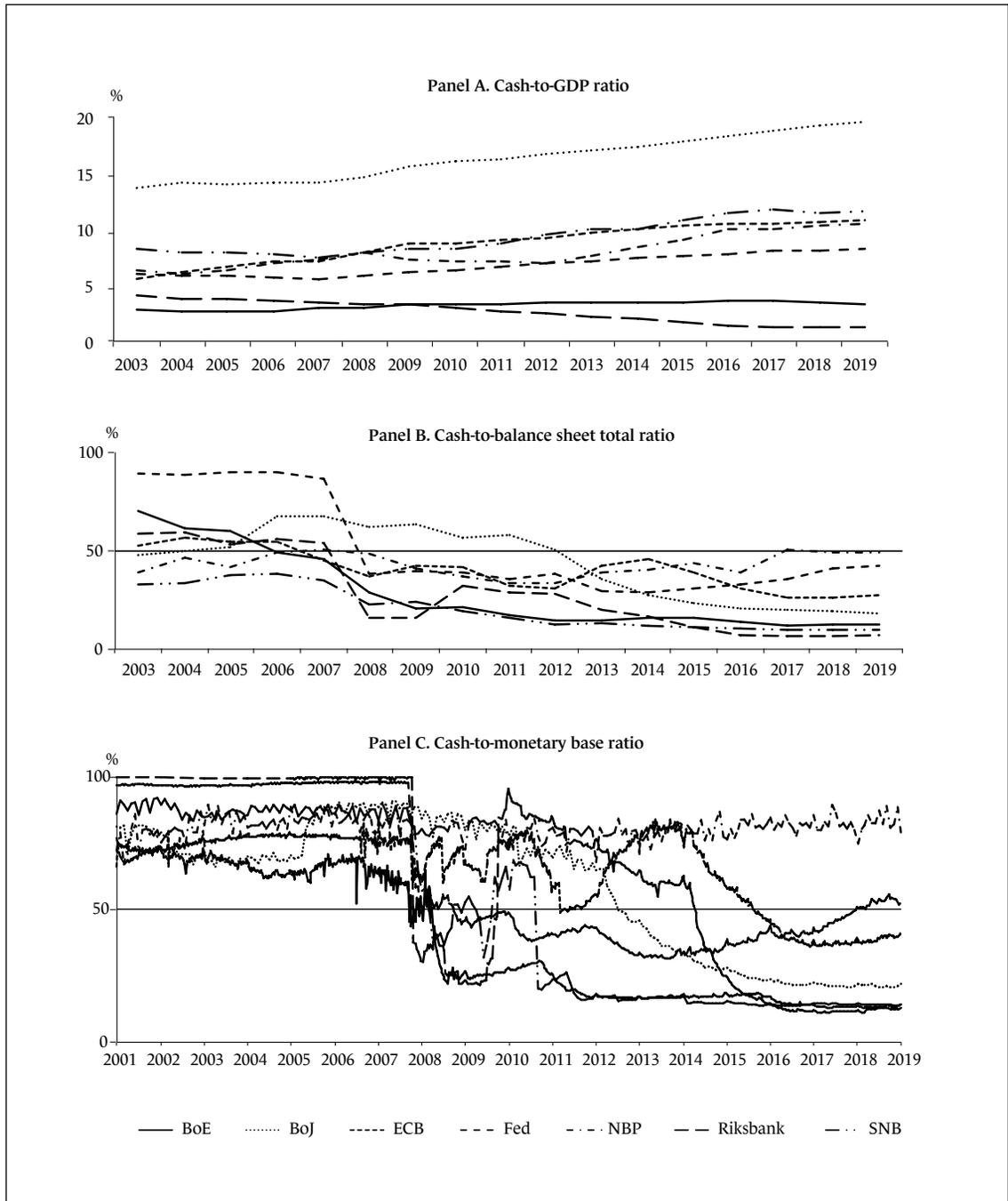
Figure 4  
Seigniorage and financial results, 2003–2019 (in % of GDP)



Note: FR – financial result (in the case of the SNB distributable annual result), S – estimated seigniorage, TR – transfer to the government (in the cases of the central banks of Belgium, France, Japan, the Netherlands, Portugal, Slovakia and the UK also includes paid income tax).

Source: annual reports of central banks, AMECO database and own calculations.

Figure 5  
Cash issuance by central banks, 2003–2019

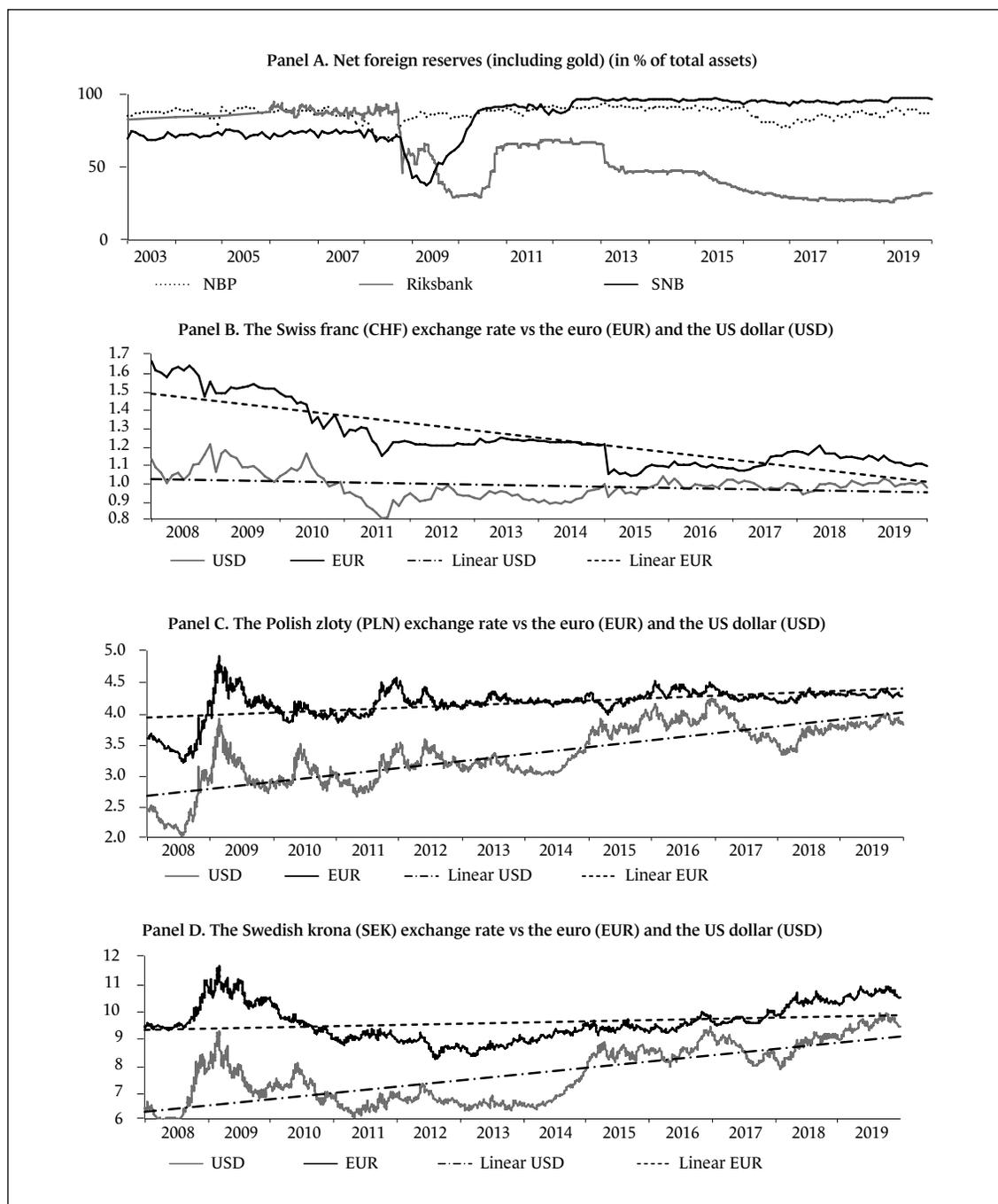


Note: (1) Panels A and B – yearly data, Panel C – weekly (BoE, ECB, Fed, Riskbank 2006–2019)/monthly (BoJ, NBP, SNB)/yearly (Riksbank 2003–2005) data; (2) monetary base is the sum of cash in circulation and the commercial banks’ reserves (in the case of the Riksbank including issued debt certificates).

Source: central banks’ websites, AMECO database and Riksbank (2014, p. 391).

Figure 6

Currency structure of three central banks' assets, 2003–2019, and exchange rates, 2008–2019

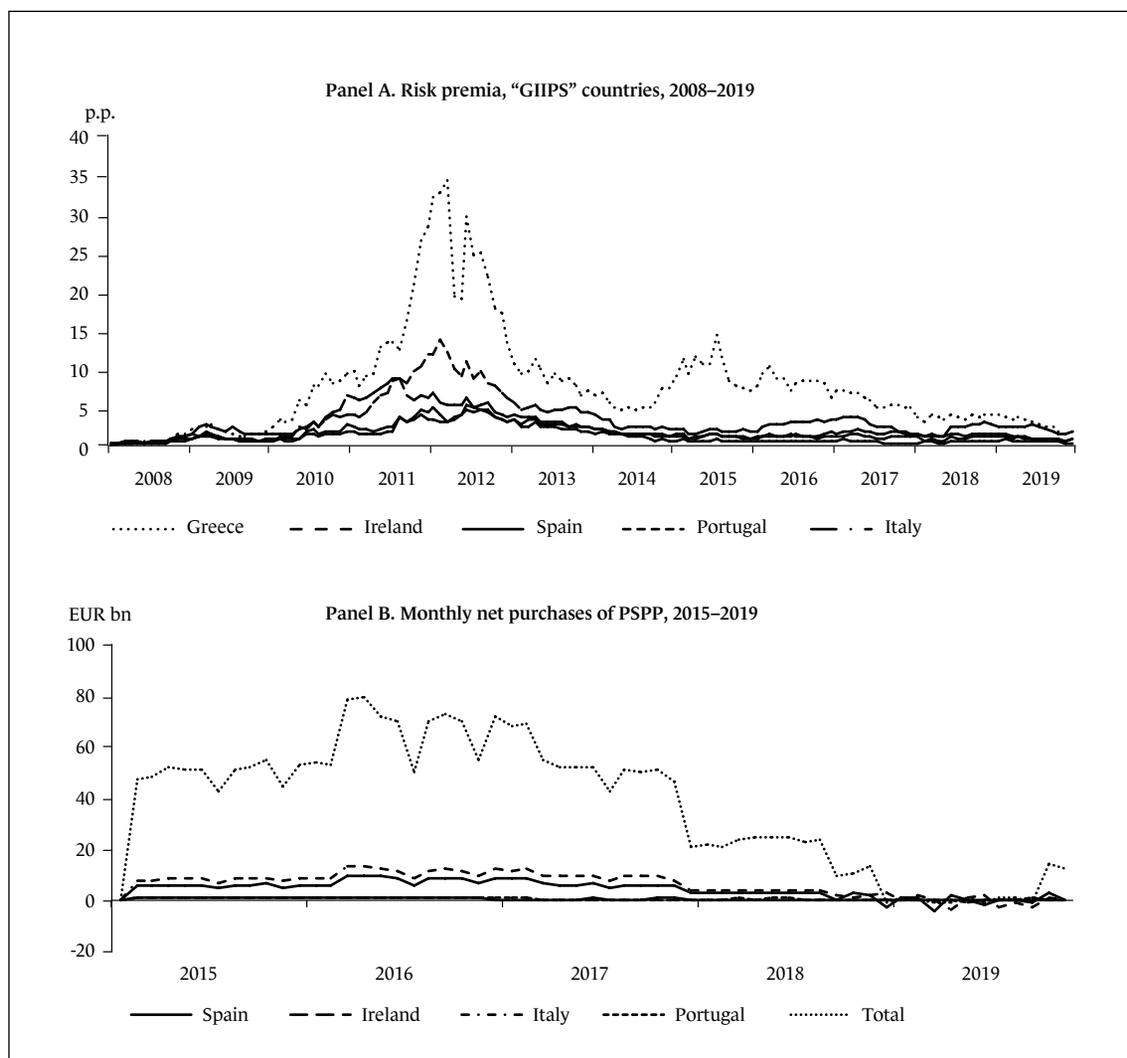


Note: (1) in Panel A, for the Riksbank before 2006 data at the end of year, since 2006 – weekly data; monthly data for NBP and the SNB; (2) in Panels B, C and D: CHF – monthly data; PLN and SEK – daily data.

Source: central banks' websites and Riksbank (2014, p. 381 and 391).

Figure 7

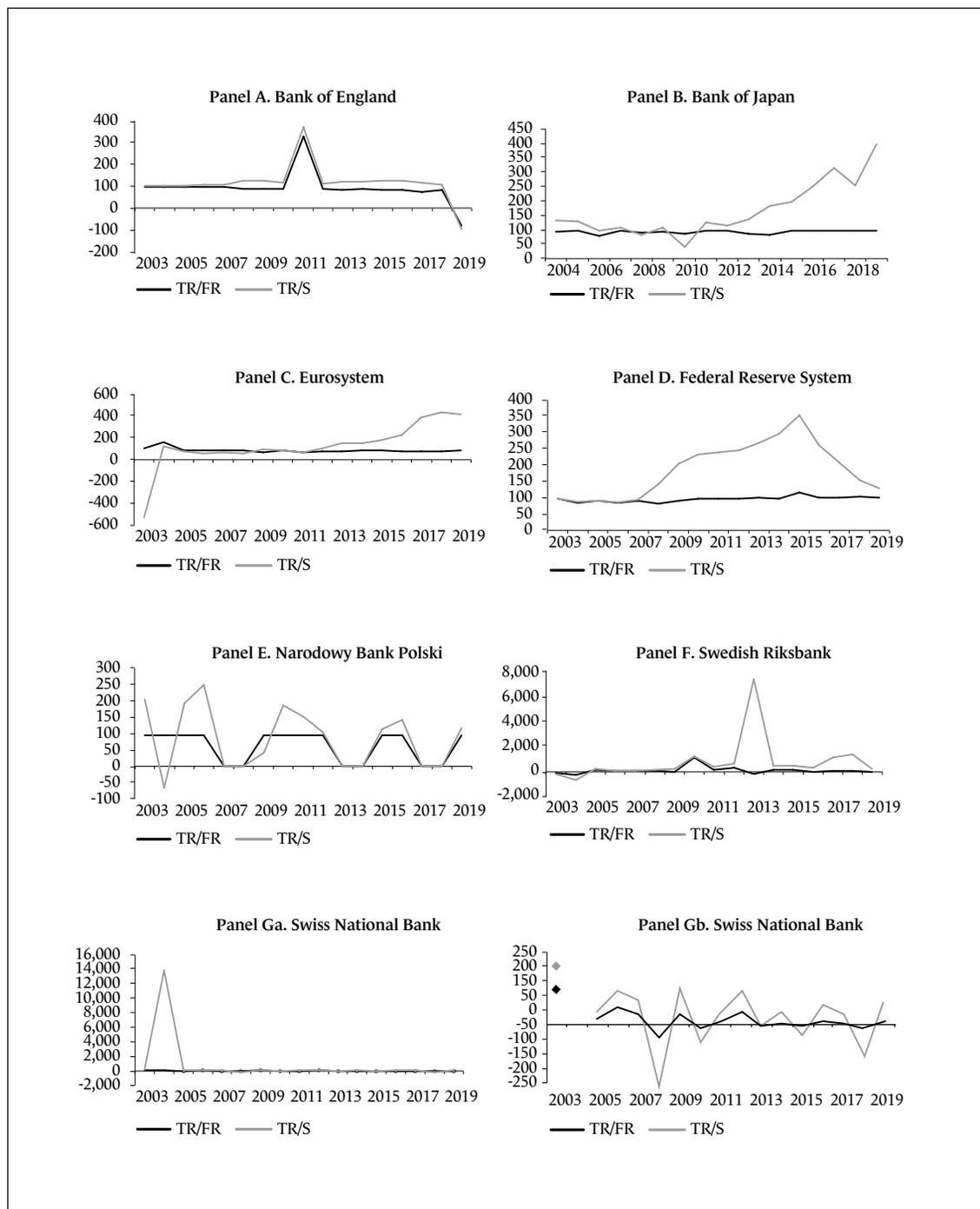
Risk premia on long-term bonds of the GIIPS countries and their purchases under the ECB PSPP



Note: "GIIPS" countries are Greece, Ireland, Italy, Portugal and Spain; "PSPP" stands for Public Sector Purchase Programme; Panel A – daily spreads between yields on 10-year Treasury bonds of a country and a comparable German bond; Panel B – Greek bonds have not been eligible under the PSPP mainly due to their low credit rating.

Source: calculations based on Reuters Datastream (Panel A) and ECB website (Panel B).

Figure 8  
 Payment ratio and fiscal seigniorage, 2003–2019 (in %)



Note: TR/FR – payment ratio, TR/S – fiscal seigniorage. See also note to Figure 4.

Source: central banks' annual reports and own calculations.

## Model księgowy senioratu: analiza renty menniczej w kontekście niekonwencjonalnej polityki pieniężnej

### Streszczenie

Celem opracowania jest rozpoznanie sytuacji w zakresie kształtowania się senioratu (renty menniczej, emisyjnej, monetarnej) we współczesnych uwarunkowaniach pieniądza kredytowego i rozwiniętych rynków finansowych, przy wykorzystaniu modelu księgowego jego powstawania i alokacji. Rozważania przeprowadzamy na dwóch płaszczyznach. Na pierwszej dokonujemy analizy teoretycznej, prowadzącej do sformułowania modelu, który jest podstawą dalszych badań. Na drugiej dokonujemy analizy empirycznej tworzenia i podziału senioratu w wybranych bankach centralnych w latach 2003–2019.

Jako punkt wyjścia proponujemy księgowy model powstawania i alokacji senioratu w powiązaniu z kształtowaniem się wyniku finansowego banku centralnego. Wychodzimy z trzech przesłanek: (1) kredyt bankowy jest ostatecznym źródłem pieniądza; (2) powstawanie senioratu wiąże się z gospodarką finansową banków centralnych, w tym z ich monopolem na emisję prawnego środka płatniczego, jakim jest nieoprocentowana gotówka; (3) bank centralny ma tzw. niezależność finansową, tzn. ma dostateczne zasoby kapitałowe do realizacji swoich funkcji oraz kontroluje swój budżet (nie finansuje więc działalności typowej dla polityki fiskalnej, np. nie udziela subsydiowanych kredytów).

Współczesny seniorat jest wielkością nieobserwowalną, stąd punktem wyjścia do jego oszacowania jest zmienna obserwowalna, jaką jest wynik finansowy banku centralnego ( $FR$ ). Powstawanie senioratu zostało zatem opisane za pomocą dwóch równań:

$$FR = S + OI \quad (1)$$

$$S = IA - E \quad (2)$$

gdzie:  $S$  – seniorat,  $OI$  – pozostały dochód netto banku centralnego,  $IA$  – dochody z jego aktywów odpowiadających wartości wyemitowanej gotówki,  $E$  – koszty emisji gotówki.

Z kolei podział (alokację) senioratu (i wyniku finansowego) opisują następujące równania:

$$FR = \Delta K + TR \quad (3)$$

$$TR = pr \cdot FR \quad (4)$$

$$pr = \frac{TR}{FR} \quad (5)$$

$$FS = \frac{TR}{S} \quad (6)$$

gdzie nowe symbole to:  $\Delta K$  – środki z zysku banku centralnego przekazane na powiększenie jego kapitału,  $TR$  – wielkość transferu do budżetu państwa,  $pr$  – współczynnik wypłaty (mówiący o udziale transferu w wyniku finansowym),  $FS$  – seniorat fiskalny (tj. ta część senioratu, która jest przekazywana przez bank centralny do budżetu państwa).

Powyższy model tworzenia i podziału senioratu został wykorzystany do badań empirycznych w odniesieniu do siedmiu banków centralnych (Bank Anglii, Bank Japonii, Eurosystem, NBP, Narodowy Bank Szwajcarii, System Rezerwy Federalnej, szwedzki Riksbank) we wspomnianym okresie, tj. w końcowych latach tzw. wielkiego umiarkowania (trwającego do połowy 2007 r.) oraz w czasie serii kryzysów (od drugiej połowy 2007 r.) i następującej po nim tzw. sekularnej stagnacji. Od roku 2008 w zdecydowanej większości wymienionych instytucji nastąpiły poważne zmiany w ich instrumentarium, prowadząc do implementacji tzw. niekonwencjonalnej polityki pieniężnej. W celu przeprowadzenia badań mających na celu ocenę wpływu tej ostatniej na tworzenie i podział senioratu stworzono autorską bazę danych (na podstawie sprawozdań finansowych banków centralnych i bazy AMECO) dotyczącą zmiennych wykorzystywanych w modelu.

Główne wyniki z badań empirycznych można sformułować następująco.

Po pierwsze, dla analizowanych banków w całym badanym okresie szacunki senioratu kształtowały się zazwyczaj poniżej 0,4% PKB. Jest to zgodne z szacunkami innych autorów dla krajów o niskiej inflacji i niskich stopach procentowych. Jednakże od 2008 r. w większości przypadków obserwujemy istotny spadek udziału senioratu w wyniku finansowym banku centralnego. Spowodowane to zostało względną stabilizacją senioratu i wzrostem wyników finansowych, co wskazuje, że w finansach banku centralnego wpływ niekonwencjonalnej polityki pieniężnej odbija się przede wszystkim na wielkości  $OI$  (równanie 1). Stabilizacja rozmiarów senioratu wynika natomiast ze wzrostu realnego popytu na gotówkę (relacji gotówka – PKB), który nastąpił we wszystkich krajach poza Szwecją, w warunkach obniżenia się średniej stopy zwrotu z aktywów banków centralnych.

Po drugie, seniorat fiskalny zazwyczaj przekraczał 100% ( $TR > S$ ), co oznacza, że dochód z emisji gotówki był najczęściej w całości transferowany do budżetu państwa. Seniorat fiskalny wykazywał tendencję do wzrostu w podokresie 2008–2019; jest to spójne z obserwacją obniżenia się udziału senioratu w wyniku finansowym banków. Realna przeciętna wielkość transferów do budżetu państwa w okresie od 2008 r. znacznie wzrosła w bankach centralnych czterech większych gospodarek, ponieważ w istotnym stopniu transferowały one z powrotem do budżetu, wypłacone im przez rządy, odsetki od skarbowych papierów wartościowych nabytych w ramach programu luzowania ilościowego.

Po trzecie, w bankach centralnych mniejszych gospodarek (Polska, Szwajcaria, Szwecja) kształtowanie się wyniku finansowego i szacunki senioratu zostały zdominowane, zwłaszcza po roku 2007, przez fluktuacje kursu walutowego. Stało się tak, gdyż w całym badanym okresie bilanse tych banków centralnych charakteryzowały się dużą długą otwartą pozycją walutową. W przypadku wszystkich trzech banków z krajów o mniejszych gospodarkach realne transfery do budżetu państwa spadły, co było przede wszystkim związane z tendencją do aprecjacji walut tych państw (szczególnie wyraźnie widoczną w przypadku franka szwajcarskiego).

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**Słowa kluczowe:** seniorat, zysk banku centralnego, niekonwencjonalna polityka pieniężna, luzowanie ilościowe, polityka ujemnej stopy procentowej

