

NBP Working Paper No. 331

Seigniorage and central banks' financial results in times of unconventional monetary policy

Zbigniew Polański, Mikołaj Szadkowski



NBP Working Paper No. 331

Seigniorage and central banks' financial results in times of unconventional monetary policy

Zbigniew Polański, Mikołaj Szadkowski

Zbigniew Polański – SGH Warsaw School of Economics and Narodowy Bank Polski (NBP);
zbigniew.polanski@sgh.waw.pl

Mikołaj Szadkowski – Narodowy Bank Polski (NBP) and SGH Warsaw School of Economics

Acknowledgments

We recognize the help of many people at different stages of our research on central bank seigniorage and financial result as its start dates back to the late 2000s. In particular, we feel deeply indebted to W.A. Allen (National Institute of Economic and Social Research, formerly with the Bank of England) and E.W. Maruszczyńska (University of Economics in Katowice), and also to G. Bachurewicz (NBP), K. Ciupa (SGH Warsaw School of Economics), M. Handig (Oesterreichische Nationalbank), M. Hołda (NBP), G. Jałuszyk (SGH Warsaw School of Economics), L. Krsnakova (Oesterreichische Nationalbank), J. Lindé (Swedish Riksbank), S. Owsiak (Cracow University of Economics), W. Przybylska-Kapuścińska (WSB University, Poznań), G. Rösl (Ostbayerische Technische Hochschule Regensburg), D. Skała (University of Szczecin), J. Wielgórska-Leszczyńska (SGH Warsaw School of Economics) and M. Zwolankowski (University of Szczecin). Earlier drafts of the paper were presented at the 31st Asian-Pacific Conference on International Accounting Issues (Warsaw, 15 October 2019), the 3rd International Conference on Economic Research 2019 (Alanya, 24 October 2019) as well as at the FinSem seminar at the University of Szczecin (Szczecin, 22 November 2019). We are very grateful to all the participants of these events who were involved in the discussions on our work. Of course, needless to say, all remaining errors are our sole responsibility.

The paper presents the personal opinions of the authors and does not necessarily reflect the official position of NBP.

Published by:
Narodowy Bank Polski
Education & Publishing Department
ul. Świętokrzyska 11/21
00-919 Warszawa, Poland
www.nbp.pl

ISSN 2084-624X

© Copyright Narodowy Bank Polski 2020

Contents

Abstract	4
List of abbreviations	5
1. Introduction	6
2. The theoretical framework	9
3. Research design	17
3.1. The time frame	17
3.2. The central bank sample	18
3.3. The meaning of unconventional policies	20
3.4. Coin issue, foreign exchange reserves and accounting policies	24
3.5. Seigniorage measurement	27
4. The impact of unconventional monetary policies on seigniorage and central banks' financial results	30
4.1. The case of the three smaller economies	38
5. The impact of unconventional monetary policies on the role of seigniorage in central banks' financial results and transfers to the government	41
6. The impact of exit policies and normalization on seigniorage and central banks' profits	52
7. Summary of main findings and final conclusions	60
References	63
Appendixes	70
Appendix 1. Definitions and estimates of seigniorage	70
Appendix 2. Central bank's balance sheet, financial result and the accounting policy	74
Appendix 3. Seigniorage, financial result and remittance to state budgets of selected central banks, 2003-18: yearly data and estimates	79

Abstract

In this paper, we estimate seigniorage and compare it with central banks' financial results and the size of transfers to the government, adopting the view of seigniorage as the monetary authority's net income from cash (currency) issuance. Based on the accounting data from the 2003-18 period, the paper analyzes seven monetary authorities: four of the larger economies (Bank of England, Bank of Japan, Eurosystem, Federal Reserve System), and three of the smaller ones (Narodowy Bank Polski, Swedish Riksbank, Swiss National Bank). With the exception of the Polish central bank, following the Global Financial Crisis and the euro area sovereign debt crisis, all of them have adopted unconventional monetary policy measures extensively. Since 2008 we have observed growing divergences between estimates of seigniorage (being typically well below 0.5 per cent of GDP) and financial results (reaching in some cases and years well above 0.5 per cent of GDP), and implied transfers to governments, the latter subject also to different rules of central banks' profit distribution. We attribute these differences primarily to unconventional activities of central banks in the case of larger economies, and to strong volatility of exchange rates in the case of smaller ones (the Riksbank being an intermediate case). We close our analysis by showing that cash and the resulting seigniorage can play the role of a buffer during the monetary policy normalization process.

Keywords: seigniorage, financial result, central bank finances, central bank profits, global financial crisis, great recession, euro area sovereign debt crisis, unconventional monetary policy, exit policies, normalization

JEL Codes: E52, E58, E65, G01, N20

List of abbreviations

AMECO	Annual macro-economic database of the European Commission's Directorate General for Economic and Financial Affairs
B	Long-term bonds purchased by central banks under QE programs
BEAPFF	Bank of England Asset Purchase Facility Fund Ltd
BoE	Bank of England
BoJ	Bank of Japan
C	Cash issued
ECB	Eurosystem (also European Central Bank)
E	Expenses of a central bank resulting from the issue of cash
EONIA	Euro Overnight Index Average
Fed	Federal Reserve System
FR	Financial result
FX	Foreign exchange
GDP	Gross Domestic Product
GFC	Global Financial Crisis
IA	Income on assets against central bank liabilities in the form of banknotes and coins in circulation (cash)
i_B	Interest rate on purchased bonds (yield at purchase date)
i_R	Central bank's reference rate
LOLR	Lender of last resort
NBP	Narodowy Bank Polski
OI	Other central bank net income
QE	Quantitative easing
R	Commercial banks' reserves
S	Seigniorage
SI	Seigniorage variant I (actual interest income on central bank's assets)
SII	Seigniorage variant II (actual total income on central bank's assets)
SNB	Swiss National Bank
TR	Transfers to the government
TR/FR	Payment ratio
TR/SII	Fiscal seigniorage
UK	United Kingdom

1. Introduction

Although it is generally accepted that maximizing profit is not a central bank goal, the issue of seigniorage is important as it is the basis of its income, and consequently, of profits transferred to the state (central) budget. Thus, seigniorage and central bank profit, while being interrelated, remain clearly an economic policy problem and, from time to time, become a widely debated political economy issue.¹

The key question that motivates us to conduct this study concerns the empirical relationship between central banks' seigniorage and their financial results (profits, potentially also losses) during the period of crises after 2007, i.e. encompassing the Global Financial Crisis of 2008-9, the Great Recession that followed and the euro area sovereign debt crisis. In particular, we ask three more detailed questions. First, how to define properly and measure seigniorage? Second, what was the impact of the crises and related unconventional policies of central banks on seigniorage, their financial results and the following transfers to respective governments? Third, what are the challenges from the viewpoint of the central banks' income statements of the so-called exit policies and attempts at the monetary policy normalization process?

In the analysis we cover the period of 2003-18 and study the performance of seven central banks: four of the larger economies (the United States, the euro area, Japan, the United Kingdom) and three of the smaller economies (Switzerland, Sweden, Poland). In other words, we analyze five central banks with a global reach (i.e. the Federal Reserve System, the Eurosystem, the Bank of Japan, the Bank of England and the Swiss National Bank), and two institutions from other open economies (i.e. the Swedish Riksbank as a representative of a highly advanced country, and Narodowy Bank Polski as a representative of a central bank from a successfully converging economy, which – being a counterpoint to the remaining cases – only

¹ Let us recall the recent case of the Reserve Bank of India (Financial Times, 2019). For a more general point see Singleton (2011: 170-3) and Rogoff (2016: 82-3 and 90-1).

very occasionally adopted some of the unconventional monetary policy tools before March 2020).

In contrast to the mainstream textbook literature, we return to the source meaning of “seigniorage”, i.e. as net income arising from the issue of cash (currency). The novelty of the paper stems from the approach applied to estimating seigniorage, as – contrary to many other academic attempts – our method relies on a direct analysis of central banks’ annual financial statements, i.e. their balance sheet items and profit and loss accounts.

During the period studied, and especially since 2008, seigniorage tended to diverge considerably with respect to central banks’ financial results and payments made to the government. Seigniorage, as defined in the paper, typically amounted to less than 0.5 per cent of current GDP. All over the crises and owing to the implementation of quantitative easing policies, the expansion of central banks’ balance sheets was usually accompanied by a considerable increase in cash issuance, although declining when calculated as a ratio of the size of their balance sheets. As a result, there was no above-average increase in seigniorage. However, the financial results (as a percentage of GDP) of almost all the central banks under study during (and after) the crises increased significantly, with the three smaller economies considered also being visibly influenced by exchange rate movements. Consequently, remittances to the state budget also increased in most cases, although they varied significantly due to different policies towards central bank profit distribution. We end our analysis by showing that cash and the resulting seigniorage can play the role of a buffer during the monetary policy normalization process. The analysis reveals that the Fed and the Eurosystem are the most protected against recording negative interest income during normalization.

The rest of the paper is organized as follows. The next two sections set the scene for our empirical research. Section 2 briefly examines different notions of seigniorage and proposes the definition used in the remainder of the paper; the concept of

seigniorage is also placed in the wider context of central bank finances. In Section 3 the sample of central banks to be studied is presented together with a discussion about their peculiarities; we also operationalize here the theoretical concept of seigniorage in line with our needs and possibilities (data access). Sections 4-6 present and discuss the empirical findings. Section 4 analyzes the impact of unconventional monetary policies on seigniorage and the central banks' financial results, stressing the different situation of central banks from the larger and the smaller economies. Section 5 discusses the role of seigniorage in the central banks' financial results and transfers to governments, while Section 6 concentrates on the potential impact of exit policies on seigniorage and the central banks' financial results. Section 7 summarizes the findings and concludes. The main body of the paper is supplemented by three appendices that provide additional evidence to the core narrative of the text.

2. The theoretical framework

There is no one generally accepted, universal definition of seigniorage. Broadly speaking, the history of money and the evolution of money-issuing mechanisms as well as banking, is also the history of its understanding. Thus, let us only very shortly review here some exemplary, modern, concepts of seigniorage from fiat money issuance, leaving a larger survey for Appendix 1.²

The most comprehensive concept of seigniorage was proposed by M.J.M. Neumann (Neumann 1992; Neumann 1996). His definition of seigniorage, the so-called “extended monetary seigniorage”, includes all financial inflows resulting from the issuance of money (understood as an increase in the monetary base) and the additional benefits associated with the net assets acquired by the central bank against the money issued, e.g. interest income. The beneficiary of seigniorage is the entire public sector (i.e. both the government and the central bank). A. Drazen presented a similar comprehensive concept of seigniorage income (Drazen 1985). According to this approach, income also relates to the growth in the volume of the monetary base and the income from domestic and foreign net assets held not only by the central bank, but also by the government.

In turn, the concept of “monetary seigniorage” refers only to the increase in the volume of the monetary base (Friedman 1971; Fischer 1982; Cukierman et al. 1990). On the other hand, the concept of seigniorage understood as an “inflation tax” perceives the benefits of the central bank in the loss of purchasing power of money (monetary base), and of the government, i.e. as the reduction in the real value of public debt, unless adequately price indexed (Keynes 1923: Chapter 2; Friedman 1953).³

² A wider and deeper analysis of the theoretical concepts of seigniorage can be found, for example, in White (1999: Chapter 7) and Reich (2017: Chapters 2 and 3 particularly).

³ Walsh (2010: Chapter 4) and Romer (2012: sub-Chapter 11.9) elaborate in detail on the mainstream academic discussion on the role of inflation and the implied seigniorage as a tax instrument.

There are at least two more approaches to seigniorage. The opportunity cost of holding money approach, i.e. the “opportunity cost seigniorage”, deals with the revenues (interest) obtained from assets acquired against money issued which simultaneously are potential costs borne by interest-free money-holders (Bailey 1956; Phelps 1973). Finally, the notion of so-called “fiscal seigniorage”, i.e. that part of seigniorage which the central bank passes on to the government (Klein and Neumann 1990: 210), deals with income on the central bank’s net assets.

Let us observe that most of these definitions abstract from the topic of costs (expenses) related to money production while they often define money as “monetary base”, i.e. the sum of cash (currency) and commercial banks’ funds on their accounts with the central bank (the latter item in monetary theory usually called “reserves”). From the theoretical, macroeconomic viewpoint such an approach is understandable as under a fiat monetary system, the costs of money production are very small in the national accounts context.⁴ On the other hand, from a practical point of view, commercial banks’ reserves can be easily turned into cash.

Furthermore, the non-remuneration of commercial banks’ reserves held with the central bank, which is usually assumed in older textbooks, was an additional argument in favor of putting them on an equal footing with cash, a non-interest-bearing financial asset. True, until quite recently both cash and reserves were non-remunerated central bank liabilities. This has, however, changed with the introduction by some central banks of remuneration on required reserves in the 1980s, and the remunerated standing deposit facility in the Eurosystem’s framework in 1999 (Bindseil 2014: 72 and 99).⁵ Subsequently, their generalized acceptance by many other central banks followed, together with the later practice – to be discussed in the next section, of penalizing by negative nominal interest rates some commercial banks’ funds deposited with the central bank. Consequently, these

⁴ Indeed, NBP calculated that in 2015 the total costs of producing and maintaining cash in circulation amounted to less than 0.03 per cent of Polish GDP (NBP 2019a: 48).

⁵ Actually, the Riksbank introduced a one deposit and one lending facility, with corresponding deposit and lending rates, already in mid-1994 (Berg and Gröthheim 1997: 146-7).

reserves became virtually identical to deposits issued by commercial banks to non-bank customers, the difference being mainly in their risk profile (reserves in a central bank are as safe as cash).

Thus, from the point of view of seigniorage accounting, the situation has changed dramatically. In the case of positive interest rates on reserves, interest rate expenses by a central bank have to be considered as an additional cost of money creation.⁶ In the case of negative rates, they are a source of central bank interest income, which is, however, difficult to consider as arising from money creation, since commercial banks lose interest as a result of not making loans and, consequently, not increasing the money stock.

Moreover, if we were to acknowledge that commercial banks' deposits with the central bank and the ones issued to their non-bank clients are almost identical in nature, this would lead to a logical conclusion that the latter also generate seigniorage, since non-bank customers' deposits are regarded as money (in the sense of monetary aggregates such as M1, M2 and so forth).⁷ Although this is obviously the case (as it is the entire banking system which ultimately generates modern money), we decided to follow a conservative approach to seigniorage. Given the above arguments and implied potential practical problems⁸, we are convinced that for the purpose of this study seigniorage creation should be tied to central bank monopoly over cash, i.e. to the creation of the legal tender of the country (monetary area). Hence, we return to the

⁶ The practical consequence for estimating seigniorage being that bank reserves, if remunerated at market rate, can be omitted as a source of seigniorage creation since the central bank costs equal its income resulting from investing the equivalent amount to reserves in assets yielding market rate returns (Kun 2003: 184 and 190).

⁷ Interestingly, the fact that modern seigniorage is created by both central banks and commercial banks is rarely recognized – exceptions are, for example, Baltensperger and Jordan (1997), Arby (2006), and Bjerg et al. (2017).

⁸ If we were to assume that commercial banks generate seigniorage gains, we would have to consider its allocation to banks' net equity, payments to the shareholders of the banks (Arby 2006: 5-6), and at least part of the taxes paid by these institutions to the state as a transfer of seigniorage. The latter would create further, highly discretionary in nature, problems in estimating the part of the tax flow resulting from "commercial banks' seigniorage". Such investigation would clearly go well beyond the scope of this study.

original (or source) meaning of seigniorage as an income from the issuance of physical money (initially full-bodied coins, over time – paper currency).

In other words, for us, as for all – to our knowledge – modern central banks⁹, the ultimate source of seigniorage is the issuance of cash, i.e. the legal tender of the jurisdictions in which central banks operate.¹⁰ Consequently, we adopt a cash-based definition of seigniorage.

Since in this paper we relate seigniorage to financial results, we cannot also abstract from the expenses incurred by central banks from cash issuance, particularly given that their reduction continues to be a major microeconomic challenge for many monetary authorities.¹¹ Therefore, our cash-based definition of seigniorage can be written in the following way:

$$S = IA - E \tag{1}$$

where:

S – seigniorage,

IA – income on assets against central bank liabilities in the form of banknotes and coins in circulation (cash),

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

In short, Equation (1) means that seigniorage is simply net income stemming from the issue of cash. More precisely, it is the income on central bank's assets against its

⁹ See an overview of concepts of seigniorage as defined by central banks in Table 1A.2 (Appendix 1). Note in particular the definition by the Swedish Riksbank. It is also worthwhile mentioning that the Currency and Bank Notes Act of 1928 (United Kingdom 1928) introduced a conceptually identical definition of seigniorage in the context of payments made by the Bank of England's Issue Department to the HM Treasury (Allen 2019: 15-6).

¹⁰ See also the discussion in Reich (2017: 3-4).

¹¹ Especially with respect to the issuance of smaller denomination coins as their production costs are often above their face value. It is also worth noting that for commercial banks, the use of cash is a costly activity, and market forces in many cases result in their motivation for reducing its usage.

liabilities in the form of banknotes and coins in circulation (held by economic agents other than the central bank) less the expenses on their issuance.

Obviously, Equation (1) implies that seigniorage is driven by three factors: (1) the volume of cash issued, (2) the return on assets held by the central bank (their interest and valuation) related to cash, and (3) the expenses due to the production (including distribution and maintenance) of cash in circulation. The question as to what shapes the central bank's financial result, however, remains to be answered.

As mentioned above, seigniorage is seen in this essay as net income from the issue of cash. But, its issuance, albeit crucial, is just one function of a modern central bank, the other functions being to a larger or lesser extent related to currency creation.¹² These other functions of a central bank result in income and costs not considered in the concept of seigniorage. Thus, the central bank's financial result equation can be written as below:

$$FR = S + OI \quad (2)$$

where the new symbols are:

FR – financial result,

OI – other central bank net income.

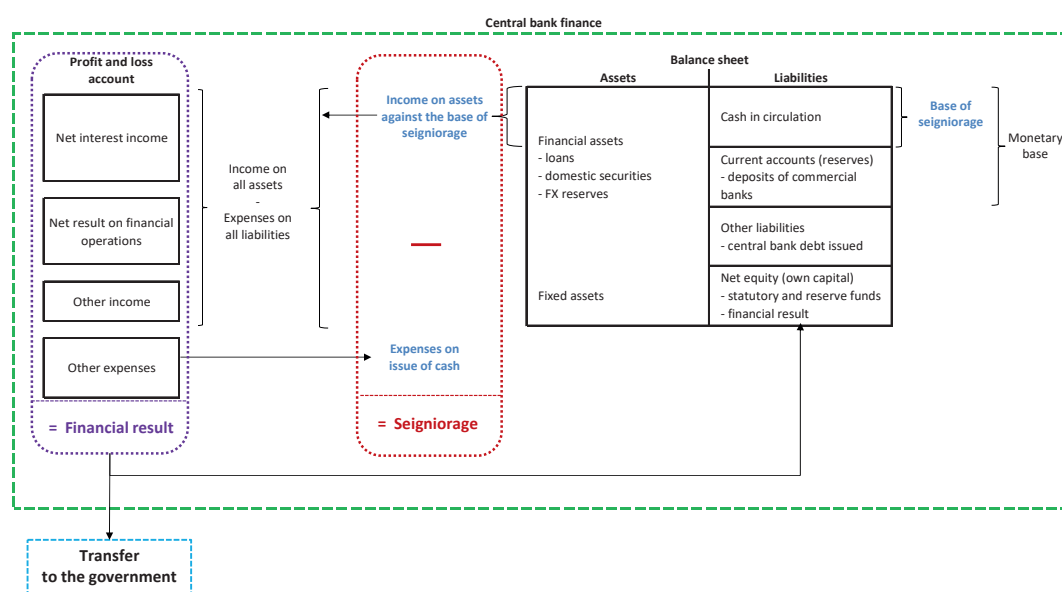
According to Equation (2), the central bank's financial result is shaped by two factors: (1) seigniorage, and (2) remaining central bank income net of related costs. As hinted earlier, the latter variable is due to the other roles performed by a central bank than

¹² On the numerous functions performed by contemporary central banks, see for example Bofinger (2001: 234-9) and Singleton (2011: 4-11). The first of these authors lists five functions, the second one – 10 (including the final one labeled “other functions”). In both cases the “bank of issue” function, i.e. the issuance of legal tender banknotes (and often coins), is mentioned as the first central bank role. See also the discussion on central banks' functions in Goodhart (1988), Ugolini (2011, 2017), and Bindseil (2019).

cash issuance. The “*OP*” variable expresses, therefore, a non-seigniorage central bank income reduced by costs unrelated to the cash-issue function.¹³

To obtain a broader picture of the issues at stake, it is worthwhile to put the above concepts of seigniorage and financial result in the larger framework of central bank finances. See Figure 1.

Figure 1. Seigniorage, financial result and central bank finances



Source: own elaboration.

In the framework of central bank finances, i.e. the financial system of a central bank, shown in a simplified form in Figure 1, we can see the links between balance sheet assets and liabilities items, seigniorage and the profit and loss account – the central bank financial result. In particular, Figure 1 makes it clear that while seigniorage is

¹³ Obviously, most of the activities of a fully-fledged modern central bank are usually more or less directly related to money issue or – more broadly – monetary policy conduct. On the other hand, however, as for example central banks functioning under currency board arrangements show, at least some of these functions may not be performed. Banking supervision, monetary and financial research or educational activities can also be (and often are) conducted by separate entities. A reverse situation may sometimes also occur; e.g. the ECB supervisory activities (conducted in the framework of the so-called first pillar of the banking union) are reimbursed by the supervised banks (see ECB, 2019: A18 and A55-A57).

normally of positive value ($S > 0$), as it relates to fiat money, i.e. currency with very low costs of issuance¹⁴, this does not necessarily have to be the case for the financial result. The latter is frequently volatile and sometimes results in negative values ($FR < 0$).¹⁵ This is because the profit and loss account is additionally determined by many factors other than seigniorage, encapsulated in the “*OP*” variable, such as expenses due to the non-issue functions of central banks, valuation changes of all assets and liabilities of a central bank, and provisions set aside. Thus, rarely, and only by chance, may the value of seigniorage equal the value of the financial result ($S = FR$). Without going into details, let us stress that in principle, from the macroeconomic point of view, losses made by the central bank are the same as government spending financed by money creation, since $FR < 0$ actually means that the generation of the new central bank money stock (the monetary base) resulting from the central bank’s expenses is larger than the reduction of this stock due to the central bank’s income.¹⁶ Alternatively, it means a situation of granting a zero-rate indefinite term loan to the government (Martínez-Resano 2004: 16).

As in the case of other financial institutions, the central bank’s financial result consists mainly of income and expenses related to financial assets and liabilities. Thus, these are mostly interest and mark-to-market gains or losses: price and foreign exchange¹⁷ revaluation results. In addition, the content and structure of the central bank profit and

¹⁴ However, as we shall see later (e.g. in Subsection 4.1 and Table 3A.2), due to foreign exchange reserves and exchange rate appreciation, particularly in smaller economies, seigniorage can be negative. See also Kun (2003).

¹⁵ On such cases, typical in most Latin American countries in the years 1987-2005, see Stella and Lönnberg (2008: 12-5). As to the Czech Republic, ten years with central bank loss during the period of 1993-2007, see Cincibuch et al. (2008). According to Deutsche Bundesbank data, during the period of 1969-1979, the Bank faced two years with no profit and seven years with a loss (Bundesbank 2020b); see also Bibow (2018: 61-73).

¹⁶ This point was suggested to us by W.A. Allen; see also Allen (2017: R66). However, a qualification is needed here. The above statement is only true when $FR < 0$ situation results in effective monetary flows between the central bank and commercial banks. A negative financial result, however, may not arise from larger realized expenses of the central bank than its income, but as a result of, for example, the central bank’s provisions creation. The latter may produce a negative financial result which does not lead to money creation.

¹⁷ I.e. due to exchange rate movements; their impact depending on whether the central bank has a closed or an open foreign currency position. In the latter case, the impact of exchange rate movements depends on their direction (appreciation or depreciation).

loss account (and implied financial result) depend on the adopted accounting policies (principles), i.e. the conventions (rules, guidelines) governing the recognition, presentation and valuation of different classes of assets and liabilities in the balance sheet. All in all, from this perspective, the central bank's financial result depends ultimately on the bank's functions and accepted accounting principles, in particular the adopted definition of income and expenses (for more see Appendix 2).

What happens to the central bank's financial result? After its calculation, as Figure 1 suggests, it is distributed to the central bank's owners (nowadays mainly the government¹⁸) and/or allocated to its net equity.

The main function of the central bank's net equity (own capital, net worth) is to absorb potential future losses (Sullivan 2003: 70). Besides the size of statutory funds, the volume of net equity depends generally on two other factors: (1) the accounting principles applied by the central bank, and (2) the principles of the distribution of its financial result, i.e. the resulting "payment ratio". The latter, the share of central bank profit transferred to the government in the financial result, is determined in practice in different ways. These may be binding legal acts (statutes regulating the activities of central banks), formal agreements between the central bank and the government (or parliament) as well as autonomous decisions of one or the other.

Summing up this part of our discussion, let us say that the volume of the central bank's financial result affects, through the payment ratio, the size of the money transfer to the Ministry of Finance (the Treasury). Since usually seigniorage is the main component of the financial result, then in "normal times" the size of the former is of crucial importance in deciding on the volume of fiscal transfer. Clearly, when the financial result is zero or negative, typically there is no such transfer.

¹⁸ In the past, before nationalizations, in the case of stock corporations, profits were usually paid out as dividends to the stockholders. However, even then a major part of profit was typically paid out to the Ministry of Finance.

3. Research design

Before we move to discuss our empirical findings, in this section we must touch upon several preliminary issues in order to present succinctly the statistical material.

3.1. The time frame

In this paper, we analyze the evolution of central banks' seigniorage, their financial results as well as transfers made to the government during the 16 years from 2003 to 2018. This time period begins and ends quite arbitrarily due to data availability and the unfinished nature of the processes involved.

The selected time frame covers two, or even three, distinct economic phases, depending on the perspective: the last years of the so-called great moderation period (until summer of 2007), the crises' period (the Global Financial Crisis of 2008-9, the Great Recession that followed and the euro area sovereign debt crisis), and finally – starting (depending on the country) around 2014 – the period of relatively sluggish growth and low inflation. If we, however, stress the monetary policy perspective, as we do in this paper, two phases can be clearly delineated in most studied cases: up to the period of crises, when only so-called conventional instruments were in place, and since 2008 when unconventional policy measures have also been adopted by central banks (see more in Subsection 3.3). In 2014, attempts at so-called “exit policies” and “normalization” started in some of the instances analyzed below, but overall, the unconventional instruments remained in place until the end of the observed period.

To be clear: these two periodizations can be easily questioned on several grounds, for example, by stressing that in Japan the crisis began much earlier (already in the 1990s), recession in the US started only in December 2007 (NBER 2010), the Lehman Brothers collapse, leading directly to the Global Financial Crisis (GFC), took place in mid-September 2008, and the US recession had already ended in June 2009 (NBER

2010). While all these facts are beyond any dispute, there is no doubt that for most major central banks (clearly with the exception of the Bank of Japan) the period of crises started in the summer of 2007. On the other hand, the first central bank to attempt to abandon crisis policies was the Federal Reserve System in the fall of 2014, when it decided to end its third round of quantitative easing. However, in mid-September 2019 the Federal Reserve System discontinued the reduction of its balance sheet, retreating from “normalization” policies. This was also the case of the Eurosystem, which decided to re-start quantitative easing in November 2019. Therefore, we do not claim that exit policies and policy normalization have been widely followed by the institutions under discussion in the period considered. In fact, during the first half of 2020, the Covid-19 pandemic and related economic events resulted in the implementation of new unconventional measures.

3.2. The central bank sample

For the time frame of 2003-18 we study the case of seven major central banks. Four of them belong to the largest economies of the developed world: the Federal Reserve System (Fed), the Eurosystem (ECB for short), the Bank of Japan (BoJ), and the Bank of England (BoE). The remaining three are the Swiss National Bank (SNB), the Swedish Riksbank (Riksbank) and Narodowy Bank Polski (NBP). The general rationale for considering these three latter institutions as a separate group is that, although similarly to the large four central banks they do operate in the international arena, their activity is, however, clearly subject to what is known as a “small open economy” situation (Walsh 2010: 422).

The three smaller central banks are very distinct. The SNB is a very special case, in some respects closer to the group of the four large central banks than to the Riksbank or NBP. This is clearly because of Switzerland’s global safe haven status and the implied international role played by the Swiss franc.

The Riksbank, the oldest uninterruptedly operating monetary authority in the world, conducted unconventional monetary policies as Sweden was strongly affected by the first wave of the crisis, later followed by domestic problems (a housing bubble and a resulting policy reaction).¹⁹ From the perspective of the adopted definition of seigniorage (see previous section), the Riksbank is also interesting because of its policies to eliminate the use of cash and advanced preparations to introduce the e-krona, a central bank digital currency (Riksbank 2017; Riksbank 2018; Riksbank 2020).

Considering NBP is worthwhile for different reasons. In fact, it is a counterpoint to the remaining six banks. This is because Poland was barely touched by the crises; actually, it proved to be quite immune to both the global and EU recessions, growing uninterruptedly since the early 1990s. Before the crisis shock, the Polish banking sector enjoyed a permanent excess (surplus) liquidity situation (Polański 2017: 33), which proved to be very helpful. As a result, NBP basically did not conduct unconventional policies. To its existing armory of instruments, it only temporarily added some repo and reverse repo operations (2008-10), FX swap operations (2009-10) and the repurchase of NBP bonds (2009) (NBP 2018: 37). Additionally, it extended one more line of domestic central bank credit (2010), reduced and increased again the reserve ratio, and conducted a few foreign exchange (FX) interventions (2010-3). In any case, before March 2020, it did not resort to unconventional policies either in the sense of quantitative easing (QE) type operations or very low (close to zero), or negative, nominal interest rates. Thus, Poland and its central bank are a quite different case from the remaining economic areas and their central banks.

Among the central banks considered, NBP was not the only one that did not conduct QE programs in the period studied. The other case was the SNB. But there is one important caveat here. The SNB did not introduce formal QE because it conducted extensive FX interventions which increased considerably the liquidity (reserves) of the Swiss banking sector having, thus, essentially achieved a similar

¹⁹ See more in Svensson (2014).

effect as regular QE operations conducted by the other five central banks (Jordan 2011; Bibow 2018: 48-52).

What is common to all of the seven central banks in the period under consideration is the fact that they enjoyed a freely floating exchange rate regime (though between September 2011 and January 2015 the SNB unilaterally set a minimum exchange rate against the euro), and freedom of capital movements. They also enjoyed significant independence (autonomy) from their respective governments (and parliaments). The degree of this independence was compromised and somewhat declined during the considered 16 years, especially after 2007 (Masciandaro and Romelli 2015: 274-80; Allen 2017; Borio 2019), but remained high by historical standards. From the perspective of this paper's topic, of crucial importance has been their financial independence (Martínez-Resano 2004: 8 and 56; see also Stella 2002), i.e. they exhibited sufficient capital and earnings generation capacity to efficiently perform their functions.²⁰ Financial independence in practice also implies an important element of transparency, i.e. the central bank's financial result being the only channel of transfer of bank's funds, including seigniorage, to the government (fiscal seigniorage).²¹ This has continued to be the case until the end of the period studied, as confirmed by the contents of central banks' annually presented accounts to the public.

3.3. The meaning of unconventional policies

By 2003, all seven central banks targeted inflation. Regarding monetary policy frameworks, three of them were full-fledged inflation targeters (the BoE, NBP, the Riksbank), while the other four used an implicit price stability anchor (the BoJ, the ECB, the Fed, the SNB) (Samarina and Apokoritis 2020). As mentioned before,

²⁰ Albeit, in some cases, e.g. the Bank of England, its capital base was apparently considered to be insufficient for the QE program, resulting in an indemnity (against losses) provided by the government (see Allen 2017: R65-R66).

²¹ This was not always the case. For example, in the 1990s many central banks from post-communist countries supplied seigniorage to the economy by other channels. See more in Cukrowski and Fischer (2003).

however, since 2007 they have all resorted, basically with the only exception of NBP (and the BoJ which started earlier), to unconventional policies. Thus, before we go ahead we should also clarify what we mean by “unconventional” – or “nonstandard” – monetary policies.

We tend to think of them as composed of two main types. First, the “QE-type” programs (operations), i.e. large-scale purchases of assets by monetary authorities conducted with the main aim of increasing the size of reserves held by commercial banks in the central bank.²² Following Borio and Disyatat (2009), we also consider a broader term of “balance-sheet policies” as the objective of increasing bank reserves – especially by the ECB – was achieved likewise by using other, “unconventional” programs.²³ Second, we consider as highly unconventional the interest rate policies aiming at close to zero and negative nominal interest rates. In fact, we are deeply convinced that ultimately the latter are more nonstandard or unconventional than the balance-sheet ones.²⁴ On both aspects of unconventional monetary policies conducted by the central banks under study, see the next two figures (Figures 2-3).

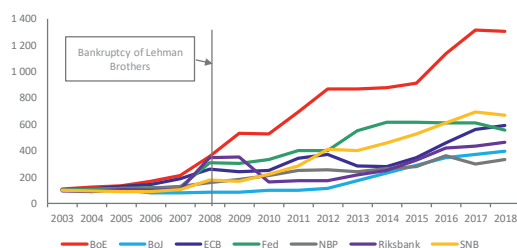
²² See Lavoie and Fiebiger (2018: 140). These authors also discuss the economic and accounting impact of different incarnations of QE programs. A more elaborate definition of quantitative easing can be found, for example, in Bénassy-Quéré et al. (2019: 282).

²³ Before starting its Asset Purchase Programme in 2015, the ECB launched a variety of non-QE balance-sheet policies such as new types of longer-term refinancing operations, the covered bonds purchase programs and so on. For more see e.g. Polański (2014a) and Polański (2015).

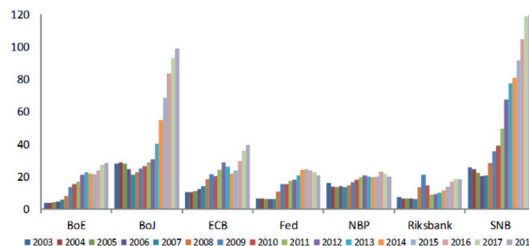
²⁴ Large scale purchases of financial assets by central banks, leading to the expansion of their balance sheets were not rare in the past (see e.g. Allen (2012) and Ferguson et al. (2015)). Zero or negative nominal rates, however, were essentially nonexistent before the late 2000s (see Homer and Sylla 2005; Rogoff 2016: 128-32).

Figure 2. Selected central banks' balance sheets developments, 2003-18

Panel A. Beginning of 2003 = 100



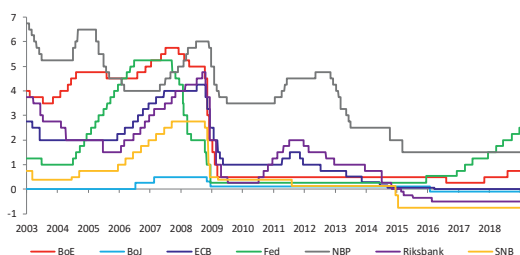
Panel B. Yearly averages balance sheets to GDP (in %)



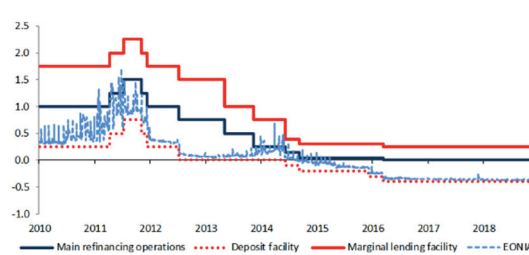
Source: annual reports of the central banks and AMECO database (access: 6 May 2020).

Figure 3. Selected central banks' rates, 2003-18 (in %)

Panel A. Main policy rates



Panel B. ECB's rates and EONIA, 2010-8 (in %)



Note: EONIA stands for Euro Overnight Index Average.

Source: central banks' websites.

The two figures and their respective panels lead to several important observations.

First, the balance sheet expansions of most of the central banks under study began well before the collapse of Lehman Brothers. This confirms that central banks were facing an unstable financial situation before the event. A different story is the case of the BoJ, which started its first official QE program already in 2001, accompanied – since 1999 – by a zero-interest policy rate (Shirai 2017: 9-11). One more important caveat has, however, to be stated here: changes in the size of central banks' balance sheets and implied fluctuations in the profit and loss accounts, which will be analyzed further on, were not only due to monetary policy actions. In the period considered,

lender of last resort (LOLR) activities were of major importance, and actually some of them evolved into QE-type activities (Mehrling 2011; Polański 2012). In the examined jurisdictions, except for Poland, which was only mildly touched by the crisis (Polański 2014b; Polański 2017), LOLR activities became important on the policy agenda, with the well-known case of the BoE and its hesitance to act as LOLR and stabilize the bank Northern Rock (second half of 2007), and they spread during the GFC. By providing emergency liquidity, central banks stabilized banking sectors while their assets further increased in the process. Yet, traditional LOLR activities deal with short-term emergency lending, and when the loan is repaid, this reduces central bank assets. Thus, in our research we will not study the impact of LOLR actions on central banks' longer-term balance sheets (and financial result) developments.

Second, in nominal terms the balance sheet of the BoE increased the most in the analyzed period (by more than 1200 per cent). In real terms, i.e. as a percentage of nominal GDP, the picture is very different, however.²⁵ The largest increase can be observed in the case of the SNB, whose balance sheet size was equivalent to about 120 per cent of Swiss GDP in both 2017 and 2018; paradoxically, as already mentioned, the bank did not conduct a QE program – almost all the increase of its balance sheet stems from the attempts to curb the appreciation of the Swiss Franc, resulting in massive purchases of FX inflows. The second largest balance sheet in terms of GDP is that of the BoJ (almost 100 per cent in 2018); not surprising, given the long history of its balance-sheet policies. On the other hand, the most stable, both in nominal and real terms, is the balance sheet of NBP, of which the explanation is trivial, as the bank was not forced at that time to implement unconventional policies.²⁶

²⁵ Let us note that we are stressing the dynamics of individual central banks' balance sheets and not comparing their sizes. The latter would be pointless as different factors (e.g. as discussed in Subsection 3.4) have an impact on the size of the balance sheet total.

²⁶ Of course, the NBP balance sheet increased in the period considered (to above 20 per cent of GDP in 2015-7), the main long-term reason being the inflow of European Union funds (Poland joined the EU in May 2004). One should also not forget about Poland's strong economic growth in the period (from 2003 until 2018 its GDP in constant prices increased by almost 90 per cent).

Third, since 2009 negative nominal interest rates in the interbank market have been gradually introduced by some central banks. They first appeared during the Great Recession, but that initially only dealt with deposit rates as was the case of the Riksbank.²⁷ By mid-2014, the ECB also implemented negative rates on deposit facilities. The next step in this development took place in 2015, when both the SNB and the Riksbank introduced negative nominal rates on their main (reference) policy rates, followed in 2016 by the BoJ. Since 2014 negative nominal market rates have also been set in some interbank money markets – in the euro area (Figure 3, panel B), Switzerland, Sweden. However, notably, both the Fed and the BoE did not move into negative territory. NBP cut its rates to the lowest level since the start of the post-communist transition (1989), setting its reference rate at 1.50 per cent in March 2015.²⁸ All in all, the period since 2014 has been increasingly marked by negative yields: 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: 1-2).

3.4. Coin issue, foreign exchange reserves and accounting policies

The seven central banks discussed in the paper differ not only in terms of macroeconomic policies pursued. As the main theme of this essay is seigniorage and the financial result, we must also stress three more important differences.

The monetary systems covered have very different histories, which resulted, among other things, in diverse traditions of issuing coins, national FX reserves ownership and adopted accounting policies. These characteristics are succinctly summarized in Table 1.

²⁷ It lowered its overnight deposit rate to -0.25 per cent in 2009-10.

²⁸ It was reduced to 1.00 per cent only in mid-March 2020, and further on to 0.50 per cent in the first half of April of that year (the deposit rate reaching 0.00 per cent).

Table 1. Selected central banks' seigniorage-related characteristics: coin issuance, foreign exchange reserves ownership and accounting principles applied

Central bank	Coin issuance	FX ownership	Accounting principles ¹
Bank of England	No	No	International Financial Reporting Standards (IFRS)
Bank of Japan	No	No	Own accounting rules
Eurosystem	Yes, in 5 national banks (Cyprus, Estonia, Lithuania, Latvia, Slovakia) ²	Yes	Eurosystem standards
Federal Reserve System	No	No	Own accounting rules
Narodowy Bank Polski	Yes	Yes	Eurosystem standards
Swedish Riksbank	Yes	Yes	Eurosystem standards
Swiss National Bank	No	Yes	Own/national accounting rules

¹ For more details see Appendix 2.

² The Eurosystem as a whole does not issue coins. However, "the ECB is responsible for approving the volume of coins that euro countries may issue." See also note (2) in Table 3A.1.

Source: central banks' websites and their annual reports, the International Monetary Fund website and Nugée (2001: 12).

Currently, coins form a very minor share of circulating cash, the latter's importance in total money stock declining in a secular, long-term, perspective. Nevertheless, issuance of coins is relatively costly, with their production costs being occasionally above their face value, especially when it comes to the lower denomination coins. Consequently, production costs of coins have some bearing on central banks' seigniorage and financial result, and are subject to close monitoring, often leading to less costly material used for newly minted coins (and attempts at limiting their role). Obviously, if issuing coins is not the bank's function, then their production costs have no impact on central bank seigniorage and profit.

The remaining two issues mentioned in Table 1 are, however, much more important for seigniorage estimation and financial result calculation.

The ownership of national FX reserves (including gold), and their presence in central banks' balance sheets, impacts on the size of balance sheets and profits, especially when large swings of exchange rates take place. In three countries mentioned in Table 1 out of the seven jurisdictions mentioned there, FX reserves are owned by the government (the Ministry of Finance). These countries are: the United Kingdom, the US and Japan (Nugée 2001: 12). In the remaining jurisdictions FX reserves are owned by their respective central banks and, consequently, are shown in their balance sheets. As for the former three countries, the situation differs in this respect. Since their central banks intervene in the FX markets in the process of managing reserves, they partly hold them in their books: in the case of the BoE, most of the UK's foreign exchange and gold reserves are not on its balance sheet, the Fed holds approximately half of federal FX reserves²⁹, while the BoJ holds up to 10 per cent of the nation's reserves. Obviously, the smaller the share of (net) FX reserves in a balance sheet, the smaller the effects, both on the balance sheet itself and size of profits, of the reserves' volatility on their value expressed in local currency, because of the exchange rate fluctuations or international price changes.

Finally, Table 1 shows that the studied central banks follow different accounting policies. It demonstrates that the seven banks use five different accounting standards (IFRS in one case, Eurosystem standards in three cases and own/national accounting rules in the remaining). This is important when comparing the central banks' performance as accounting practices have an impact on the size of the balance sheet total and tend to either moderate or exacerbate their earnings volatility (Martínez-Resano 2004: 9). For more see Appendix 2.

²⁹ See Humpage (1994: 3) and Bindseil (2004: 56-7). In both countries, in the 1930s the handling of official foreign currency reserves (and gold) changed, implying modifications in their ownership and their role in central banks' books, and the establishment of separate (from central banks' balance sheets) FX accounts (funds).

3.5. Seigniorage measurement

Before going further, we must touch upon the issue of seigniorage measurement, or more precisely, some of its operational aspects. Prior to this, let us signal again that the following analysis considers only central banks' financial statements and not seigniorage and profit/loss that arise in other monetary bodies (e.g. mints in the case of central banks not issuing coins).

Let us recall that we defined seigniorage as net income from the issuance of money (legal tender). Equation (1) must be adapted for empirical investigation as its practical application faces two important problems.

First, there is a question about unambiguous identification (or assignment) of income related to the issue of money as it is usually not possible to directly indicate which assets were acquired in exchange for the cash (banknotes)³⁰ issued.

Second, central banks do not often present information about the amount of expenses incurred broken down into performed functions, including those related to the issue of cash. The practice of presenting information on the cost of cash production is more common. However, these expenses do not include all costs related to the issuance of currency by the central bank.

Considering these reservations, we adopted a certain practical solution in the process of calculating seigniorage. We propose here two variants (options) for estimating seigniorage.³¹ They differ in the scope of income on assets related to currency issued:

³⁰ With the exception of the Bank of England, which under the 1844 Bank Charter Act was divided for accounting purposes into the Issue Department, covering banknote issuance activity, and the Banking Department, which encompasses all other activities (Bholat and Darbyshire 2016: 17). In this case, it is thus possible to indicate in the balance sheet of the Issue Department which assets are related to banknotes issued.

³¹ Szadkowski (2017; 2019: 132) proposes six options for estimating seigniorage based on Equation (1).

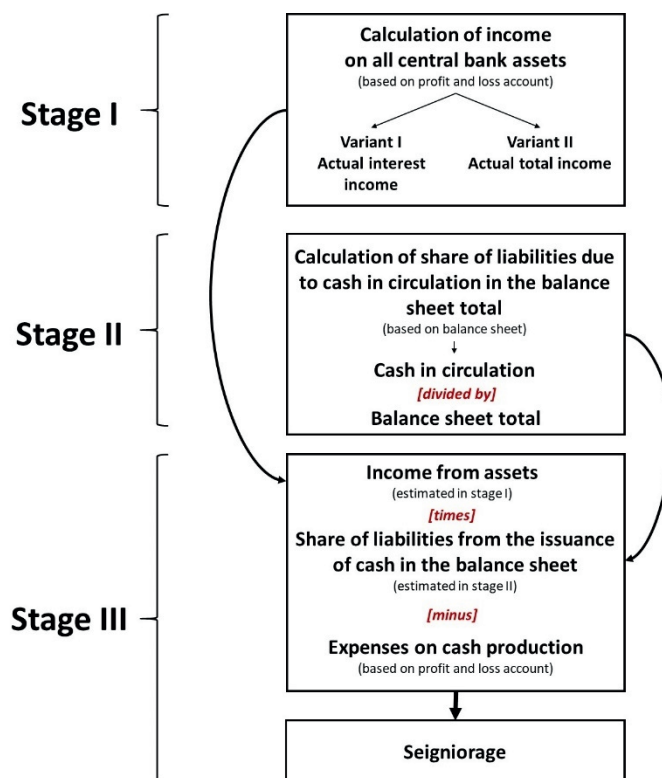
-
- variant I – actual interest income on the central bank’s assets (in what follows also “narrow” seigniorage measure, or “SI”),
 - variant II – actual total income on the central bank’s assets (“broader” seigniorage measure, or “SII”).

As regards the expenses related to issued currency, the cost of cash (or banknotes) production was considered. When no relevant information was available, overhead expenses were taken as an approximation to the cost of cash (banknote) production.³²

The basis for the estimation was the volume of cash (or banknotes) in circulation recorded in the central bank’s balance sheet. Estimates of revenues on assets were carried out in three stages (see Figure 4). In the first one, income on all central bank assets was calculated according to the variants adopted (I – actual interest income; II – actual total income). In the second stage, the share of liabilities due to cash (banknotes) in circulation in the balance sheet total was determined. In the third stage, the income from assets estimated in the first stage was multiplied by the share of liabilities from the issuance of cash in the balance sheet, calculated in the second stage. The result, diminished by the expenses on cash (banknotes) production, is regarded as the estimate of seigniorage. The estimations were made for each central bank separately in each year covered by the analysis.³³

³² It is especially crucial for those central banks which possess their own printing works and thus do not distinguish all expenses on cash production in their overhead expenses (e.g. the Bank of Italy).

³³ See also notes to Table 3A.1.

Figure 4. Algorithm for seigniorage calculation

Source: own elaboration.

To facilitate the inter-temporal and cross-country perspective, the estimated values of seigniorage (and calculated related variables) were divided by the respective current values of GDP for every year of the period studied.³⁴ The complete set of estimates and calculations is available in Annex 3, while in the following two sections we present them in graphical form (figures) and as averages (tables).

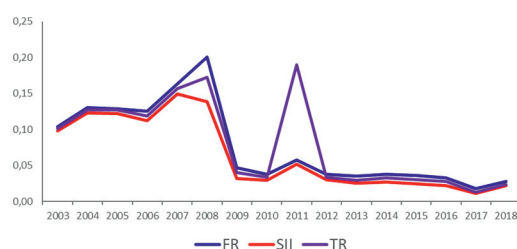
³⁴ GDP numbers were downloaded from the European Commission's AMECO database.

4. The impact of unconventional monetary policies on seigniorage and central banks' financial results

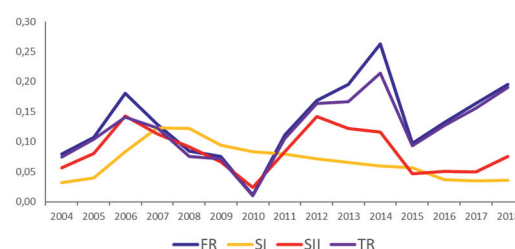
Let us compare estimated seigniorage (in both variants) with financial result developments during the period under observation for the seven central banks. See Figure 5.

Figure 5. Seigniorage (variant I and II) and financial result developments, 2003-18
(in % of current GDP)

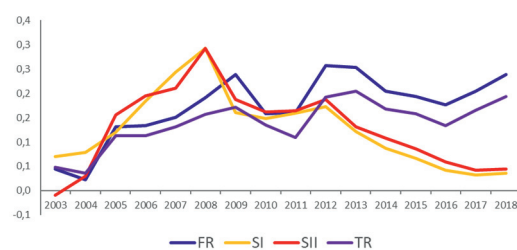
Panel A. Bank of England



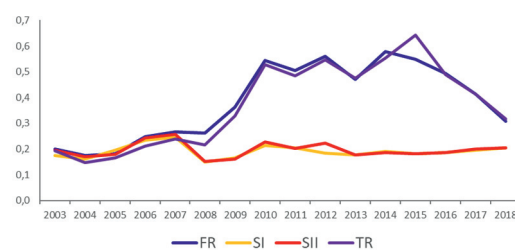
Panel B. Bank of Japan



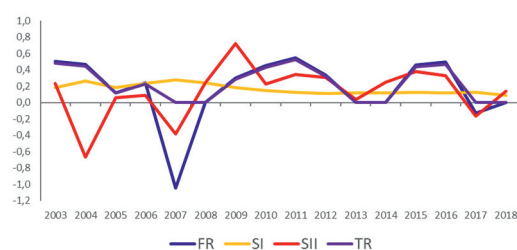
Panel C. Eurosystem



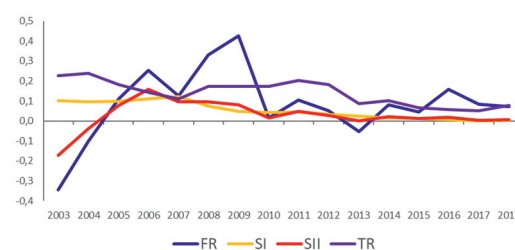
Panel D. Federal Reserve System

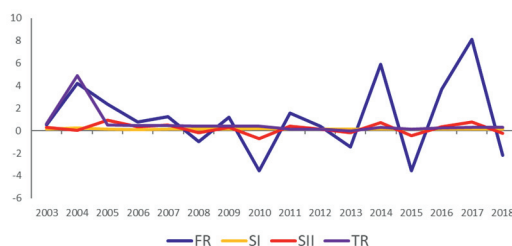


Panel E. Narodowy Bank Polski



Panel F. Swedish Riksbank



Panel G. Swiss National Bank

Notes: (1) FR – financial result, SI – seigniorage variant I (actual interest income on the central bank's assets), SII – seigniorage variant II (actual total income on the central bank's assets), TR – transfers to the government; (2) see notes to Table 3A.1 (Appendix 3).

Source: Tables 3A.1-3A.4.

What do we learn from Figure 5?

First, both variants applied to the calculation of seigniorage show that during the period studied its evolution tended to diverge considerably with respect to central banks' financial results (and payments to the government). According to the first (narrow) variant (SI), seigniorage continued to be the basis for both of them; this was, however, not entirely the case according to the second (broader) variant (SII). Whereas before the crisis seigniorage usually determined the profits of central banks (in some cases it was even higher than the financial result), the situation changed during the crisis and afterwards. For some central banks financial results skyrocketed (the Fed, the BoJ, to some extent also the Eurosystem), but seigniorage remained at the level recorded before the crisis or its pace of growth was not equally high. In the case of the BoE its profit for 2007-8 jumped and then declined below the level recorded before the crisis. For NBP and the SNB we observe high volatility of financial results.

Second, in the period studied seigniorage typically amounted to less than 0.5 per cent of GDP. This number refers to our broader measure of seigniorage estimates (SII); only in five cases (one – NBP, the remaining four – the SNB) out of 111 estimated

was seigniorage above this figure.³⁵ In the case of the narrow variant of seigniorage estimate (SI), the number was consistently below 0.3 per cent of GDP. Such results are in line with seigniorage estimates for countries with low inflation and interest rates (see Table 1A.3). The impact of low interest rate policy on the size of seigniorage is particularly visible in the first variant of estimates: in the period 2008-18 they were clearly lower, as confirmed by Table 2. Let us also note that in the case of the Riksbank, seigniorage (in both variants) gradually approached almost zero.

Third, seigniorage calculated according to the first option was quite stable, while seigniorage according to the second option was much more volatile; see also Tables 2 and 3. This is because the latter includes not only interest income, but also the results of asset valuation (price and foreign exchange gains and losses – if they are recognized as income or expense in the profit and loss account of the central bank). This volatility is particularly striking for the SNB and NBP where, as we will elaborate in more detail in Subsection 4.1, seigniorage resulted mainly from FX revaluation gains or losses. In both these cases, the main part of their assets consists of FX reserves, while liabilities are mainly denominated in local currency.

³⁵ Detailed calculations for each year of the 2003-18 period are presented in Appendix 3 (Tables 3A.1 and 3A.2).

Table 2. Average seigniorage – variant I (SI) of selected central banks: 2003-7 vs 2008-18 (in % of current GDP)

Central bank	2003-7	2008-18	Difference in p.p.
Bank of England	-	-	-
Bank of Japan	0.07	0.07	0.00
Eurosystem	0.14	0.12	-0.02
Federal Reserve System	0.20	0.19	-0.01
Narodowy Bank Polski	0.23	0.14	-0.09
Swedish Riksbank	0.11	0.03	-0.08
Swiss National Bank	0.15	0.14	-0.01

Note: calculations based on data provided in Table 3A.1; in case of the BoE it was not possible to calculate variant I of seigniorage (SI), since there is no possibility to separate interest income and other gains in the profit and loss account of the BoE's Issue Department (see also note (1) in Table 3A.1).

Source: Table 3A.1.

Table 3. Average seigniorage – variant II (SII) of selected central banks: 2003-7 vs 2008-18 (in % of current GDP)

Central bank	2003-7	2008-18	Difference in p.p.
Bank of England	0.12	0.04	-0.08
Bank of Japan	0.10	0.08	-0.02
Eurosystem	0.12	0.13	0.02
Federal Reserve System	0.21	0.19	-0.02
Narodowy Bank Polski	-0.13	0.26	0.39
Swedish Riksbank	0.02	0.03	0.01
Swiss National Bank	0.42	0.09	-0.34

Note: calculations based on data provided in Table 3A.2.

Source: Table 3A.2.

Fourth, the financial results after 2007 were much higher than in the preceding period. Contrary to our estimates of seigniorage, the financial results of most central banks tended to increase, in some cases considerably. Table 4 provides concisely more information on this latter development.

Table 4. Average financial result of selected central banks: 2003-7 vs 2008-18 (in % of current GDP)

Central bank	2003-7	2008-18	Difference in p.p.
Bank of England	0.13	0.05	-0.08
Bank of Japan	0.12	0.14	0.02
Eurosystem	0.10	0.21	0.11
Federal Reserve System	0.21	0.46	0.25
Narodowy Bank Polski	0.06	0.22	0.16
Swedish Riksbank	0.01	0.12	0.11
Swiss National Bank	1.82	0.84	-0.98

Note: calculations based on data provided in Table 3A.3.

Source: Table 3A.3.

Table 4 shows that in most cases (five out of seven) financial results, relative to GDP, increased after 2007; the two outliers (the BoE and the SNB) will be discussed in a moment. Before, let us note, however, that such a general development took place because the central banks' balance sheet policies during the crisis period resulted (as we shall see in Figure 7) mainly in increases of liabilities other than cash, i.e. commercial banks' reserves.

The financial result of the BoE did not increase after 2007 because of two reasons. On the one hand, the increased assets and liabilities were remunerated at the same interest rate, i.e. the central bank's reference rate – the Bank Rate (see e.g. Bank of England 2019: 104 and 137). Thus, the increased balance sheet total did not result in an increase in the bank's profit. On the other hand, those assets which had been financed

by cash issue were also remunerated at this reference rate, which was considerably reduced after 2007 (see Figure 3, Panel A). As regards the case of the SNB, the observed higher average financial results before 2007 were due mainly to the write-back of the provisions for the assignment of free assets in 2004 (i.e. proceeds from the sale of gold; see SNB 2005: 95, 105 and 116).

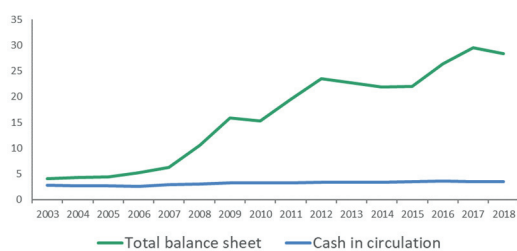
Fifth, both variants of seigniorage estimates differed from the financial results and profit transfers, in particular after 2007. As one could expect, central bank profit transfers to the government typically followed financial results. In Section 5 we will analyze, however, the divergences between the latter two variables.

To explain some of these developments, let us remind that our definition of seigniorage (Equation 1) stresses that cash (legal tender issue) is the basis for seigniorage. Therefore, let us see in Figure 6 the cash trends in the context of the total balance sheet (assets) developments of the seven central banks.

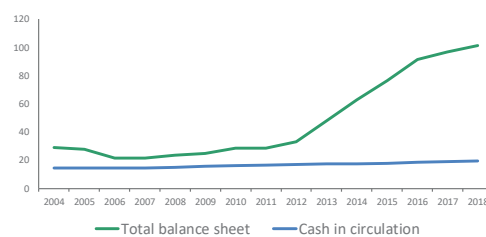
Before the outbreak of the GFC, a typical balance sheet of a central bank was mainly determined by the volume of cash (banknotes) outstanding. Generally speaking, at that time central banks usually recorded positive financial results while they were mainly determined by seigniorage, i.e. the income on issued currency was one of the main factors influencing the central banks' profits (Szadkowski 2017; Szadkowski 2019: 146-7). This changed as central banks turned to the QE-type measures in their monetary policies. In the case of our seven central banks, this evolution is visible in all panels of Figure 6, except for the one dealing with NBP (Panel E), which can be easily explained by the fact that the Polish bank essentially did not conduct unconventional policies at that time.

Figure 6. Cash and total balance sheet developments, 2003-18 (in % of GDP)

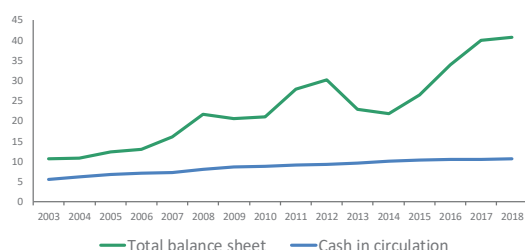
Panel A. Bank of England



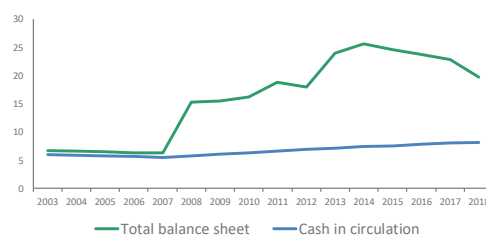
Panel B. Bank of Japan



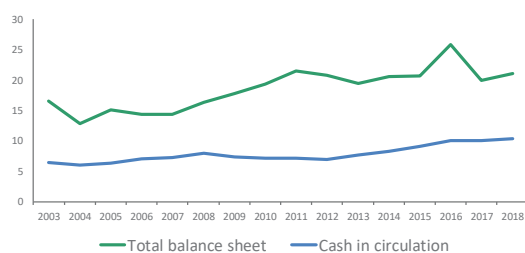
Panel C. Eurosystem



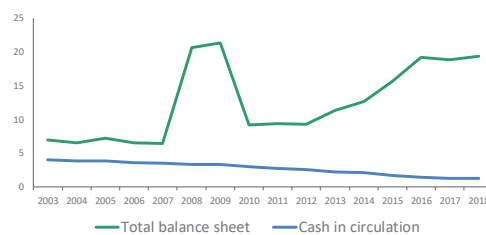
Panel D. Federal Reserve System



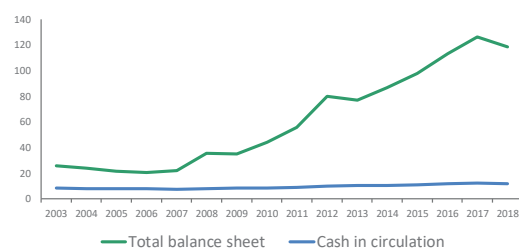
Panel E. Narodowy Bank Polski



Panel F. Swedish Riksbank



Panel G. Swiss National Bank



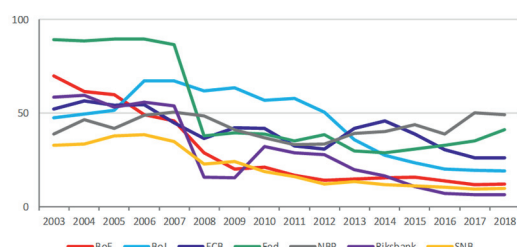
Note: Total balance sheet and cash in circulation are calculated as volume at the end of a given year.

Source: annual reports of the central banks and AMECO database (access: 6 May 2020).

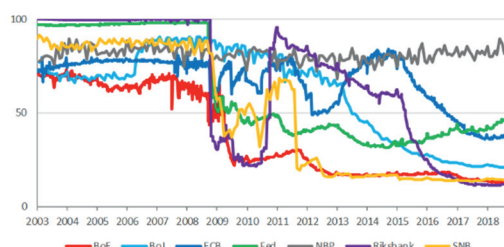
Although after 2007 an enormous growth in the volume of central bank assets was observed, it only partly resulted from the issue of cash. As shown in Figure 7, Panel A, liabilities due to cash in relation to the balance sheet total decreased for all observed central banks (once again except for NBP). While before the crisis, cash was one of the main positions in central bank balance sheets, during the period of extensive use of QE-type operations, their share reached no more than half of the balance sheet total. This happened despite considerable growth of cash in circulation (with the exception of Sweden) in real terms – see Panel C in Figure 7.³⁶

Figure 7. Cash issuance by selected central banks, 2003-18 (in %)

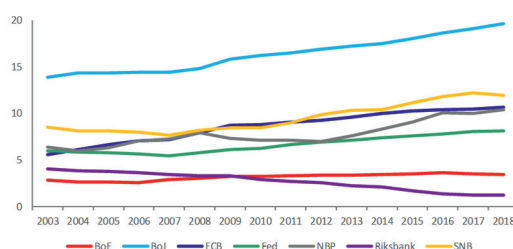
Panel A. Cash-to-balance sheet total ratio



Panel B. Cash-to-monetary base ratio



Panel C. Cash-to-GDP ratio



Note: (1) Panels A and C – yearly data, Panel B – weekly/monthly/yearly data; (2) the 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: as in Figure 6, central banks' websites (access: 11 February 2020), and Riksbank (2014: 391).

Let us now have a look at Panel B (Figure 7): in almost all cases, a diminishing role of cash in circulation in relation to the monetary base can be observed. Considering

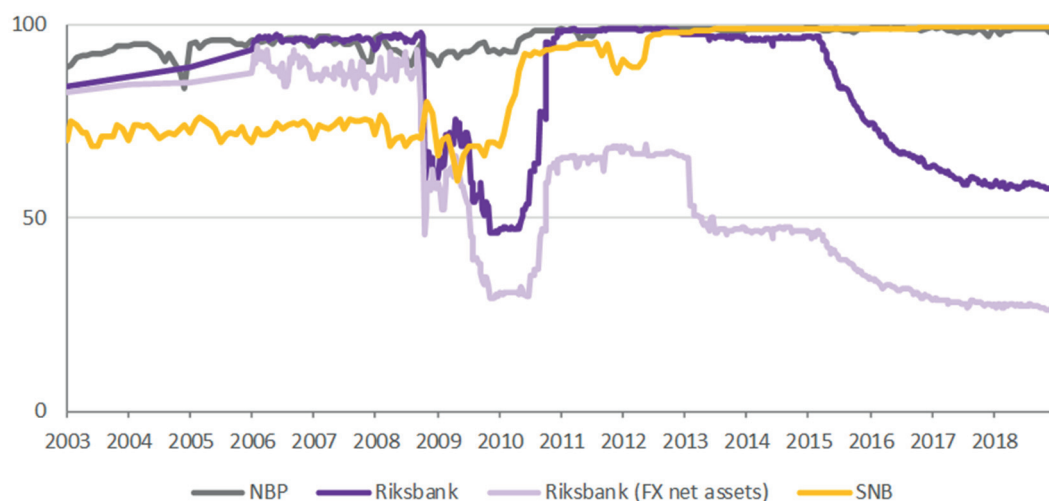
³⁶ See also, in a more detailed and much wider perspective, Jobst and Stix (2017).

the growth of balance sheet totals (Figures 2 and 6), this leads to the conclusion that the latter resulted primarily from the increase of commercial banks' reserves held with central banks.

4.1. The case of the three smaller economies

As for the three smaller economies (Poland, Sweden and Switzerland), the analyzed developments were highly influenced by one more factor – the volatility of their respective exchange rates. This was due to the fact that while central banks compile their balance sheets and financial statements in local currencies, the assets of the three central banks tended to be mostly composed of FX reserves. Over time, as shown in Figure 8, the role of foreign portfolios in the three institutions substantially increased, although the case of the Swedish Riksbank is a little bit more complex.

Figure 8. Foreign reserves (including gold) in the three central banks' assets, 2003-18 (in %)



Note: for the Riksbank before 2006 data at the end of year, since 2006 – weekly data; monthly data for NBP and the SNB.

Source: central banks' websites (access: 11 February 2020) and Riksbank (2014: 391).

In the case of NBP, FX reserves surpassed half of the value of its balance sheet total by the mid-1990s as a consequence of an abrupt increase of capital inflows, after concluding agreements on Poland's foreign debt restructuring (1994) and the start of its gradual opening to international capital flows (Ötcher-Robe et al., 2007: 39-40). After European Union accession (May 2004), the EU transfers became the main driving factor behind the growth of foreign reserves – after 2010 their value reached almost 100 per cent of the NBP balance sheet. In Switzerland, although it does not belong to the EU and does not (formally) conduct quantitative easing policies, a similar process took place – since around 2012, FX reserves of the SNB have reached almost the total value of its balance sheet. Obviously, this resulted from the SNB's interventions on the FX market aimed at curtailing the appreciation of the Swiss franc, which – among others – resulted in its top-heavy balance sheet (relative to national GDP). See Figure 2, Panel B.

As hinted, the case of the Riksbank is slightly different. True, as Figure 8 confirms, its FX reserves quickly increased after 2010 to almost the total value of its balance sheet, but this had already finished by 2015 with the start of QE operations. What is more, the evolution of Riksbank's FX net assets differed from their gross value, especially after 2008, when the Riksbank borrowed foreign currency from the Swedish National Debt Office (the purpose of this action being the strengthening of the holdings of official FX reserves; see Riksbank 2019a: 87).

In all three cases, but particularly as concerns NBP and the SNB, the strong inflow of FX reserves led to pronounced currency mismatches in the balance sheets resulting in high volatility of FX revaluation gains or losses.³⁷ In other words, and continuing using commercial bank finance terminology, their substantial FX exposures resulted from large open long positions in their balance sheets. Moreover, since securities which make up the bulk of FX reserves are valued at market prices (mark-to-market), central banks are also exposed to the high volatility of price revaluation gains and

³⁷ However, while the SNB records in its financial result FX revaluation gains and losses, NBP includes only unrealized losses in its financial result (see Appendix 2).

losses.³⁸ Consequently, large volatility of the broader seigniorage measure (SII) and of the financial results took place. If seigniorage based on interest income (SI) is considered alone, the developments in both central banks are in line with the ones in the remaining five banks (see Table 2). However, in the two institutions, seigniorage based on total income and the financial result proved to be very volatile during the analyzed period (see Figure 5, and Tables 3 and 4), often leading to situations of negative seigniorage, no profit and no payments to the state budget.

³⁸ As regards recording price revaluation gains and losses in the financial result, the earlier remark (in previous footnote) applies to the SNB and NBP, respectively (see also Appendix 2).

5. The impact of unconventional monetary policies on the role of seigniorage in central banks' financial results and transfers to the government

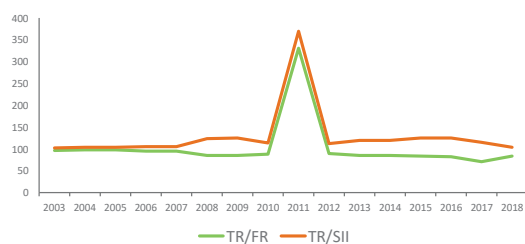
Let us go back for a while to Figure 1. After seigniorage, other central bank net income and the financial result come into existence, the latter is largely transferred to the government. The next figure presents the relevant information for the analysis focusing on the importance of seigniorage in the distribution of central bank profits during the period under consideration.

Figure 9 shows the evolution of magnitudes which were defined in the wider central bank financial framework context in Section 2. The figure displays the evolution of the payment ratio (i.e. the portion of central bank transfers to the government in its profits) and of fiscal seigniorage (i.e. the part of seigniorage which the central bank passes on to the government). The first one is calculated as the value of central bank transfers to the Ministry of Finance in relation to the financial result (TR/FR), while the second one is measured as the value of central bank transfers to the Ministry of Finance related to our broader estimate of seigniorage (TR/SII).

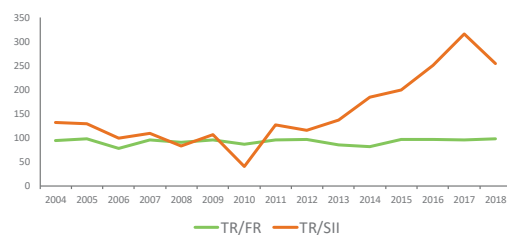
What can be learnt from the panels in Figure 9?

Figure 9. Payment ratio and fiscal seigniorage, 2003-18 (in %)

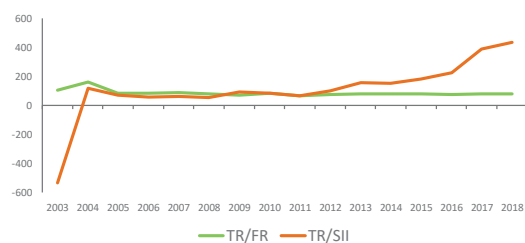
Panel A. Bank of England



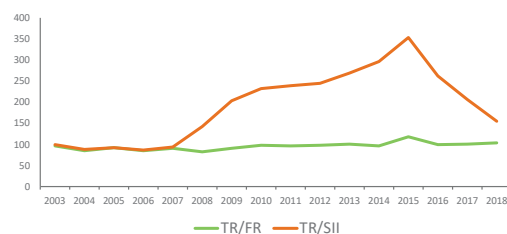
Panel B. Bank of Japan



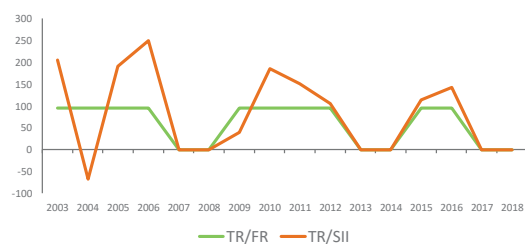
Panel C. Eurosystem



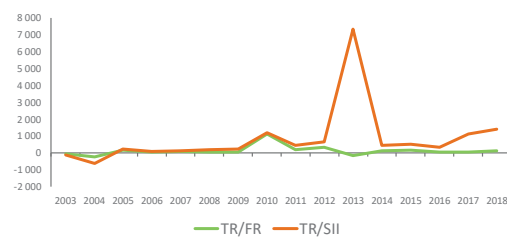
Panel D. Federal Reserve System



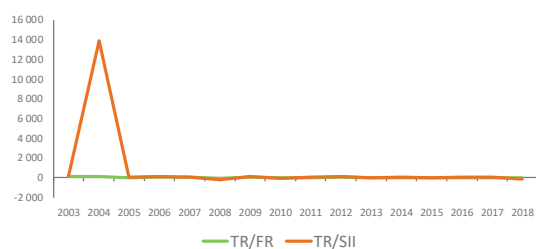
Panel E. Narodowy Bank Polski



Panel F. Swedish Riksbank



Panel G. Swiss National Bank



Note: (1) TR/FR – payment ratio, TR/SII – fiscal seigniorage; (2) as in Figure 5.

Source: Tables 3A.5-3A.6.

The overall picture is a little bit messy, with three clear outliers (the BoE in 2011, the Riksbank in 2013 and the SNB in 2004) distorting the general view.³⁹ One could naively expect that the payment ratio should not surpass 100 per cent (as the central bank would not be expected to make a larger yearly transfer than its financial result), but this is what exactly happened in the cases of the BoE in 2011, the Riksbank (in particular in 2010, but also in a few more years), the SNB (in 2003-4) and in some other instances (the ECB in 2003-4; the Fed in particular in 2015). Besides, in some years, in the cases of the Riksbank and the SNB, payment ratios reached negative values, meaning that in a given year the central bank recorded a loss while at the same time making a transfer to the government – see Table 3A.5 for further details. Indeed, strong inter-temporal smoothing mechanisms for central bank payments to the governments have been in place in some central banks.⁴⁰ For example, the Riksbank calculates the amount to be transferred as a part of the average adjusted financial result for the previous five years (Riksbank 2019b), while the SNB calculates the transfers to the Confederation and cantons based on periodic agreements which stipulate the volume of transfers which do not always relate to the profit earned by the SNB in a given year (SNB 2020). Obviously, the central banks under study differ highly in terms of the rules governing profit distribution and transfers to the government.

Concerning fiscal seigniorage developments, one can notice two apparently inconsistent processes. On the one hand, as could be expected, they basically went hand in hand with the payment ratio developments, the BoE being the most notable

³⁹ An obvious technical reason being the very different scale of the vertical axis in the cases of the Riksbank and the SNB. Thus, we suggest also looking at the underlying data for Figure 9 in Tables 3A.5 and 3A.6 (Appendix 3).

⁴⁰ The exception in our sample was the central bank of Poland. According to the 2004 amendment to the 1997 Act on NBP (Article 62), 95 per cent of its profit is transferred to the Ministry of finance and the remaining 5 per cent is allocated to the reserve fund while the loss is absorbed by the latter fund. Thus, as can be seen in Panel E in Figure 9, the payment ratio for NBP was either 95 per cent or zero (in the years when there were no transfers – see also Panel E in Figure 5). A sort of smoothing mechanism in the NBP financial framework was only established by the end of 2019 with the introduction of new rules governing the central bank's creation of a provision against the FX risk of the zloty (NBP 2019b).

example⁴¹, as well as both the Riksbank and the SNB if we abstract from the outlier years (2013 and 2004 respectively). On the other hand, fiscal seigniorage showed considerable volatility – from highly negative values (the ECB in 2003 achieving – 534 per cent⁴²) to extremely positive values (the SNB in 2004 reaching a record 13,887.9 per cent). As one would expect, this last development resulted from a one-off payment, mentioned already in the previous section.

However, we are rather inclined to stress different factors when explaining the volatility of fiscal seigniorage vis-à-vis the payment ratio development. Namely, we tend to indicate the role of the “other central bank net income” variable from the financial result equation (Equation 2). While seigniorage (both SI and SII – see Figure 5) changed as a result of cash and rate of return on assets developments (Figures 6 and 7), the main factor behind financial result developments was the “other central bank net income” variable. The strong growth of the latter being a direct function of QE-type operations of central banks and their impact on central banks’ balance sheet size. Clearly, with the onset of the 2008 crisis and the adoption of QE-type tools, the “other income” variable increasingly generated transfers to the governments. That is why, since 2008 in most cases, fiscal seigniorage, the relationship between strongly growing transfers and relatively stable seigniorage, surpassed 100 per cent (NBP and the SNB being partly exceptions⁴³).

More information on the impact of unconventional monetary policies on the role of seigniorage and the “other central bank net income” on payments to the government

⁴¹ The reason being the applied mechanism of profit distribution according to which all seigniorage (profit of the Issue Department) and half of the Banking Department’s profit is paid to the Treasury (Bank of England 2019: 139 and 149).

⁴² This was because the estimated seigniorage was negative (mainly due to the appreciation of the euro and, thus, some of the Eurosystem’s National Central Banks, and the ECB itself, recorded unrealized exchange rate losses in their financial results – see Table 2A.2).

⁴³ During the period 2008-18, NBP, which did not conduct QE-type operations, enjoyed fiscal seigniorage above 100 per cent in five years (out of 11); in the case of the SNB, because of its profit distribution mechanism, such a situation took place only twice during the same period. For details see Table 3A.6.

can be obtained by following a similar approach as before, i.e. by plainly distinguishing two subperiods – the years 2003-7 and 2008-18. See Tables 5-6.

Table 5. Average payment ratio of selected central banks: 2003-7 vs 2008-18 (in %)

Central bank	2003-7	2008-18	Difference in p.p.
Bank of England	97.1	106.9	9.8
Bank of Japan	91.0	92.2	1.2
Eurosystem	105.2	78.6	-26.6
Federal Reserve System	89.3	98.1	8.8
Narodowy Bank Polski	76.0	51.8	-24.2
Swedish Riksbank	0.4	188.6	188.2
Swiss National Bank	71.3	2.8	-68.5

Note: payment ratio is calculated as the value of central bank transfers to the government related to the financial result of the central bank.

Source: Table 3A.5.

As a result of QE-type policies, as expected, the payment ratio increased in most cases in the second sub-period. There were three exceptions, however. Leaving aside NBP (a non-QE central bank), two other banks faced a decline in the payment ratio, namely the Eurosystem and the SNB. In the first case, the main reason for this was that the ECB itself and the Bank of France recorded losses before 2008 (the ECB in 2003-4 and the Bank of France in 2003) and, hence, the financial result of the whole Eurosystem was lower than the total of transfers to the Ministries of Finance.⁴⁴ In the case of the SNB, the aforesaid one-off transaction of 2004 had an impact: if this year's data is taken out of the sample, the average payment ratio in the first sub-period declines to 60.2 per cent, which makes the difference decline to -57.3 p.p. (instead of 68.5 p.p.). Therefore, the other reason was the applied profit distribution mechanism,

⁴⁴ See Tables 3A.3 and 3A.4. It is worth noting, that the ECB's profit is distributed to the Eurosystem's National Central Banks, which then transfer it to their Ministries of Finance within their own profit distribution schemes.

which in principle is based on the mentioned periodic agreements between the SNB and the Federal Department of Finance, which assume fixed amount of transfers.

Let us now turn to fiscal seigniorage developments.

Table 6. Average fiscal seigniorage of selected central banks: 2003-7 vs 2008-18 (in %)

Central bank	2003-7	2008-18	Difference in p.p.
Bank of England	104.4	141.6	37.1
Bank of Japan	116.8	164.4	47.6
Eurosystem	(44.2)	176.8	221.0
Federal Reserve System	91.3	236.5	145.2
Narodowy Bank Polski	116.0	67.2	-48.9
Swedish Riksbank	(67.4)	1 259.4	1 326.8
Swiss National Bank	2 872.7	0.8	-2 871.9

Note: (1) fiscal seigniorage is calculated as the value of central bank transfers to the government related to seigniorage (SII); (2) figures in parenthesis present situations when a central bank recorded negative seigniorage and at the same time made a transfer to the government.

Source: Table 3A.6.

Table 6, presenting information on average fiscal seigniorage, again confirms the exceptionality of NBP and the SNB. The reasons are the same as earlier: NBP was a non-QE central bank, while in the case of the SNB the impact of the 2004 one-off transaction was one reason⁴⁵, the other being the faster pace of diminishing seigniorage than transfers.⁴⁶

⁴⁵ If the 2004 outlier is taken out of the sample, the 2003-7 fiscal seigniorage average declines to 118.9, reducing its difference with the average of the second subperiod to -118.1 p.p. (from -2871.9 p.p.).

⁴⁶ While the average transfer to the Ministry of Finance decreased by half (from 0.50 per cent to 0.26 per cent of GDP), the estimated seigniorage (SII) diminished by more than three-quarters (from 0.42 per cent to 0.09 per cent of GDP; both numbers calculated without the 2004 outlier).

However, a much more important phenomenon visible in Table 6 (of course, with the exception of NBP and the SNB), is that fiscal seigniorage in all the remaining cases was growing strongly. In the three cases of the ECB, the Fed and the Riksbank, the average fiscal seigniorage in the second subperiod (2008-18) was more than 100 p.p. larger than in the first subperiod (2003-7). Even if we take out the outlier observations for the BoE (year 2011) and the Riksbank (year 2013), the differences continue to be largely positive.⁴⁷ In the case of the Riksbank, unusually positive, because of the impact of the vanishing seigniorage (Figure 5, Panel F) as a result of the strong decline in cash in circulation in Sweden (Figure 6, Panel F, and Figure 7). Evidently, in other cases of increasing fiscal seigniorage, the main reason for this was the rise of the “other central bank net income” resulting mostly from QE-type operations.

Finally, however, what was the macroeconomic impact of the QE-type policies on central bank transfers to the government? A summary answer is provided by Table 7 and the comments following it.

⁴⁷ 14.4 p.p. (from 37.1 p.p.) and 720.5 p.p. (from 1326.8 p.p.), respectively. See Tables 3A.2 and 3A.4.

Table 7. Average transfers to the government by selected central banks: 2003-7 vs 2008-18 (in % of GDP)

Central bank	2003-7	2008-18	Difference in p.p.
Bank of England	0.13	0.06/0.50	-0.07/0.37
Bank of Japan	0.11	0.12	0.01
Eurosystem	0.09	0.16	0.07
Federal Reserve System	0.19	0.45	0.26
Narodowy Bank Polski	0.25	0.22	-0.03
Swedish Riksbank	0.18	0.12	-0.06
Swiss National Bank	1.38	0.26	-1.12

Note: calculations based on data provided in Table 3A.4.

Source: Table 3A.4.

The amount of transfers to the government stems from the size of the financial result and the payment ratio, while the former is due to seigniorage and the “other central bank net income” (Equation 2). Table 7 summarizes all these factors, putting them into a nominal GDP context. In such a perspective, we can see that in the case of the three smaller economies (Poland, Sweden, Switzerland) real transfers declined in the second period, suggesting that their appreciating currencies (the Swedish krona until 2012), together with large FX exposures, had a severe negative impact (see Subsection 4.1). In the three large economies (Japan, the euro area, and the US), transfers to their respective governments increased due to the lesser importance of exchange rate fluctuations for the financial position of their central banks, and extensive QE-type operations resulting in bloated (and sometimes more risky) balance sheets (Figure 2); in the case of the BoJ, the increase in the transfers was minuscule in real terms as a result of the fact that this institution had been conducting QE-type operations since the start of the millennium.

Lastly, in Table 5, we also have the BoE, which at first glance looks like an outlier. However, closer inspection shows that this is only seemingly an outlier: the decline in

the average transfers to the government (as a percentage of GDP) during the 2008-18 period was due, above all, to the decreasing reference rate of the central bank (Bank Rate), which resulted in diminishing seigniorage, as well as to the method applied to register QE-type operations.

The latter statement deserves some explanation. The BoE, unlike the Fed, the ECB or the BoJ, has not purchased QE securities on its balance sheet, but granted loans to its subsidiary created in 2011 (the Bank of England Asset Purchase Facility Fund Ltd – BEAPFF), which has purchased debt securities on its own balance sheet. Thus, the increased balance sheet of the BoE was the result of loans made to the BEAPFF (on the asset side) and simultaneous increase in central bank reserves (on the liability side). Though the BEAPFF is owned by the bank, its operations are entirely indemnified by the Treasury, and its surplus for these operations is partly passed on to the Treasury (Bank of England 2019: 137).⁴⁸

When including payments made by the BEAPFF to the Treasury, the total average transfer made to the government for the period 2008-18 is 0.50 per cent of GDP⁴⁹ (instead of 0.06 per cent of GDP – as in Table 5, left figure), i.e. producing an increase of 0.37 p.p. when compared to the earlier period (instead of the 0.07 p.p. decline). Therefore, the final outcome is entirely in line with the observations made for the three remaining central banks from the larger economies.

In concluding this part of the paper, let us relate Tables 4 and 7. When comparing average financial results (Table 4) and average transfers to the government (Table 7), we should bear in mind that the latter can be interpreted as a product of the financial result and the payment ratio – see Table 5. As we can see from this table, in the instances of the BoE, the BoJ and the Fed there were only minor (i.e. below 10 p.p.)

⁴⁸ Recently, it must be stressed, some modifications in this system have taken place. To our knowledge they have not altered essentially the previous regulations, however. See agreement on the new capital framework in HM Treasury (2018).

⁴⁹ Own estimate based on annual reports of the Bank of England and the Bank of England Asset Purchase Facility Fund (available on the Bank of England's website).

changes in the payment ratio. Thus, in these cases changes in the average financial results directly, and almost proportionally, translated into changes in transfers to the government.⁵⁰

As concerns the Eurosystem, average changes in financial results and transfers took place in the same direction as well. However, due to payment ratio changes after 2007, in the second subperiod the pace of growth of transfers was lower than that of financial results. Consequently, both declined in the second subperiod: while in the case of financial results the difference was 0.11 p.p., in the case of transfers it was only 0.07 p.p. This was because in the Eurosystem, the payment ratio results from national level decisions, which in turn are due to individual National Central Banks' decisions on strengthening their capital. The latter decisions, obviously, impact on the size of amounts transferred to the governments.

In the case of the remaining three central banks (NBP, the Riksbank and the SNB), the changes in the average financial result and average transfers in the second subperiod differed highly, in two instances to such an extent that their signs also changed (see NBP and the Riksbank). Clearly, major changes in the payment ratio took place in these three cases. As already mentioned in the paper, NBP transfers almost all of its profit (95 per cent) to the government. In the studied period, NBP recorded losses in 2007 and 2017, and no profits in 2008, 2013-4 and 2018 (see Table 3A.3). Therefore, during these six years transfers to the government were not made (Table 3A.4). In the first subperiod, such a situation took place in one year (out of five years), while in the second subperiod five times (out of 11 years). This explains the decline in the payment ratio and in average transfers in the second subperiod.

In order to explain the developments in the remaining two cases, we also have to rely on some of the information already provided. Transfers to the government made by the Riksbank are based on the average 5-year adjusted financial result and, hence,

⁵⁰ In the case of the Fed, the higher increase in transfers (0.26 p.p.) than the increase in the financial result (0.25 p.p.) observed in the second subperiod was due to payments made from its capital (surplus fund), which took place in 2015 and 2018 (Fed 2015: 51; Fed 2019: 43-4).

there is no direct relation between its yearly financial results and annual transfers. 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 relation between the size of the transfer and the recorded financial result in a given year, and the time periods studied. The inter-temporal smoothing mechanisms embedded in the financial systems of these two central banks resulted in a highly unstable payment ratio, i.e. a distorted relationship between their financial results and transfers to the government.

6. The impact of exit policies and normalization on seigniorage and central banks' profits

Following the analysis of seigniorage (and related variables) it is time to emphasize its potential role during the period of exit policies and normalization, i.e. after the decision to abandon unconventional monetary policy is made. Since 2014 some of the seven central banks have been coping with this challenge. As mentioned in Subsection 3.1, in 2019 both the Fed and the ECB discontinued these attempts, however. The spread of the Covid-19 virus in the first quarter of 2020 definitely stopped exit policies, with the return of a new wave of unconventional policies, not only by the two above-mentioned banks. In particular, it should be noticed that in the second half of March 2020, NBP started to conduct QE operations, joining the other studied banks in such unconventional actions.

Clearly, the 2019-20 developments are outside the scope of this paper. The new expansion of QE-type activities linked to new interest rate reductions⁵¹, nonetheless means that exit policies and normalization issues will come back to prominence soon. Let us, therefore, study them in more detail from the point of view of their potential impact on central banks' financial results.

To do so, however, it is necessary to change somewhat the perspective of analysis. We propose to concentrate on two factors which simultaneously influence seigniorage and the financial results of central banks. They are interest rates, and the size of the central bank's balance sheet (including, implicitly, the volume of cash in circulation).

As regards interest rates, it is supposed that their normalization will gradually take place. This means that the nominal interest rate level will return to positive values, i.e. above zero. The Fed was a case in point until mid-2019 (Figure 3, Panel A). Interest rates will probably not return to the levels recorded before the 2007-14 crisis

⁵¹ In our sample of central banks, only the Riksbank increased rates after 2018 without starting to cut them again; however, in early 2020 its repo rate reached only 0.00 per cent.

(as already observed, e.g. by Schnabl in 2016), but they should reach such a level that enables central banks to conduct monetary policy with the effective usage of conventional instruments (interest rate policy). For the analysis conducted in this paper it is important simply to conclude that interest rates must ultimately rise during exit policies.

The second factor that has to be considered is the “normalization” of central banks’ balance sheet size. It has often been argued that together with the withdrawal of unconventional instruments, central banks’ balance sheets will gradually return to their pre-crisis levels. However, a glimpse at the volume of central banks’ balance sheets since 2014 (Figure 2) and the current (as of 2020) developments lead to the conclusion that they will remain at high levels for at least a longer period.

Therefore, it is justified to assume that central banks’ balance sheets will remain at elevated levels for a longer time, while banks first start increasing their reference interest rates. It is interesting to see how such operations may impact on the financial results of central banks, or – more precisely – on their net interest income.

Let us consider the balance sheet of a stylized central bank, a bank that has conducted unconventional operations in the form of purchasing debt securities (quantitative easing). Such banks hold bonds purchased under QE programs (B) on the asset side. They were not only purchased to provide liquidity, but also to bring market yields close to zero. These bonds are mostly fixed-income assets with long-term maturities and are remunerated at the yield prevailing at the purchase date (i_B). This means that the average yield of purchased bonds is near zero. Central banks will most probably hold them until maturity. The purchase price for these securities was mainly paid to the accounts of commercial banks kept with central banks on their liability side, i.e. they supplied reserves (R). Commercial banks’ reserves are short-term liabilities which are remunerated at the central banks’ current reference rates (i_R). Hence, the central banks’ balance sheets generate an interest rate risk resulting from a mismatch between long-term fixed interest rate income on assets ($i_B \cdot B$) and short-term floating

interest rate expenses on liabilities ($i_R \cdot R$). The interest rate on reserves depends on decisions made by the central bank itself (on the reference rate). Moreover, all the time central banks issue cash (C) which is an unremunerated liability (we assume no cash expenses). Thus, considering the following simplified balance sheet equation:

$$B = R + C \quad (3)$$

where:

B – purchased long-term bonds,

R – commercial banks' reserves,

C – cash issued;

we can write a simplified (i.e. including only interest income and expenses) financial result equation:

$$FR = i_B \cdot B - i_R \cdot R - 0 \cdot C \quad (4)$$

where the new symbols are:

i_B – interest rate on purchased bonds (yield at purchase date),

i_R – central bank's reference rate.

Considering Equation (3), we can rewrite Equation (4) as follows:

$$FR = i_B \cdot (R + C) - i_R \cdot R \quad (5)$$

In turn, considering Equation (2), we can re-arrange the last equation to a new one:

$$FR = i_B \cdot C + (i_B - i_R) \cdot R \quad (6)$$

where:

$i_B \cdot C = S$ – seigniorage calculated according to variant I (SI), assuming no cash expenses (“ E ” in Equation 1),

$(i_B - i_R) \cdot R = OI$ – other net interest income (from Equation 2).

The increase in central bank reference rate above the interest rate on bonds will lead to a decrease in the central bank’s financial result due to negative other income (OI).⁵² In an extreme situation it could lead to a negative financial result (central bank’s losses). The question is: is there any solution to counter such a possible unfavorable trend? Seigniorage could be such a remedy, at least partially.

In the previous sections the emphasis was placed on seigniorage as a single calculated number that expresses the net income related to cash in circulation (C). As presented in Equation (2), seigniorage can, however, also be analyzed from the perspective of central banks’ financial results. Seigniorage’s unique feature derives from the fact that it is related to unremunerated liabilities. Thus, taking into account Equation (6), it is easy to demonstrate that a central bank’s financial result can be positive even if the interest rate on bonds is lower than the interest rate on reserves (the central bank’s reference rate). This is because the expression “ $i_B \cdot C$ ” represents the value of income which the central bank basically gets for free. More formally, our argument can be written as:

$$FR > 0 \Leftrightarrow i_B \cdot C > (i_R - i_B) \cdot R \quad (7)$$

In other words, with unremunerated liabilities in the form of cash, a central bank has more space to increase its reference interest rate above the interest rate on bonds held until it faces the danger of recording losses. Under these circumstances one more

⁵² We consider only interest income and expenses. To simplify our analysis, we assume no price/FX valuation gains/losses. Moreover, debt securities purchased by central banks under QE are usually not valued mark-to-market, e.g. as it is in the cases of the Fed, the ECB and the BoJ. This approach is adopted in our simple arithmetic reasoning. See also Appendix 2.

question emerges, however. When will a break-even-point take place, i.e. when will a central bank record no profit ($FR = 0$)?

To answer this question, let us return to Equation (6):

$$FR = 0 \Leftrightarrow i_B \cdot C + (i_B - i_R) \cdot R = 0, \quad (8)$$

and re-arrange the equation to:

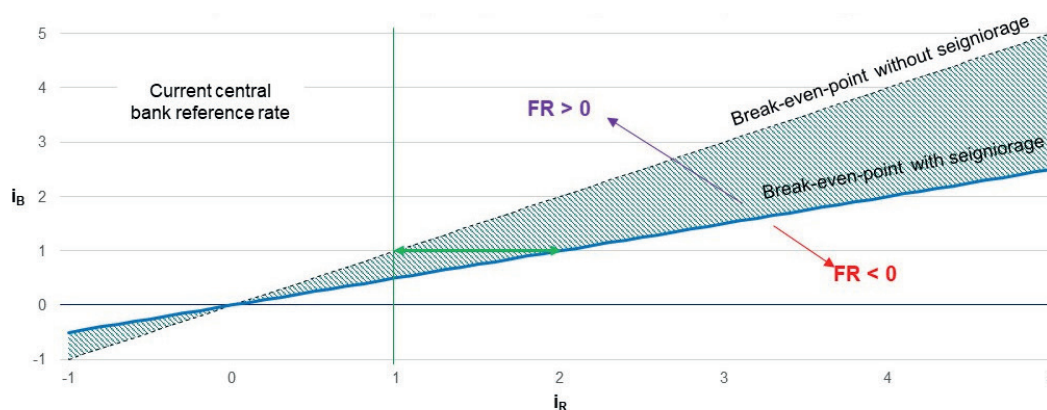
$$\frac{i_R}{i_B} = \frac{C+R}{R} = \frac{B}{B-C} \quad (9)$$

The relation between interest rates (i_R, i_B) depends on the relation of remunerated assets (bonds: B) to remunerated liabilities (reserves: $B - C$). According to Equation (9), the higher the share of cash in the balance sheet, the higher the central bank's reference rates can be until it records no profit (i.e. a break-even-point takes place).

Figure 10 below presents two situations: (1) when there is no cash in the central bank balance sheet, and (2) when half of the balance sheet consists of liabilities due to cash issued. In the first case, a break-even-point appears when both interest rates are equal ($i_R = i_B$). In the second case, an increase in the central bank reference rate does not lead to a negative financial result until a certain threshold. This threshold depends on the relation between remunerated assets and liabilities. In this case, the central bank can increase interest rates by 1 p.p. (from 1 per cent to 2 per cent) until it records negative net interest income (the potential to increase the central bank reference rate is shown by a horizontal green line with arrows).⁵³

⁵³ We assume that at the beginning the interest on bonds is the same as the central bank's reference rate and is equal to 1 per cent.

Figure 10. Central bank break-even-point without seigniorage (no cash issued) and with seigniorage (cash issued = $\frac{1}{2}$ balance sheet total)



Source: own elaboration.

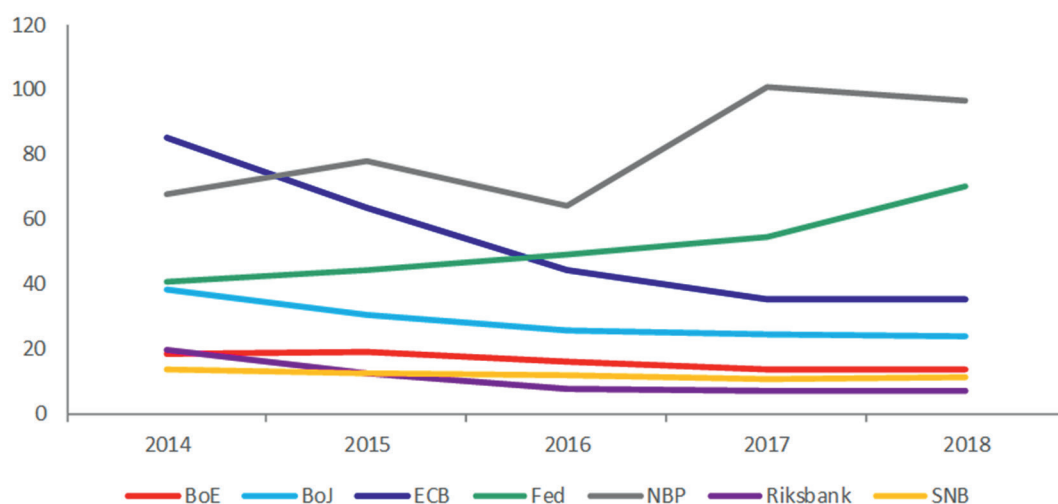
This analysis shows that seigniorage is a sort of buffer that protects the financial results of central banks from recording losses. Thus, cash (a central bank zero interest liability), and the resulting seigniorage, also give some freedom for maneuver (vis-à-vis the rate of return on assets) to central bank interest rate policy.

Now when it is known how to interpret the break-even-point with seigniorage, calculations can be made and their results for selected central banks analyzed. However, before we proceed further, one caveat has to be made. In practice, it is not known what exactly the interest rate of central banks' assets is (monetary authorities do not usually publish such information in their annual reports or accounts⁵⁴). Therefore, the results of our calculations must be presented as a relation between the central bank's reference rate and the interest rate on central bank's assets, exceeding of which leads to negative net interest income.⁵⁵

⁵⁴ Although some central banks (the Fed, the BoE) publish information about the income they earned on the purchased securities, it is still necessary to make additional assumptions for the calculation of the break-even rate.

⁵⁵ See Equation (9). For the sake of simplicity, it is calculated as total assets (equivalent to " B ") divided by the difference between total assets and cash issued ($B - C$).

Figure 11. Relation between the reference rate and the interest rate on assets (i_R/i_B) for selected central banks, 2014-8: the break-even-point with seigniorage, exceeding of which would result in negative net interest income (in %)



Source: own calculations based on annual reports of the central banks.

As shown in Figure 11, among those central banks which conducted QE purchases of debt securities or intervened in the FX market in the considered period, the Fed – not surprisingly given the amount of its banknotes circulating worldwide – was the most protected by seigniorage income. For example, if the reference rate had been higher by more than two-thirds of the interest rate on assets in 2018, then the Fed would have recorded negative net interest income (a loss).⁵⁶ In this group the second most protected institution is the ECB, then the BoJ, the BoE⁵⁷ and the SNB⁵⁸. In the case

⁵⁶ In this case the following operations were made. At the end of 2018 total assets were equal to USD 4.1 trillion, while cash issued amounted to USD 1.7 trillion. Thus, the break-even point with seigniorage was equal to 170 per cent ($4.1 / (4.1 - 1.7)$). It means that assuming the same yield on purchased bonds and the Fed reference rate, the latter could be increased by 0.7 of its current level until the Fed would record negative net interest income.

⁵⁷ However, in this case a reservation must be made, namely that the Bank of England's main asset (loans to the BEAPFF – see Section 5) is remunerated at the reference rate (Bank Rate). This means that a rise in the reference rate would result in an increase in interest expenses on liabilities and simultaneously in an increase in interest income on assets. Thus, the Bank of England is quite well protected as regards interest rate risk.

⁵⁸ The SNB's assets are denominated in foreign currency and, thus, are remunerated at foreign interest rates. Hence, they depend on the reference rates of foreign central banks. The same observation applies to NBP.

of the Swiss bank, if its reference rate had been higher by more than one-tenth of the interest rate on assets, then the SNB would have recorded negative net interest income. The Riksbank is the least protected central bank, because if the reference rate had increased by only less than one-tenth of the interest rate on assets, the bank would have recorded a loss.

In the case of the BoJ, the SNB and until very recently the Riksbank, the reference rate has been, however, negative. This means that these central banks earn on remuneration of their liabilities (negative interest on reserves is recorded as income). Thus, these central banks potentially record an interest rate loss due to unremunerated liabilities in the form of cash issued.⁵⁹

NBP has resorted neither to QE nor to systematic FX interventions in the period under consideration. On the basis of Equation (9) alone, it would be regarded as the most protected against interest rate risk among the seven institutions studied. It would not have recorded negative interest rate income until its reference rate was almost twice as high as the interest rate on its assets.

⁵⁹ The same applies to the Eurosystem. Although its reference rate is zero, the deposits exceeding the amount of the required reserve are remunerated at the deposit facility rate, which is currently negative.

7. Summary of main findings and final conclusions

The key insights from the theoretical and empirical analysis presented in this paper can be broadly summarized in the following way.

Our opening theoretical discussion has shown that at the current stage of monetary system development in advanced economies, a reasonably accurate notion of seigniorage should be based on the concept of cash – the legal tender issued by central banks. Thus, we have defined seigniorage as central bank net income from cash issuance. Since we are studying the impact of monetary policy on central bank finances, we contemplate seigniorage as a component of the central bank's financial result.

Following the adoption of this cash-based definition, the key empirical findings of our research can be reported as follows.

First, for the period studied (2003-18) and the sample of seven central banks, two measures were used to capture the size of seigniorage. The first, narrower, one is based on interest income on central bank assets, while the second, broader, one is based on total income on assets. The impact of low interest rate policy on the size of seigniorage is particularly visible in the first variant of estimates, while that of QE-type activities is visible in the second. According to the first variant, seigniorage was consistently below 0.3 per cent of GDP, while according to the second it typically amounted to less than 0.5 per cent of GDP. This is in line with other estimates of seigniorage in a low inflation (and interest rate) environment.

Second, both measures applied to the calculation of seigniorage have shown that during the period considered they tended to decline, while their changes tended to diverge considerably with respect to the central banks' financial results. In the post-2007 period, the financial results of most central banks – contrary to our estimates of seigniorage – increased strongly, reaching in some cases and some years well above 0.5 per cent of GDP. This was because the central banks' QE policies during the crisis

period resulted mainly in increases in liabilities other than cash, i.e. commercial banks' reserves, generating "other central bank net income" not included in the concept of seigniorage. This phenomenon was visible in five (out of seven) central banks, particularly in the case of the Fed and the Eurosystem.

Third, similar developments to those concerning financial results took place with respect to the transfers of profits to state budgets. These transfers and financial results mostly moved hand in hand, except for NBP, the Riksbank and the SNB, due to their different policies (visible in highly distinct payment ratios) towards central bank profits distribution. Furthermore, because of the large FX portfolios of these central banks and appreciation pressures on their currencies (and in the case of the Riksbank also because of the secular reduction in cash in circulation), fiscal transfers declined as a percentage of GDP. In the larger economies, on the contrary, these transfers increased (again particularly strongly in the case of the Fed and the Eurosystem).

Fourth, fiscal seigniorage, i.e. the portion of seigniorage which the central bank passes on to the government, increased considerably after 2007, often surpassing 100 per cent, except for NBP and the SNB. This was possible thanks to the strongly increasing "other central bank net income" as a result of the extensive QE-type policies conducted by the remaining five banks.

Fifth, NBP, the Riksbank and the SNB are rather peculiar cases in the sample of central banks studied due to their substantial FX exposures resulting from large open long positions in their balance sheets. If seigniorage based on interest income on assets (variant I) is considered alone, the developments in all three central banks are in line with global ones. However, in two of the institutions, seigniorage based on total income (variant II) and the financial result proved to be very volatile during the analyzed period. In both cases, such developments have resulted from the aforementioned appreciation pressures on domestic currencies. In the case of the Riksbank, one more important factor has been at play, namely, the vanishing cash in

circulation reduced the base of seigniorage so that in both variants of our estimates it reached (in GDP terms) almost zero.

Sixth, generally speaking, the size of seigniorage after 2007 was shaped by two main forces: (1) the decline in the return on assets (variant II seigniorage), which had a negative impact, and (2) the cash issued, which had mostly (except for the above-mentioned case of the Riksbank) a positive impact. The first of them was of major importance. This suggests that for exit policies and the normalization process it can be presumed that the higher the role of cash in a central bank's balance sheet, the less likely the negative impact of interest rate increases on the financial result (and the implied payments to the government) will take place. Alternatively, it can be said that cash and the resultant seigniorage may provide some freedom (versus the return on assets) to the interest rate policy of central banks. Thus, seigniorage can be seen as providing a financial buffer to monetary authorities.

Seventh, considering the role of cash in seigniorage creation, the Riksbank's recent experience with a strong reduction in currency in circulation points to an essential problem – seigniorage (according to our definition) may disappear as physical cash disappears. Whether this is ultimately to happen depends, however, on what the legal and economic characteristics of the public digital currency, which is to replace cash someday, will be. In any case, the mere fact of abolishing traditional cash may call for a new definition of seigniorage.

References

- Allen W.A. (2012): “Quantitative monetary policy and government debt management in Britain since 1919”, *Oxford Review of Economic Policy*, Vol. 28, No. 4, pp. 804-36.
- Allen W.A. (2017): “Quantitative easing and the independence of the Bank of England”, *National Institute Economic Review*, No. 241, August, pp. R65-R69.
- Allen W.A. (2019): *The Bank of England and the Government Debt. Operations in the Gilt-Edged Market, 1928–1972*, Cambridge University Press, Cambridge.
- Arby M.F. (2006): *Seigniorage Earnings of Commercial Banks and State Bank of Pakistan*, MPRA Paper, No. 4955, Munich.
- Bailey J. (1956): “The welfare cost of inflationary finance”, *Journal of Political Economy*, Vol. 64, No. 2, pp. 93-110.
- Baltensperger E., Jordan T.J. (1997): “Seigniorage, banking and the optimal quantity of money”, *Journal of Banking and Finance*, Vol. 21, No. 6, pp. 781-96.
- Bank for International Settlements (1996): *Implications for Central Banks of the Development of Electronic Money*, Basle, [<https://www.bis.org/publ/bisp01.pdf>].
- Bank of Canada (2013): “Seigniorage”, [<https://www.bankofcanada.ca/wp-content/uploads/2010/11/seigniorage.pdf>, access: 2.01.2020].
- Bank of England (2019): *Annual Report and Accounts 1 March 2018–28 February 2019*, Bank of England, [<https://www.bankofengland.co.uk/annual-report/2019>].
- Berg C., Gröthheim R. (1997): “Monetary policy in Sweden since 1992”, in: *Monetary Policy in the Nordic Countries: Experiences since 1992*, BIS Policy Papers, No. 2, Basle, pp. 140-82, [<https://www.bis.org/publ/policy02.htm>].
- Bénassy-Quéré A., Cœuré B., Jacquet P., Pisani-Ferry J. (2019): *Economic Policy. Theory and Practice*, second edition, Oxford University Press, Oxford, New York.
- Bholat D., Darbyshire R. (2016): *Accounting in Central Banks*, Bank of England, Staff Working Paper No. 604.
- Bibow J. (2018): *Unconventional Monetary Policies and Central Bank Profits: Seigniorage as Fiscal Revenue in the Aftermath of the Global Financial Crisis*, Levy Economics Institute of Bard College, Working Paper No. 916, [http://www.levyinstitute.org/files/download.php?file=wp_916.pdf&pubid=2593].
- Bindseil U. (2004): *Monetary Policy Implementation: Theory, Past, Present*, Oxford University Press, Oxford, New York.
- Bindseil U. (2014): *Monetary Policy Operations and the Financial System*, Oxford University Press, Oxford, New York.
- Bindseil U. (2019): *Central Banking before 1800. A Rehabilitation*, Oxford University Press, Oxford, New York.
- Bjerg O., McCann D., Macfarlane L., Hougaard Nielsen R., Ryan-Collins J. (2017): *Seigniorage in the 21st Century: A Study of the Profits from Money Creation in the United Kingdom and Denmark*, Copenhagen Business School, CBS Working Paper, [<https://research.cbs.dk/en/publications/seigniorage-in-the-21st-century-a-study-of-the-profits-from-money>].
- Bofinger P. (2001): *Monetary Policy. Goals, Institutions, Strategies, and Instruments*, Oxford University Press, Oxford, New York.
- Borio C. (2019): *Central Banking in Challenging Times*, Bank for International Settlements, BIS Working Papers No. 829, [<https://www.bis.org/publ/work829.htm>].

- Borio C., Disyatat P. (2009): *Unconventional Monetary Policies: An Appraisal*, Bank for International Settlements, BIS Working Papers No. 292, [https://www.bis.org/publ/work292.pdf].
- Buiter W.H. (2007): “Seigniorage”, *Economics: The Open-Access, Open-Assessment E-Journal*, [http://dx.doi.org/10.5018/economics-ejournal.ja.2007-10].
- Bundesbank (2020a): “Seigniorage”, Glossary, Deutsche Bundesbank, [https://www.bundesbank.de/action/en/729724/bbksearch?firstLetter=S , access: 2.01.2020].
- Bundesbank (2020b): “Profits of the Deutsche Bundesbank”, [https://www.bundesbank.de/resource/blob/826466/173f03e8d5cef4c8b90ee5dc20432234/mL/2020-02-28-geschaeftsbericht-gewinnverteilung-data.pdf].
- Burda M., Wyplosz C. (2009): *Macroeconomics. A European Text*, fifth edition, Oxford University Press, Oxford, New York.
- Cincibuch M., Holub T., Hurník J. (2008): *Central Bank Losses and Economic Convergence*, Czech National Bank, Working Paper Series No. 3, [https://www.cnb.cz/export/sites/cnb/en/economic-research/.galleries/research_publications/cnb_wp/cnbwp_2008_03.pdf].
- Cukierman A., Edwards S., Tabellini G. (1990): *Seigniorage and Political Stability*, Centre for Economic Policy Research, CEPR Discussion Papers No. 381, London.
- Cukierman A. (1992): *Central Bank Strategy, Credibility, and Independence: Theory and Evidence*, The MIT Press, Cambridge, Massachusetts; London, England.
- Cukrowski J., Fischer M.F. (2003): “Seigniorage wealth and redistribution in Central and Eastern European Countries”, *Post-Communist Economies*, Vol. 15, No. 1, pp. 27-46, [https://www.tandfonline.com/doi/pdf/10.1080/1463137032000058377].
- Drazen A. (1985): “A general measure of inflation tax revenues”, *Economic Letters*, Elsevier, Vol. 17, No. 4, pp. 327-30.
- ECB (2016): *Guideline of the ECB of 3 November 2016 on the legal framework for accounting and financial reporting in the European System of Central Banks*, ECB/2016/34, OJ L 347 20.12.2016, with later amendments.
- ECB (2019): *Annual Report 2018*, European Central Bank, Frankfurt am Main, [https://www.ecb.europa.eu/pub/annual/html/index.en.html].
- ECB (2020): “What is seigniorage”, European Central Bank, [https://www.ecb.europa.eu/explainers/tell-me/html/seigniorage.en.html, access: 2.01.2020].
- Fed (2015): *Federal Reserve Banks Combined Financial Statements. As of and for the Years Ended December 31, 2015 and 2014 and Independent Auditors' Report*, Federal Reserve System, Washington, D.C., [https://www.federalreserve.gov/aboutthefed/files/combinedfinstmt2015_508.pdf].
- Fed (2019): *Federal Reserve Banks Combined Financial Statements. As of and for the Years Ended December 31, 2018 and 2017 and Independent Auditors' Report*, Federal Reserve System, Washington, D.C., [https://www.federalreserve.gov/aboutthefed/files/combinedfinstmt2018.pdf].
- Ferguson N., Schaab A., Schularick M. (2015): *Central Bank Balance Sheets: Expansion and Reduction since 1900*, Center for Economic Studies & Ifo Institute, CESifo Working Papers No. 5379.
- Financial Times (2019): “RBI to pay bumper \$3.9bn dividend to Indian government” (by S. Mundy), 18 February.

- Fischer S. (1982): “Seigniorage and the case for a national money”, *Journal of Political Economy*, Vol. 90, No. 2, pp. 295-313.
- Friedman M. (1953): “Discussion of the inflationary gap”, in: *Essays in Positive Economics*, University of Chicago Press, Chicago and London, pp. 251-62.
- Friedman M. (1971): “Government revenue from inflation”, *Journal of Political Economy*, University of Chicago Press, Vol. 79, No. 4, pp. 846-56.
- Goodhart C. (1988): *The Evolution of Central Banks*, MIT Press, Cambridge, Massachusetts; London, England.
- Groeneveld H., Visser A. (1997): “Seigniorage, electronic money and financial independence of central banks”, *Banca Nazionale del Lavoro Quarterly Review*, Vol. 50, No. 200, pp. 69-88,
[<https://ojs.uniroma1.it/index.php/PSLQuarterlyReview/article/view/10571/10455>].
- Gros D. (1989): *Seigniorage in the EC: The Implications of the EMS and Financial Market Integration*, IMF Working Paper, WP/89/7, January 23.
- Humpage O.F. (1994): “Institutional aspects of U.S. intervention”, Federal Reserve Bank of Cleveland, *Economic Review*, Vol. 30, No. 1, pp. 2-19.
- HM Treasury (2018): “Financial relationship between HM Treasury and the Bank of England: memorandum of understanding”, Her Majesty Treasury, London,
[<https://www.bankofengland.co.uk/-/media/boe/files/memoranda-of-understanding/financial-relationship-between-hmt-and-the-boe-memorandum-of-understanding.pdf?la=en&hash=26A0368C7F8A2C492B665EC28D473C7B3279A116>].
- Homer S., Sylla R.E. (2005): *A History of Interest Rates*, 4th edition, John Wiley & Sons Hoboken, New Jersey.
- Jobst C., Kernbauer H. (2016): *The Quest for Stable Money. Central Banking in Austria, 1816-2016*, Campus, Frankfurt am Main.
- Jobst C., H. Stix (2017): *Doomed to Disappear? The Surprising Return of Cash Across Time and Across Countries*, Centre for Economic Policy Research, Discussion Paper DP12327.
- Jordan T.J. (2011): “Does the Swiss National Bank need equity?”, Statistisch-Volkswirtschaftliche Gesellschaft, Basel, 28 September
[https://www.snb.ch/en/mmr/speeches/id/ref_20110928_tjn/source/ref_20110928_tjn.en.pdf].
- Keynes J.M. (1923): *A Tract on Monetary Reform*, Macmillan and Co., Limited, London.
- Klein M., Neumann M.J.M (1990): “Seigniorage: What is it and who gets it?”, *Weltwirtschaftliches Archiv*, vol. 126, pp. 205-21.
- KPMG (2012): *Current trends in central bank financial reporting practices*, United Kingdom
[<https://home.kpmg/content/dam/kpmg/pdf/2014/03/banking-financial-reporting-practices.pdf>].
- Kun J. (2003): “Seigniorage in selected Acceding Countries: Current situation and future prospects on the road towards monetary integration”, *Focus on Transition*, Oesterreichische Nationalbank, No. 2, pp. 176-95.
- Kurtzig J., Mander B. (2003): “Survey of central bank accounting practices”, in: *Accounting Standards for Central Banks*, N. Courtis, B. Mander (eds.), Central Banking Publication, London, pp. 21-46.
- Lavoie M., Fiebigier B. (2018): “Unconventional monetary policies, with a focus on quantitative easing”, *European Journal of Economics and Economic Policies: Intervention*, Vol. 15, No. 2, pp. 139-46.

- Martínez-Resano J.R. (2004): *Central Bank Financial Independence*, Banco de España, Documento Ocasional No. 0401, [https://www.bde.es/f/webpi/SES/staff/martinezresanojoseramon/central_bank_financial_independence.pdf].
- Masciandaro D., Romelli D. (2015): “Ups and downs of central bank independence from the Great Inflation to the Great Recession: Theory, institutions and empirics”, *Financial History Review*, Vol. 22, Part 3, December, pp. 259-89.
- Mehrling P. (2011): *The New Lombard Street. How the Fed Became the Dealer of Last Resort*, Princeton University Press, Princeton and Oxford.
- NBER (2010): “September 20, 2010 announcement of June 2009 business cycle trough/end of last recession,” National Bureau of Economic Research, [<http://www.nber.org/cycles/sept2010.pdf>].
- NBP (1997): *The Act on Narodowy Bank Polski of 29 August 1997*, Journal of Laws of 2017 item 1337 (consolidated version), [http://www.nbp.pl/en/aktyprawne/the_act_on_the_nbp.pdf].
- NBP (2018): *Annual Report 2017. Banking Sector Liquidity, Monetary Policy Instruments of Narodowy Bank Polski*, [<http://www.nbp.pl/en/publikacje/instruments/instruments2017.pdf>].
- NBP (2019a): *Koszty instrumentów płatniczych na rynku polskim. Raport końcowy z projektu badawczego NBP* [The costs of payments instruments on the Polish market. The ending report of the NBP research project], [<http://www.nbp.pl/systemplatniczy/koszty-instrumentow-platniczych/raport-koszty-instrumentow-platniczych.pdf>].
- NBP (2019b): “Uchwała nr 6/2019 Rady Polityki Pieniężnej z dnia 5 listopada 2019 r. w sprawie zasad tworzenia i rozwiązywania rezerwy na pokrycie ryzyka zmian kursu złotego do walut obcych w Narodowym Banku Polskim” [Resolution No. 6/2019 of the Monetary Policy Council of 5 November 2019 on the principles for creating and releasing the provision against the foreign exchange rate risk of the zloty at Narodowy Bank Polski], *Dziennik Urzędowy NBP*, item 14, [<https://dzu.nbp.pl/eDziennik/#/actbymonths>].
- Neumann M.J.M. (1992): “Seigniorage in the United States: How much does the U.S. government make from money production?”, *Federal Reserve Bank of St. Louis Review*, Vol. 74, No. 2, pp. 29-40.
- Neumann M.J.M. (1996): “A comparative study of seigniorage: Japan and Germany”, *Bank of Japan Monetary and Economic Studies*, Vol. 14, No. 1, pp. 104-42.
- Nugée J. (2001): *Foreign Exchange Reserves Management*, Centre for Central Banking Studies, Bank of England.
- Ötker-Robe, İ., Polański, Z., Topf, B., Vávra, D. (2007): *Coping with Capital Inflows: Experiences of Selected European Countries*, International Monetary Fund Working Paper, WP/07/190, Washington, D.C., [<http://www.imf.org/external/pubs/ft/wp/2007/wp07190.pdf>].
- Phelps E.S. (1973): “Inflation in the theory of public finance”, *Swedish Journal of Economics*, Vol. 75, No. 1, pp. 67-82.
- Polański Z. (2012): „Przemiany funkcji pożyczkodawcy ostatniej instancji w czasie kryzysu” [Changes in the lender of last resort function during the crisis], in: *Współczesna bankowość centralna* [Contemporary central banking], W.L. Jaworski, A. Szelaągowska (eds.), CeDeWu, Warsaw, pp. 85-112.

- Polański Z. (2014a): “Polityka pieniężna i rynki finansowe” [Monetary policy and financial markets], in: *Kryzys a polityka stabilizacyjna w Unii Europejskiej* [Crisis and stabilisation policy in the European Union], P. Albiński (ed.), Oficyna Wydawnicza SGH, Warsaw, pp. 62-94 and 113-54, [http://administracja.sgh.waw.pl/pl/OW/publikacje/Documents/Kryzys%20a%20polityka_a_Albinski.pdf].
- Polański Z. (2014b): “Poland during the crisis: A ‘green island’ approaching the euro area?”, in: *Poland and the Eurozone*, J. Hölscher (ed.), Palgrave Macmillan, Houndmills, Basingstoke, pp. 165-89.
- Polański Z. (2015): “Otoczenie monetarne dla polityki zacieśnienia fiskalnego” [Monetary environment during fiscal austerity], in: *Dylematy polityki makroekonomicznej w warunkach kryzysu zadłużeniowego w Unii Europejskiej* [Macroeconomic policy dilemmas in the context of the debt crisis in the European Union], P. Albiński, Z. Polański (eds.), Oficyna Wydawnicza SGH, Warsaw, pp. 45-94.
- Polański Z. (2017): *Stabilization Policies and Structural Developments: Poland and the Crises of 1929 and 2008*, CASE Working Papers, No. 9 (133), Warsaw, [<http://www.case-research.eu/index/?id=f30f224f1a61462305b7c1040e32676a>].
- Reich J. (2017): *Seigniorage. On the Revenue from the Creation of Money*, Springer, Cham.
- Riksbank (2014): *Historical Monetary Statistics of Sweden Volume II: House Prices, Stock Returns, National Accounts, and the Riksbank Balance Sheet, 1620-2012*, Ekerlids Förlag, [https://www.riksbank.se/globalassets/media/forskning/monetar-statistik/volym2/foa_historical_statistics_-volume2_140613.pdf].
- Riksbank (2017): *The Riksbank’s e-krona project. Report 1*, Sveriges Riksbank, [https://www.riksbank.se/globalassets/media/rapporter/e-krona/2017/rapport_ekrona_uppdaterad_170920_eng.pdf].
- Riksbank (2018): *The Riksbank’s e-krona project. Report 2*, Sveriges Riksbank, [<https://www.riksbank.se/globalassets/media/rapporter/e-krona/2018/the-riksbanks-e-krona-project-report-2.pdf>].
- Riksbank (2019a): *Annual Report for Sveriges Riksbank 2018*, Stockholm, [<https://www.riksbank.se/globalassets/media/rapporter/arsredovisning/engelska/annual-report-2018.pdf>].
- Riksbank (2019b): “The General Council of the Riksbank’s proposal for the allocation of profit 2018 and so forth”, [<https://www.riksbank.se/globalassets/media/rapporter/arsredovisning/engelska/proposal-for-the-allocation-of-profit-2018.pdf>].
- Riksbank (2020): *The Riksbank’s e-krona pilot*, Sveriges Riksbank, [<https://www.riksbank.se/globalassets/media/rapporter/e-krona/2019/the-riksbanks-e-krona-pilot.pdf>].
- Rogoff K.S. (2016): *The Curse of Cash*, Princeton University Press, Princeton and Oxford.
- Romer D. (2012): *Advanced Macroeconomics*, fourth edition, McGraw-Hill Irwin, New York.
- Samarina A., Apokoritis N. (2020): *Evolution of Monetary Policy Frameworks in the Post-crisis Environment*, De Nederlandsche Bank working paper 664, [https://www.dnb.nl/binaries/Working%20paper%20No.%20664_tcm46-386783.pdf].
- Sargent T.J., Velde F.R. (2003): *The Big Problem of Small Change*, Princeton University Press, Princeton and Oxford.
- Schnabl G. (2016): *Central Banking and Crisis Management from the Perspective of Austrian Business Cycle Theory*, Center for Economic Studies & Ifo Institute, CESifo Working Paper No. 6179.

-
- Schwarz C., Karakitsos P., Merriman N., Studener W. (2014): *Why accounting matters. A central bank perspective*, ECB Occasional Paper Series, No. 153, [https://www.ecb.europa.eu/pub/pdf/scpops/ecbop153.pdf].
- Shirai S. (2017): *Mission Incomplete. Reflating Japan's Economy*, Asian Development Bank Institute, Tokyo.
- Singleton, J. (2011): *Central Banking in the Twentieth Century*, Cambridge University Press, Cambridge.
- SNB (2005): *Annual Report 2004*, Swiss National Bank, Berne and Zurich, [https://www.snb.ch/en/iabout/pub/annrep/id/pub_annrep_2004].
- SNB (2020): "Profit and distribution of profits", Swiss National Bank, Zurich, [https://www.snb.ch/en/iabout/snb/annacc/id/snb_annac_profit].
- Stella P. (2002): *Central Bank Financial Strength, Transparency, and Policy Credibility*, International Monetary Fund Working Paper WP/02/137, Washington, D.C., [https://www.imf.org/en/Publications/WP/Issues/2016/12/30/Central-Bank-Financial-Strength-Transparency-and-Policy-Credibility-15893].
- Stella P., Lönnberg A. (2008): *Issues in Central Bank Finance and Independence*, International Monetary Fund Working Paper No. 37, Washington, D.C., [https://www.imf.org/external/pubs/ft/wp/2008/wp0837.pdf].
- Sullivan K. (2003): "Profits, dividends and capital – considerations for central banks", in: *Accounting Standards for Central Banks*, N. Courtis, B. Mander (eds.), Central Banking Publication, London, pp. 69-88.
- Svensson L.E.O. (2014): "Inflation targeting and "leaning against the wind", *International Journal of Central Banking*, Vol. 10, No. 2, pp. 103-14, [http://www.ijcb.org/journal/ijcb14q2a5.pdf].
- Szadkowski M. (2017): *Koncepcja senioratu a gospodarka finansowa banku centralnego* [The concept of seigniorage and central bank finances], unpublished PhD dissertation, SGH Warsaw School of Economics, Warsaw.
- Szadkowski M. (2019): *Koncepcja senioratu a gospodarka finansowa banku centralnego* [The concept of seigniorage and central bank finances], Oficyna Wydawnicza SGH, Warsaw.
- Ugolini S. (2011): *What do we really know about the long-term evolution of central banking? Evidence from the past, insights for the present*, Norges Bank, Working Paper, [https://www.norges-bank.no/globalassets/upload/english/publications/working-papers/2011/wp_2011_15.pdf].
- Ugolini S. (2017): *The Evolution of Central Banking: Theory and History*, Palgrave Macmillan, London.
- United Kingdom (1928): *Currency and Bank Notes Act 1928*, [http://www.legislation.gov.uk/ukpga/Geo5/18-19/13/introduction/enacted].
- Walsh C.E. (2010): *Monetary Theory and Policy*, third edition, MIT Press, Cambridge, Massachusetts.
- White L.H. (1999): *The Theory of Monetary Institutions*, Blackwell Publishers, Malden, USA; Oxford, UK.

Websites

Bank of England:	http://www.bankofengland.co.uk/
Bank of Japan:	http://www.boj.or.jp/en/
Eurosystem:	
ECB:	http://www.ecb.europa.eu
Austria:	http://www.oenb.at/
Belgium:	http://www.nbb.be
Cyprus:	https://www.centralbank.cy/en/home
Estonia:	http://www.eestipank.ee/en
Finland:	http://www.suomenpankki.fi/en/
France:	https://www.banque-france.fr/en
Germany:	http://www.bundesbank.de/
Greece:	http://www.bankofgreece.gr/pages/en/default.aspx
Ireland:	http://www.centralbank.ie/
Italy:	http://www.bancaditalia.it
Latvia:	http://www.bank.lv/lat/main/all/
Lithuania:	http://www.lb.lt
Luxembourg:	http://www.bcl.lu/en/index.php
Malta:	http://www.centralbankmalta.org/
Netherlands:	http://www.dnb.nl/en/home/index.jsp
Portugal:	https://www.bportugal.pt/en
Slovakia:	http://www.nbs.sk/en/home
Slovenia:	http://www.bsi.si/en/
Spain:	http://www.bde.es/homee.htm
Federal Reserve System:	http://www.federalreserve.gov/
Narodowy Bank Polski:	http://www.nbp.pl/
Swedish Riksbank:	http://www.riksbank.com/
Swiss National Bank:	http://www.snb.ch/
AMECO:	https://ec.europa.eu/info/business-economy-euro/indicators-statistics/economic-databases/macro-economic-database-ameco/ameco-database_en
International Accounting Standards Board	https://www.ifrs.org
International Monetary Fund	https://dsbb.imf.org/nsdp (Dissemination Standards Bulletin Board)

Appendixes

Appendix 1. Definitions and estimates of seigniorage

Table 1A.1. A survey of selected definitions of seigniorage: economic literature

Author	Definition	Comment
Bénassy-Quéré et al. (2019: 288-9)	Seigniorage – central bank “income resulting directly from money issuance”; can be measured as “the increase in base money (...) over a given period” or as “the opportunity cost of holding base money.”	Base-money-based definition.
Bofinger (2001: 369-72)	Seigniorage – “the difference between the face value of the money issued by the State (Banknotes, coins, and central bank balances) and their relatively low production costs.” Monetary seigniorage – “assumption that any increase in the monetary base is identical to a revenue of the government”; “normally defined as a real magnitude.” Fiscal seigniorage – “provides a good description of the revenues that a government obtains from owing a central bank. It is almost identical with the central bank profit in those countries where outright open-market operations do not play a major role”; “normally defined as a real magnitude.”	Base-money-based definition.
Buiter (2007: 2 and 4)	Commodity currency: seigniorage refers “to the difference between the face value of a coin and its costs of production and mintage.” Paper currency: “‘seigniorage’, the resources appropriated by the monetary authority through its capacity to issue zero interest fiat money.”	Base-money-based definition.
Burda and Wyplosz (2009: 532)	Seigniorage – “exploitation by the government of the monopoly power of the central bank to create money as a means of raising real resources”	Base-money-based definition.
Cukierman (1992: 47)	Seigniorage revenues – “the amount of real resources bought by the government by means of new base money injections.” Seigniorage – “measured in terms of the increase in base money as a percentage of total government revenues inclusive of the increase in base money.”	Base-money-based definition.
Goodhart (1988: 21)	“Even when private note issues are not legal tender, the issuers obtain seigniorage, i.e. the margin between the rate of interest, generally zero (...) on the notes and the	Cash-based definition. May

Author	Definition	Comment
	interest on the (default-free) assets held by the private note issuers against such note liabilities.”	refer to private and public issuers.
Jobst and Kernbauer (2016: 77)	Seigniorage: - originally: “Profit resulting from the difference between the face value of coins and the lower cost of coin metal and production.” - today: “Profit accruing to the central bank because it does not pay interest on its banknote liabilities but receives interest on its assets.”	Cash-based definition.
Reich (2017: 1, 3 and 4)	Seigniorage: - historically: “government’s revenue from the supply of coin.” - usual (modern) meaning: “government’s revenue from the supply of money [as] legal tender”; “Seigniorage is the government’s revenue from the provision of the national currency.”	Cash-based definition.
Rogoff (2016: 81-2)	Seigniorage – “the government’s total profit from printing money – including both the inflation tax and the monopoly rents accrued by accommodating greater real demand.” Monetary seigniorage – “extent the government is able to spend beyond its means each year by printing money and spending it.”	Cash-based definition.
Sargent and Velde (2003: 376)	Seigniorage – “Fee charged on the coining of money to cover production costs and to provide revenue to the king. Also, profit earned by the monetary authority from the issue of currency.”	Cash-based definition.
Singleton (2011: 5)	Seigniorage – income “generated when the central bank uses non-interest-bearing notes to purchase securities that do pay interest.”	Cash-based definition.

Source: own compilation based on publications mentioned in the first column (for more details see references).

Table 1A.2. A survey of selected definitions of seigniorage: central banks

Central banks	Definition	Comment
Bank for International Settlements (1996: 15)	“When central banks came to be monopoly suppliers of banknotes, seigniorage came to be reflected in the profits made by them and ultimately remitted to their major or only shareholder, the government.”	Cash-based definition (only banknotes).
Bank of England (2019: 29)	“The Issue Department is funded by buying interest-yielding assets to back the notes in circulation. The interest earned on these assets is used to fund the costs of note production and supply. The net profits/losses of the Issue Department are referred to as seigniorage, and paid/claimed directly to/from HM Treasury via the National Loans Fund.”	Cash-based definition (only banknotes).
Bank of Canada (2013)	“Seigniorage is the revenue earned from the issue of money. (...) In Canada today, seigniorage can be calculated as the difference between the interest the Bank of Canada earns on a portfolio of Government of Canada securities—in which it invests the total value of all bank notes in circulation—and the cost of issuing, distributing, and replacing those notes.”	Cash-based definition (only banknotes).
Bundesbank (2020a)	“The term “seigniorage” originally referred to the profit the holder of minting rights (“seigneur”) could generate from minting coins. (...) Despite changes in minting and minting rights, the term seigniorage is still in use today. However, its definition has become vaguer and broader in scope, sometimes being referred to as the profit generated by a central bank when it creates money and sometimes to the profit a central bank makes in general.”	Relativity and subjectivity of definition stressed.
ECB (2020)	“Euro banknotes are developed by the ECB, manufactured at a printing works and then stored in the vault at your country’s central bank. They make their way to you via your bank, which pays the face value of the notes to the central bank. (...) The central bank earns interest on the money it lends, or receives a return on the assets it acquires – and this is called seigniorage income.”	Cash-based definition (only banknotes).
Riksbank (2019a: 67)	“The Riksbank’s seigniorage is the part of the Bank’s reported result that arises from the right to issue banknotes and coins.”	Cash-based definition.

Source: own compilation based on publications mentioned in the first column (for more details see references).

Table 1A.3. A survey of estimates of seigniorage

Author	Estimates	Comment
Bank for International Settlements (1996: 8)	Seigniorage in the range from 0.28 per cent of GDP (France, United Kingdom) to 0.65 per cent of GDP (Italy).	“Seigniorage is roughly estimated by multiplying notes and coin outstanding by the long-term rate of interest on government securities.” Estimates for 1994.
Fischer (1982: 308-9)	Seigniorage in the range from 0.3 per cent of GNP (Denmark, Finland and France 1973-78) to 6.2 percent of GNP (Argentina 1960-75).	Seigniorage as the average of the change in high-powered money.
Groeneveld and Visser (1997: 80)	Seigniorage in the range from 0.28 per cent of GDP (France and the UK 1994) to 1.35 percent of GDP (Belgium 1980).	Seigniorage as total value of banknotes and coins multiplied by the average long-term interest rate on 10-year government bonds.
Gross (1989)	Seigniorage in the range from 0.33 per cent of GDP (United Kingdom) to 2.42 per cent of GDP (Greece).	Opportunity cost definition of seigniorage; estimates for 1987.
Rogoff (2016: 83-4)	Seigniorage in the range from -0.06 per cent of GDP (Sweden) to 1.37 per cent of GDP (Russia).	Monetary seigniorage approach; seigniorage revenue/GDP, 2006-15 average.
Singleton (2011: 171-2)	“The central bank is the goose that lays the golden egg for the government. (...) The relatively autonomous free-range goose can bring in seigniorage revenue of up to 1 per cent of GDP. By imposing an inflation tax on citizens, the battery farm goose can bring in seigniorage worth between 5 and 10 per cent of GDP for an extended period. Finally, the force-fed goose can engineer an inflation tax that yields up to 25 per cent of GDP for the government until the inevitable collapse.”	No source of estimates provided.
Szadkowski (2017)	Seigniorage ranged from 0.05 per cent of GDP to 0.26 per cent of GDP.	Averages for 45 central banks; 2003-12 period.

Source: own compilation based on publications mentioned in the first column (for more details see references).

Appendix 2. Central bank's balance sheet, financial result and the accounting policy

There are three basic categories of benefits and costs associated with central bank assets and liabilities: (1) interest income and expenses, (2) price valuation gains and losses, and (3) foreign exchange (FX) valuation gains and losses.

Each of these benefit and cost categories can be realized or unrealized. The accrued but unpaid interest on assets or liabilities is an unrealized gain or loss. In turn, at the time of coupon payment and, thus, when the actual financial flow arises, the interest is a realized gain or loss. A similar distinction occurs in relation to price differences that are due to a change in the value (price) of assets or liabilities. These differences ensuing from periodic (e.g. at the end of the month or year) valuation of assets or liabilities are treated as unrealized. When a given asset is sold, or a liability is fulfilled, the gain or loss is treated as realized. As concerns FX differences, they are treated similarly to price differences since they relate to assets (sometimes also to liabilities) denominated in foreign currencies and result from fluctuations in FX rates (Szadkowski 2019: 73-4).

It is helpful for further analysis to start with a simplified central bank balance sheet. See Table 2A.1.

Table 2A.1. Stylized central bank balance sheet

Assets	Liabilities
Financial assets	Cash in circulation
- loans	Current accounts (reserves)
- domestic securities	- deposits of commercial banks
- FX reserves	Other liabilities
	- central bank debt issued
Fixed assets	Net equity (own capital, net worth)
	- statutory and reserve funds
	- revaluation account
	- provisions equivalent to reserves
	- financial result

Source: own compilation.

In the case of central bank assets, interest income arises in relation to almost every category of assets (excluding, e.g. fixed assets), like debt securities or loans. A similar situation applies regarding price differences. They refer mainly to debt securities held by the central bank. In addition, FX differences apply to FX reserves.

In the case of central bank liabilities, the situation is more complicated. First, some categories of liabilities do not generate expenses for the central bank.⁶⁰ This applies to liabilities due to cash (banknotes and coins) issued as well as to central bank's net equity (own capital). Second, costs related to interest expenses can be assigned to other categories of liabilities (e.g. current accounts held by the central bank). Third, in the case of other liabilities to domestic banks, as well as other liabilities, price valuation differences may occur. For example, they will take place when the central bank issues its own debt securities whose current price fluctuates because of changes in market interest rates.

When the basic benefits and costs associated with individual components of central bank's balance sheet are set, their impact on the bank's financial result should be considered. This impact on the profit and loss account largely depends on the accounting policy applied by the central bank. The accounting principles determine:

- whether the given benefits or costs are identified by the bank,
- whether the benefits or costs, which are identified by the bank, are included in its financial result, and
- how these benefits and costs are included in the financial result.

Regarding the first issue, it is worth bearing in mind that some central banks do not recognize, as part of their financial management, all sources of benefits and costs associated with assets and liabilities (for more details on the practice of the seven central banks discussed in the paper see Table 2A.2 at the end of the appendix). Most often this concerns price and FX differences, in the part regarding unrealized income and costs; such banks, therefore, do not recognize unrealized price and/or FX gains or losses. This means that they do not mark-to-market their assets and liabilities; instead, they use a historical cost approach as the main valuation policy.⁶¹ This also means, however, that only when the assets are sold, or the liabilities are settled, do the gains or losses relating to price or FX changes appear in their balance sheets.⁶²

The second issue concerns the recognition of certain income and expense items in the profit and loss account of the central bank. Some banks (see Table 2A.2) identify valuation gains and losses, but do not include them or include them only partially in their financial result. This is because central banks often subordinate their financial management to the prudence principle. Unrealized gains (sometimes also unrealized losses) are not part of the bank's financial result due to their risky nature. Instead, they are recorded directly in a "revaluation account" on the liabilities side of the balance sheet, forming part of the central bank's net equity (see Table 2A.1). Thanks to this, they are not subject to further distribution and subsequent transfers to the

⁶⁰ This does not mean, however, that these items cannot be assigned (indirectly) any costs incurred by the central bank (e.g. expenses on the production or purchase of banknotes and coins being a case in point).

⁶¹ E.g. this approach has been adopted by the Fed, the ECB and the BoJ as regards the purchased debt securities under QE programs.

⁶² As the difference between the sale price and historical cost which is taken to the profit and loss account.

government.⁶³ Another manifestation of the prudence principle in central banks' accounting policies is the creation of provisions (called "provisions equivalent to reserves"). Such provisions are mainly used to cover the financial risks faced by central banks. Thus, central banks can withhold part of the income in one year in order to use it to cover losses materialized due to the financial risk in another year.⁶⁴

Finally, the third issue refers to the way income and expenses are calculated in the financial result of the central bank with respect to, *inter alia*, the recording date. It is possible to include income and expenses using the accrual principle, i.e. recognizing them in the accounting period in which they are earned or incurred. An alternative is the cash settlement method, i.e. recognizing income and expenses in the period in which they are received or paid. When discussing the way of recognizing income and expenses in the financial result, the method used to calculate them should also be considered. This applies, for example, to such matters as the method of calculating price and FX rate differences, or the method of calculating interest on income or expenses (straight-line vs internal rate of return⁶⁵).

Generally speaking, there are three types of accounting policies (conventions) currently used by central banks worldwide:⁶⁶

- International Financial Reporting Standards (IFRS),
- Eurosystem's accounting principles (rules), and
- other accounting principles (own or national accounting).

In principle, all accounting rules envisage that interest income or expenses on financial assets or liabilities are included in central banks' profit and loss accounts on an accrual basis. As regards recording valuation results, however, there is no common approach:

- The BoE and the SNB record unrealized gains and losses in their profit and loss account;⁶⁷
- The Eurosystem's central banks, NBP and the Swedish Riksbank take unrealized losses to their profit and loss account with some exceptions; e.g. debt securities held for monetary policy purposes in the Eurosystem which are valued at amortized cost adjusted for impairment, or debt securities issued by NBP which are valued at nominal price (face value). According to the prudence principle unrealized gains are recorded in the revaluation account on the liabilities side of

⁶³ Until they are realized when they are included in the profit and loss account. See also Schwarz et al. (2014: 11-2).

⁶⁴ The creation of provisions is taken to the financial result as an expense while their usage is recognized as income.

⁶⁵ Straight-line means the calculation of income or expense at the rate proportional to the time allotted (*pro rata temporis*). The internal rate of return method means calculation of income or expense using the discount rate at which the accounting value of a financial asset or liability (e.g. debt security) is equal to the present value of future cash flows.

⁶⁶ See also Kurtzig and Mander (2003: 25-6) and KPMG (2012: 12-20).

⁶⁷ The Bank of England also distinguishes financial assets available for sale which are valued at current market price but gains and losses are recorded in the financial result when the financial asset is derecognized or impaired.

the balance sheet (see Table 2.A.1) – thus central banks do not distribute unrealized gains to the government;

- The BoJ does not record unrealized gains and losses in the profit and loss account with the exception of price revaluation of foreign currency-denominated bonds and mutual funds instruments as well as FX revaluation of foreign currency-denominated assets and liabilities;
- The Fed does not record unrealized gains and losses in the profit and loss account apart from FX revaluation of foreign currency-denominated assets and liabilities.

Table 2A.2. compares the accounting conventions applied by the central banks under study.

Table 2A.2. Accounting policy applied by selected central banks (as of end of 2017)

Subject	IFRS	Eurosystem's accounting rules	Own accounting
Legal basis	International Financial Reporting Standards (IFRS) approved by the International Accounting Standards Board (IASB)	Guideline of the ECB of 3 November 2016 on the legal framework for accounting and financial reporting in the European System of Central Banks (ECB/2016/34, OJ L 347 20.12.2016, with later amendments)	Internal regulations of the central bank or national accounting regulations
Central banks	BoE	Eurosystem's central banks, NBP, Riksbank	BoJ, Fed, SNB
Recognition of interest income/expenses in the financial result	Yes	Yes	Yes
- date of recognition	Accrual	Accrual	Accrual
Recognition of realized price and FX gains and losses in the financial result	Yes	Yes	Yes
Recognition of unrealized price gains in the financial result	Yes/No	No	Yes/No
Recognition of unrealized price losses in the financial result	Yes/No	Yes ¹	Yes/No
Recognition of unrealized FX gains in the financial result	Yes	No	Yes/No
Recognition of unrealized FX losses in the financial result	Yes	Yes	Yes/No

¹ With the exception of debt securities held for monetary policy purposes, which can be valued at amortized cost.

Note: “/” means “and/or”.

Source: own compilation based on financial statements of selected central banks.

Appendix 3. Seigniorage, financial result and remittance to state budgets of selected central banks, 2003-18: yearly data and estimates⁶⁸

Table 3A.1. Seigniorage estimates according to variant I in selected central banks, 2003-18 (in % of current GDP)

Year	Central bank						
	Bank of England	Bank of Japan	Euro-system	Federal Reserve System	Narodowy Bank Polski	Swedish Riksbank	Swiss National Bank
2003	-	-	0.07	0.17	0.18	0.10	0.12
2004	-	0.03	0.08	0.16	0.26	0.09	0.23
2005	-	0.04	0.12	0.20	0.18	0.10	0.16
2006	-	0.08	0.18	0.24	0.24	0.11	0.07
2007	-	0.12	0.24	0.25	0.28	0.12	0.15
2008	-	0.12	0.29	0.15	0.24	0.07	0.13
2009	-	0.09	0.16	0.17	0.19	0.05	0.13
2010	-	0.08	0.15	0.21	0.15	0.04	0.18
2011	-	0.08	0.16	0.20	0.13	0.04	0.16
2012	-	0.07	0.17	0.18	0.11	0.03	0.13
2013	-	0.07	0.12	0.18	0.12	0.02	0.14
2014	-	0.06	0.09	0.19	0.12	0.01	0.12
2015	-	0.06	0.07	0.18	0.13	0.01	0.13
2016	-	0.04	0.04	0.19	0.12	0.01	0.13
2017	-	0.04	0.03	0.19	0.12	0.00	0.13
2018	-	0.04	0.04	0.20	0.09	0.00	0.13

Notes: (1) the BoE prepares a separate balance sheet for the Issue Department and, consequently, publishes a separate profit and loss statement. Since there is no possibility to separate interest income and other gains in this document, it was not possible to calculate variant I of seigniorage (SI); (2) seigniorage for the Eurosystem is calculated as the sum of net income for National Central Banks and the ECB. Although the ECB publishes the Eurosystem's balance sheet, it does not present the Eurosystem's aggregated profit and loss account. Moreover, the ECB is entitled to issue banknotes only. Coins are issued by individual governments; however, some countries passed this right to the National Central Banks (see Table 1). In such cases, the central banks present coins issued as other liabilities. For the Eurosystem as a whole we calculated seigniorage only in relation to banknotes issued.

Source: own calculations based on annual reports of the central banks and AMECO database (access: 6 May 2020).

⁶⁸ The BoJ did not publish its profit and loss account for 2003 in English.

Table 3A.2. Seigniorage estimates according to variant II in selected central banks, 2003-18 (in % of current GDP)

Year	Central bank						
	Bank of England	Bank of Japan	Euro-system	Federal Reserve System	Narodowy Bank Polski	Swedish Riksbank	Swiss National Bank
2003	0.10	-	-0.01	0.20	0.23	-0.17	0.29
2004	0.12	0.06	0.03	0.17	-0.66	-0.04	0.04
2005	0.12	0.08	0.16	0.18	0.06	0.08	0.91
2006	0.11	0.14	0.19	0.24	0.09	0.16	0.37
2007	0.15	0.11	0.21	0.26	-0.38	0.09	0.52
2008	0.14	0.09	0.29	0.15	0.24	0.10	-0.18
2009	0.03	0.07	0.19	0.16	0.72	0.08	0.32
2010	0.03	0.02	0.16	0.23	0.23	0.01	-0.70
2011	0.05	0.08	0.16	0.20	0.35	0.05	0.38
2012	0.03	0.14	0.19	0.22	0.31	0.03	0.13
2013	0.02	0.12	0.13	0.18	0.04	0.00	-0.18
2014	0.03	0.12	0.11	0.19	0.25	0.02	0.72
2015	0.02	0.05	0.09	0.18	0.38	0.01	-0.44
2016	0.02	0.05	0.06	0.19	0.33	0.02	0.37
2017	0.01	0.05	0.04	0.20	-0.16	0.00	0.78
2018	0.02	0.08	0.04	0.21	0.14	0.01	-0.25

Notes: as in table 3A.1 and: (1) in the case of the BoE, seigniorage (SII) is equal to the financial result of the Issue Department; (2) the Riksbank has been publishing its own seigniorage calculations in the annual reports since 2008. Although they are based on the same definition of seigniorage as ours (see Table 1A.2) and on similar assumptions as we adopt in this paper for SII estimates, unrealized losses on price and FX valuation are not treated as part of seigniorage by the Riksbank. Therefore, we present our own calculations.

Source: as in Table 3A.1.

Table 3A.3. Financial result in selected central banks, 2003-18 (in % of current GDP)

Year	Central bank						
	Bank of England	Bank of Japan	Euro-system	Federal Reserve System	Narodowy Bank Polski	Swedish Riksbank	Swiss National Bank
2003	0.10	-	0.04	0.20	0.50	-0.35	0.49
2004	0.13	0.08	0.02	0.18	0.47	-0.10	4.23
2005	0.13	0.11	0.13	0.18	0.12	0.11	2.36
2006	0.13	0.18	0.13	0.25	0.24	0.25	0.77
2007	0.16	0.13	0.15	0.27	-1.05	0.12	1.26
2008	0.20	0.08	0.19	0.26	0.00	0.33	-0.96
2009	0.05	0.07	0.24	0.36	0.30	0.43	1.17
2010	0.04	0.01	0.16	0.54	0.45	0.02	-3.54
2011	0.06	0.11	0.16	0.51	0.55	0.11	1.59
2012	0.04	0.17	0.26	0.56	0.34	0.05	0.38
2013	0.03	0.20	0.25	0.47	0.00	-0.05	-1.42
2014	0.04	0.26	0.20	0.58	0.00	0.08	5.90
2015	0.04	0.10	0.19	0.55	0.46	0.05	-3.55
2016	0.03	0.13	0.18	0.49	0.49	0.16	3.70
2017	0.02	0.16	0.20	0.41	-0.13	0.08	8.12
2018	0.03	0.20	0.24	0.31	0.00	0.07	-2.17

Source: as in Table 3A.1.

Table 3A.4. Transfers to the government in selected central banks, 2003-18 (in % of current GDP)

Year	Central bank						
	Bank of England	Bank of Japan	Euro-system	Federal Reserve System	Narodowy Bank Polski	Swedish Riksbank	Swiss National Bank
2003	0.10	-	0.05	0.19	0.48	0.23	0.61
2004	0.13	0.07	0.04	0.15	0.45	0.24	4.90
2005	0.13	0.10	0.11	0.16	0.12	0.18	0.49
2006	0.12	0.14	0.11	0.21	0.23	0.14	0.46
2007	0.16	0.12	0.13	0.24	0.00	0.11	0.43
2008	0.17	0.08	0.16	0.22	0.00	0.17	0.42
2009	0.04	0.07	0.17	0.33	0.29	0.17	0.42
2010	0.03	0.01	0.13	0.53	0.43	0.17	0.41
2011	0.19	0.11	0.11	0.49	0.52	0.20	0.16
2012	0.03	0.16	0.19	0.55	0.32	0.18	0.16
2013	0.03	0.17	0.20	0.47	0.00	0.09	0.00
2014	0.03	0.21	0.17	0.55	0.00	0.10	0.31
2015	0.03	0.09	0.16	0.64	0.44	0.07	0.15
2016	0.03	0.13	0.13	0.49	0.47	0.06	0.26
2017	0.01	0.16	0.17	0.41	0.00	0.05	0.30
2018	0.02	0.19	0.19	0.32	0.00	0.08	0.29

Source: as in Table 3A.1.

Table 3A.5. Payment ratio of selected central banks, 2003-18 (in % of the financial result)

Year	Central bank						
	Bank of England	Bank of Japan	Euro-system	Federal Reserve System	Narodowy Bank Polski	Swedish Riksbank	Swiss National Bank
2003	97.7	-	107.4	95.7	95.0	(65.7)	125.3
2004	97.8	94.0	160.8	84.3	95.0	(238.9)	115.9
2005	98.5	97.0	86.0	91.3	95.0	162.8	20.8
2006	95.2	77.8	84.4	85.0	95.0	55.9	60.1
2007	96.2	95.3	87.6	90.1	0.0	87.9	34.5
2008	86.1	89.7	82.1	82.0	0.0	52.8	(43.6)
2009	86.1	95.0	71.6	90.5	95.0	40.8	36.2
2010	89.0	86.0	85.3	97.0	95.0	1 131.4	(11.6)
2011	330.7	95.1	67.9	96.0	95.0	190.8	10.1
2012	90.0	96.6	74.8	97.6	95.0	351.6	41.9
2013	84.9	85.2	81.1	100.6	0.0	(164.1)	0.0
2014	86.2	81.3	81.7	95.7	0.0	125.5	5.2
2015	83.6	96.0	81.8	117.2	95.0	143.3	(4.3)
2016	83.3	96.4	75.8	99.0	95.0	35.7	7.1
2017	71.9	95.7	81.2	99.8	0.0	58.6	3.7
2018	83.9	97.3	81.2	103.5	0.0	107.9	(13.4)

Note: (1) “payment ratio” is calculated as the value of central bank transfers to the government in relation to the financial result; (2) figures in parenthesis present situations when in a given year a central bank recorded a loss and at the same time made a transfer to the government.

Source: own calculations based on annual reports of the central banks.

Table 3A.6. Fiscal seigniorage of selected central banks, 2003-18 (in % of seigniorage (SII))

Year	Central bank						
	Bank of England	Bank of Japan	Euro-system	Federal Reserve System	Narodowy Bank Polski	Swedish Riksbank	Swiss National Bank
2003	103.4	-	(534.0)	98.2	206.0	(133.0)	212.8
2004	103.5	131.8	120.0	86.9	(67.2)	(642.1)	13 887.9
2005	104.3	128.7	72.4	92.2	191.8	234.1	53.8
2006	106.0	98.2	57.9	86.2	249.5	88.9	125.7
2007	105.0	108.5	62.7	92.8	0.0	115.1	83.2
2008	124.8	83.0	53.8	142.5	0.0	179.2	(225.6)
2009	126.0	106.3	91.4	202.9	39.9	215.3	133.2
2010	113.9	40.4	83.3	231.7	185.1	1 208.4	(59.0)
2011	369.5	126.5	66.6	239.3	151.3	430.5	42.8
2012	112.1	115.4	103.0	244.6	105.9	653.9	118.5
2013	119.4	136.6	156.1	268.9	0.0	7 322.7	0.0
2014	120.0	184.2	154.4	295.6	0.0	458.4	42.7
2015	125.8	198.4	183.6	353.3	114.2	510.1	(34.6)
2016	126.2	249.9	227.6	261.5	142.6	334.9	70.1
2017	115.3	314.7	390.0	206.2	0.0	1 133.5	38.4
2018	104.6	253.3	435.3	154.6	0.0	1 406.6	(118.0)

Note: (1) “fiscal seigniorage” is calculated as the value of central bank transfers to the government related to seigniorage (SII); (2) figures in parenthesis present situations when in a given year a central bank recorded negative seigniorage and at the same time made a transfer to the government.

Source: as in Table 3A.5.

www.nbp.pl

