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**Research Report**

## Should we care about central bank profits?

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# Should we care about central bank profits?

Francesco Chiacchio, Grégory Claeys and  
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## Executive summary

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**CENTRAL BANKS ARE** not profit-maximising institutions; their objectives are rather of macroeconomic nature. The European Central Bank's overriding objective is price stability. Nevertheless, there are three good reasons to conclude that it is preferable for central banks to achieve profits rather than to record losses.

**FIRST, TAXPAYERS ENDOW** central banks with large amounts of resources and one should be worried if this amount of resources did not produce any income. In a way, the efficient use by the central bank of the financial resources with which it is endowed is as relevant as the efficient use of the human resources at its disposal.

**SECOND, FINANCIAL STRENGTH** could affect the ability of monetary authorities to fulfil their mandates. In particular there is the fear that a central bank incurring systematic losses and ending up with negative capital would find it difficult to effectively pursue its macroeconomic objective.

**THIRD, PROFITABLE OPERATIONS** might be an indication that central banks are implementing the right policies: to achieve profits the central bank must purchase assets when they are undervalued and sell when they are overvalued, thus stabilising their prices.

**OVERALL, THE EUROSISTEM** has so far respected the principle of it being better to realise profits than losses. The accounts of the ECB, indeed of the entire Eurosystem, show that it generates a fairly stable profit flow. Monetary operations, ie refinancing operations, and securities purchases contribute substantially to these profits.

**THIS CONCLUSION IS** confirmed by measuring the financial results of past purchases of foreign exchange and more recent purchases of securities from a mark-to-market perspective, instead of an accounting perspective. In the specific case of the Public Sector Purchase Programme (PSPP) this was because the coupons on the securities more than offset the capital losses: overall the Eurosystem has bought securities under the PSPP programme at prices higher than current ones.

**THE CONSIDERATIONS THAT** might justify purchase operations, like the PSPP or other similar interventions, are very complex and require careful judgement. Once their macroeconomic desirability is established, however, the ECB has the necessary financial strength to implement them safely.

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# 1 Introduction

The profits of the European Central Bank, or more precisely of the whole Eurosystem (the ECB and the 19 national central banks), were put in the spotlight in May 2018 when the European Commission proposed, as part of its plan for the post-2020 multiannual financial framework, to use a share of the central bank profits to build a stabilisation tool for the euro area (see Claeys, 2018, for details).

The question of profits made by central banks is often neglected. Central banks are not profit-maximising institutions: their objectives are of a macroeconomic nature. In the euro area, the central bank's dominant aim is price stability and the central bank should be judged only on its ability to reach this objective, not by how much profit it makes. However, although maximising profits should not be an objective of the central bank, profits could still be relevant for three reasons: 1) from a fiscal perspective, as a revenue source for governments (as highlighted by the European Commission's May 2018 proposal); 2) for the ability of central banks to conduct monetary policy; and 3) as an indicator of the quality of the pursued policies.

This Policy Contribution investigates first these three main reasons to care about central bank profits. It then documents the profit situation of the Eurosystem<sup>1</sup>, the use of those profits and discusses their potential economic implications.

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## 2 Relevance of central bank profits

The first reason to be interested in central banks' profits is that taxpayers endow central banks with large amounts of resources and one should be worried if this amount of resources were not to produce any income. More specifically, central bank profits are mainly transferred to governments and thus represent a source of fiscal revenue. Lower revenue from this source would mean governments would have to fill the gap either with more taxes or with more debt. While central banks' profits are generally a very small share of public revenues (from a high of around 1.6 percent in Malta, Cyprus and Ireland, to less than 0.2 percent in Lithuania, Slovakia, France and Luxembourg), the issue is nevertheless politically sensitive and thus relevant in the euro area because of the multi-country nature of the Eurosystem and the potential distributional consequences of monetary policy (especially of potential losses resulting from it) for the countries of the euro area.

The second reason to care about central banks' profits is that financial strength could affect the ability of monetary authorities to fulfil their mandates. To measure financial strength, two concepts can be used: economic capital and accounting capital. While both concepts are important, the measurement of losses and capital according to accounting criteria is very different from that resulting from economic criteria. A central bank with negative accounting capital can nonetheless still have large capital in economic terms<sup>2</sup>. Economic capital can be conceptually defined, analogically to the definition used for private companies, as the difference between the market value of assets and the market value of liabilities, and would thus correspond to an equity concept. If central banks were normal companies and their shares were quoted on the market, their economic capital would be their market capitalisation<sup>3</sup>. An equivalent concept is given by the difference between the net present

1 As an aside – though important – the financial statements of the Eurosystem, in particular those of the national central banks, are quite user-unfriendly, making it difficult for researchers to report and analyse them.

2 For instance, Willem Buiter (2008) notes that “the conventional balance sheet of the Fed or of any other central bank is a completely unreliable guide to and indicator of the financial health and strength of that central bank” (page 5).

3 A few central banks are, or were in the past, quoted on stock exchanges, but their peculiar dividend policies, with most of their profits given to the state, do not allow the equity market to properly evaluate their economic capital.

value of monetary income flows (often called seigniorage in the economic literature) and the net present value of the cost of running the central bank. The central bank can make the net present value of monetary income in nominal terms as large as it wishes, just by issuing more liabilities, ie base money. In real terms, however, the net present value of monetary income will be limited by the fact that money creation should lead, sooner or later, to inflation. This will give, in turn, an incentive to money holders to reduce their money balances, thus reducing, so to say, the base of the inflation tax.

Still, in normal circumstances, especially for advanced economies characterised by low inflation and little exposure to foreign currencies, the net present value of monetary income will be large enough to grant a positive economic capital to a central bank, even if its accounting capital is negative. As a consequence, even if the accounts show losses and eventually a negative capital, this should not impair a central bank's ability to discharge its macroeconomic duties<sup>4</sup>. In practice, there have been many examples of central banks with negative accounting capital – resulting from sustained losses – which have been nonetheless able to fulfil their macroeconomic mandates without major hurdles<sup>5</sup>.

However, despite these theoretical arguments and historical examples, central bankers have never been persuaded that they can, in practice, incur losses in a sustained way and end up with negative capital without damaging their ability to carry out responsible monetary policies (Bindseil *et al*, 2011; Vergote *et al*, 2010). Their main counter-argument is that sustained losses leading to negative, or insufficient, capital could end up threatening their independence. On one hand, they fear that financing operating costs through the printing press instead of profits could lead them to deviate from their price stability mandate. On the other hand, their worry is that asking the support from the treasury could lead to political capture, which could threaten their ability to deliver low inflation. Nevertheless, in addition to the fact that the operating costs of the Eurosystem are negligible in comparison to the size of the euro-area economy and would probably not have any impact on inflation even if they had to be financed via the printing press, the practical relevance of these arguments is debateable. While Stella's (2003) results indicated that financial weakness was correlated with impaired inflation control, more recent empirical analyses, such as Benecká *et al* (2012), nuance these results and show that a simple correlation between the financial weakness of the central bank and bad macroeconomic outcomes is not sufficient to imply causality, as both could be the result of bad policy arrangements.

Finally, a third (and more interesting) reason to care about central bank profits is that profitable operations might be an indication that central banks are implementing the right policies. This idea was first introduced by Milton Friedman (1953), who developed this argument for foreign exchange rate interventions by the central bank. However, this idea can be extended to interventions in securities markets or indeed any market. Friedman's point is summarised by the following quotation: *"it would do little harm for a government agency to speculate in the exchange market provided it held to the objective of smoothing out temporary fluctuations and not interfering with fundamental adjustments. And there should be a simple criterion of success – whether the agency makes or loses money"* (Friedman, 1953, page 188). Friedman's argument is that if a central bank buys a financial asset, like foreign exchange or a security, when its price is low and sells it when its price is high, it reduces the ups and down in the price of the asset, arguably moving it towards its fundamental value, while making profits. Profits are thus a sign of desirable stabilisation.

Papadia (2018) developed a variant of Friedman's idea: when a shift from a 'good' to a

4 Bindseil *et al* (2011) reach these conclusions when taking at face value the model they develop (which, they hasten to suggest, one should not do): *"central bank capital still does not seem to matter for monetary policy implementation, in essence because negative levels of capital do not represent any threat to the central bank being able to pay for whatever costs it has [...]. One could therefore conclude that the model implies a perfect dichotomy between the central bank balance sheet structure and its ability to fulfil its monetary policy tasks"* (page 23).

5 See Klüh and Stella (2008) and Sweidan (2011) for examples.

‘bad’ equilibrium occurs, because of a deterioration of expectations, the price of financial assets undergoes a sudden downward spike. In these conditions central-bank purchases can help restore the good equilibrium, leading to higher prices and financial gains. Profits thus do not derive from good timing and clever central-bank speculation against exogenous changes in financial prices, but more fundamentally from changes in equilibrium prices, which are endogenous to central bank action. Papadia called the purchase at prices higher than those that the market generates in the bad equilibrium but lower than those that would prevail in the good equilibrium as ‘Diamond-Dybvig pricing’ for central bank facilities. This pricing rule derives its name from the multiple equilibrium model developed by these two authors (Diamond and Dybvig, 1983) and is suggested as a principle for market intervention by a central bank, particularly in distressed market conditions.

In conclusion, given these arguments, while one can question, in theory, the relevance of central bank profits, in practice it is preferable for the central bank to remain in a reasonably profitable situation. So, the answer to our initial question is that one should care about the profitability of the central bank, even if the motivation is not, like that of the European Commission, to get hold of part of its profits.

### 3 The accounting profits of the Eurosystem

Figure 1 shows various definitions of Eurosystem profits as measured by its specific accounting methods (Vergote *et al*, 2010). The red line is the narrowest profit definition, the other lines add to it different items (change of general risk provisions and revaluation accounts), which reflect the Eurosystem’s accounting policy of setting aside buffers to mitigate the risk of losses.

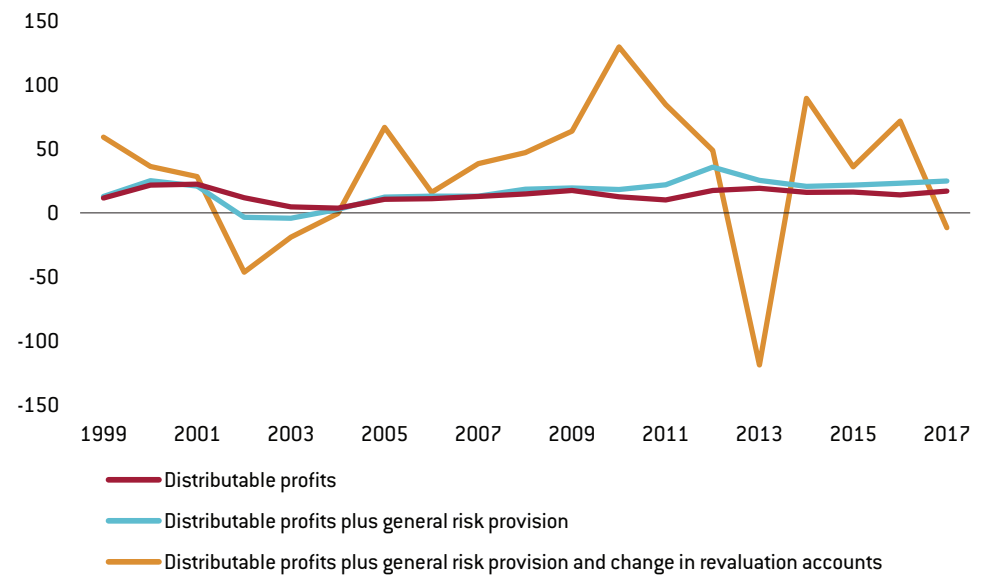
While it should be recalled that the Eurosystem’s financial reports are not fully harmonised, three observations can be made on the basis of Figure 1.

The first is the different volatility between the different definitions of Eurosystem profits. Despite relatively high volatility in terms of yearly gross profits, the Eurosystem manages to smooth its distributable profits thanks to its accounting practices. The stability of profits from one year to the next increases as the definition of profits narrows: the red line is more stable than the blue line and much more stable than the yellow line (Figure 1). One important factor in this pattern is the asymmetric recognition of valuation changes in the Eurosystem accounting policy: valuation losses are recognised in the income statement as soon as they surpass the relevant revaluation account (if any), while valuation gains go into the revaluation accounts. So, for example, an appreciation of the euro would lead to a loss on foreign reserves and thus on the income statement, unless there were sufficient revaluation accounts for this item, while a depreciation of the euro, resulting in gains on foreign reserves, would just go into revaluation accounts. The Eurosystem has adopted this asymmetric treatment of gains and losses to take into account that unrealised revaluation gains are not definitely adding to profits<sup>6</sup>.

The second observation from Figure 1 is that the Eurosystem mostly generates, in aggregate, consistent positive profits, even if the profit situation of individual national central banks varies to a considerable extent. Figure 1 shows a profit level, in the narrowest definition, mostly bracketed between €10 and €20 billion per year. Table 1 reports the average profit according to the different definitions during the entire 1999-2017 period and for two sub-periods: 1999-2007 and 2008-2017.

<sup>6</sup> This policy is justified on prudence grounds by Vergote *et al* (2010).

**Figure 1: Eurosystem profits (€ billions)**



Source: Bruegel based on ECB and national central banks' annual accounts, Eurosystem consolidated balance sheet. Note: Latest observation is 2017. Distributable profits are defined as net profits before allocation to ordinary reserves and other funds, shareholders, the state, and other special items. The red line refers to all 19 national central banks, the blue line includes provisions made by the ECB, the yellow adds changes obtained from the Eurosystem consolidated balance sheets.

**Table 1: Average Eurosystem profit according to different definitions (€ billions)**

Profits definition	1999-2007	2008-2017	1999-2017
Distributable profits (1)	12.2	15.5	13.9
(1) plus general risk provisions (2)	10.2	23.0	16.9
(2) plus change in revaluation accounts (3)	19.9	44.0	32.6

Source: Bruegel based on ECB and national central banks' annual accounts, Eurosystem consolidated balance sheet.

The third observation is that profits did not fall during the Great Recession; if anything they increased during this period. This was in contrast with expectations that the lower level of the ECB's key interest rates during the Great Recession, down to negative values (for the deposit rate) since June 2014, would dampen profits because of lower monetary income, often proxied by the amount of banknotes times the interest rate.

The maintenance of significant profit levels can be attributed to open market operations continuing to contribute positively despite low interest rates, and asset purchase programmes providing additional revenues. Starting from a favourable profit position this provides protection from the losses that could be made as a consequence of future interest rate increases. When the ECB starts increasing its key policy rates, the remuneration of reserves created to buy assets should quickly exceed the (rather low) yields on the vast portfolio of securities held by the Eurosystem as a consequence of quantitative easing and thus result in some losses<sup>7</sup>.

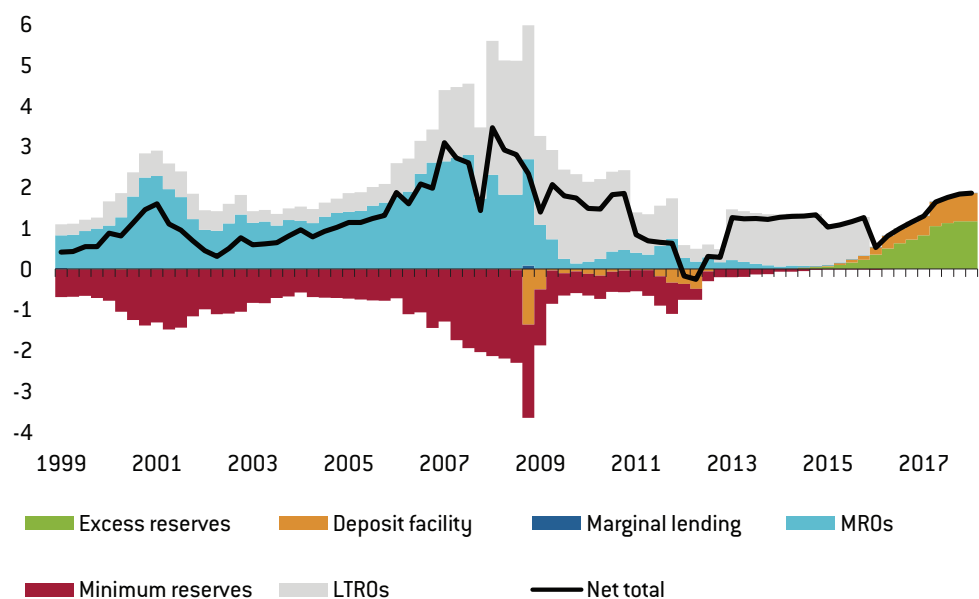
<sup>7</sup> However, some central banks have already started building buffers to compensate for these future potential losses due to the combination of QE holdings and future rate increases. For instance, as DNB (2017) says, "The Governing Board [of the DNB] has deemed it necessary to continue to strengthen the buffers and has decided to add a further EUR 500 million to the provision for credit and interest rate risk. This is a provision that DNB can use in a negative scenario to absorb financial losses resulting from quantitative easing (QE)".

In addition, mark-to-market losses on the portfolio of securities could eat into revaluation accounts and end up in the profit and loss account.

We now examine in more detail the contribution of the most important monetary policy tools of the Eurosystem to its profits.

Figure 2 shows the income resulting from refinancing operations, the deposit facility, minimum reserves and excess reserves. On the cost side, the most important item was the remuneration of minimum reserves (at the main refinancing operations (MRO) rate) until its remuneration in 2016 was brought down to zero. On the revenue side, until the beginning of the Great Recession in October 2008, when they were gradually replaced by longer-term refinancing operations (LTRO), the most important item was the revenue from MRO. Finally, since the interest rate on the deposit facility and excess reserves was brought down to a negative value, these liabilities have become the biggest sources of revenue for the Eurosystem.

**Figure 2: Result of selected monetary policy operations (€ billions)**



Source: ECB. Note: Last observation is 2018Q1. More information in Annex 1

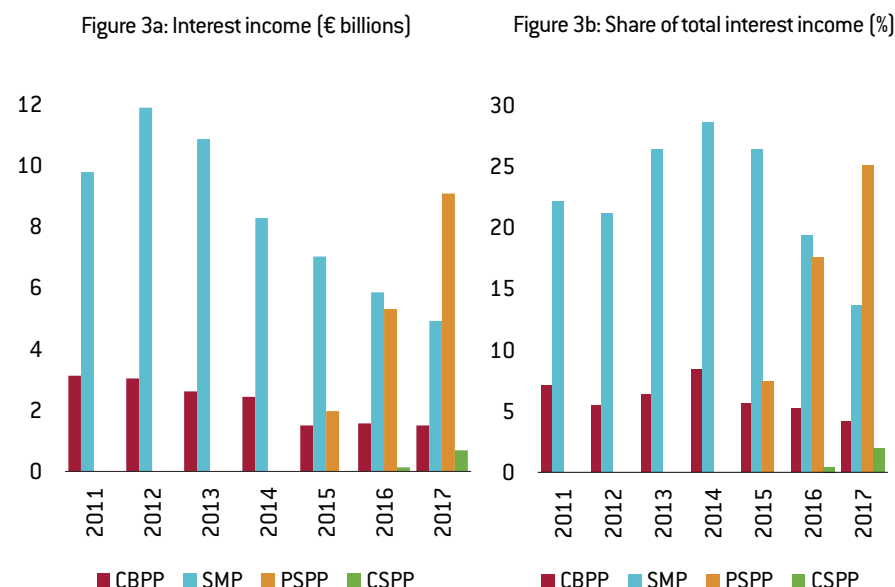
In net terms, the profit from temporary operations grew with the onset of the Great Recession in October 2008 and the resulting increase in the Eurosystem balance sheet, but then the very low interest rates led to a reduction of profits down to zero in 2012. Profits subsequently recovered because of the increase in income from LTRO and from the negative rate on excess reserves and the deposit facility. Overall, though for different reasons and at different levels, the Eurosystem's net revenue from its standard operations has been positive since its creation in 1999 (with an insignificant and temporary exception in the first half of 2012).

Another important source of income for the Eurosystem was the coupon and the amortisation<sup>8</sup> of the portfolio of securities bought for monetary policy purposes. Figures 3a and 3b show the accounting income from the portfolio of securities bought for monetary policy purposes (with the exception of the Asset-Backed Securities Purchase Programme (ABSPP) given its small size). The Securities Market Programme (SMP) provided revenue of between

<sup>8</sup> Amortisation is negative if a security has been bought above par and positive if it has been bought below par and is added to the coupon to account for the income of a security.

€4.9 and €11.9 billion each year between 2011 and 2017, resulting in the largest contribution to income from monetary policy securities purchases until 2017, when it was surpassed by the Public Sector Purchase Programme (PSPP). Overall, the four main asset purchase programmes<sup>9</sup> – the three-phase Covered Bond Purchase Programme (CBPP), the Securities Market Programme (SMP), the Public Sector Purchase Programme (PSPP) and the Corporate Sector Purchase Programme (CSPP) – have represented between 27 percent and 45 percent of the interest income of the Eurosystem over the years, showing the importance of these programmes for the overall revenue of the Eurosystem.

**Figure 3: Interest income from asset purchase programmes**



Source: Bruegel based on national central banks and ECB annual accounts. Note: More information in Annex 1.

## 4 Distribution of the Eurosystem's profits

As far as the ECB is concerned, a maximum of 20 percent of its net profits is allocated to the general reserve fund (up to 100 percent of the ECB's capital), while the remainder is distributed proportionally to the ECB's shareholders (ie the national central banks). The general reserve fund is also used, if needed, to offset losses, while the ECB Governing Council may also decide to use monetary income for this purpose, proportionally and up to its allocation to national central banks (ECB annual accounts, 2017).

The way central-bank profits are distributed to governments, after allocations to maintain an adequate level of financial buffers, differs across the euro area. In fact, while the Eurosystem is able to lay down accounting rules (for 'core' operations) for all national central banks, it does not have the legal authority to rule on how they and the ECB distribute their profits (Bunea *et al.*, 2016).

In most cases, governments are the only shareholders and potential receivers of distributable profits, in the form of dividends, direct appropriations, allocations to a state fund or similar. Profits may also be used to increase equity and special funds, or be paid as dividends (of predetermined or capped amounts) to private shareholders (this is the case for the central banks of Belgium, Greece and Italy<sup>10</sup>).

<sup>9</sup> Again, the Asset Backed Securities Purchase Programme is not considered here given its very small size.

<sup>10</sup> See Annex 2 for more details on how profits are allocated in these countries.



Depending on the specific legal framework, national central banks have various degrees of autonomy with respect to the amount of profits they distribute to their respective governments. Some central banks are also liable to pay corporation tax (among other taxes, with different types of exemptions), which increases the actual transfer to the government.

Focusing on the largest six national central banks in terms of paid-up shares of ECB capital, most profits are distributed to governments. On average, in the last five years, transfers to the governments represented approximately 85 percent of gross profits. While quite high in percentage terms and increasing over time, these transfers are still small in value, as on average they collectively reached only about 0.3 percent of general government revenues in the last five years.

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## 5 Mark-to-market profits of the Eurosystem operations

### 5.1 Past episodes of ECB intervention

When looking at whether Eurosystem mark-to-market profits fulfil Friedman's criterion of desirable interventions, it is useful to first look at some past ECB market interventions.

The ECB intervened in the foreign exchange market at the turn of the year 2000, when the euro was at a trough against the dollar and the yen and the ECB bought a fairly large amount of euros against these two currencies. At that time, in particular, one euro bought only about \$0.82. Currently one euro buys about \$1.20, meaning an appreciation close to 50 percent, bringing about an equivalent gain for the ECB on the volume of its interventions. While we could find no precise figure on the size of these interventions, available evidence (Henning, 2007) indicates an amount of around €7 billion in purchases, which would give a mark-to-market profit of about €3 billion.

For a later intervention episode, Papadia and De Sousa (2013) estimated the mark-to-market (ie not accounting) gains from the purchases under the Securities Market Programme (SMP) at more than €14 billion. Papadia (2014) updated the figure for the SMP to nearly €17 billion and that for the Covered Bond Purchase Programme (CBPP) to nearly €6 billion.

So the foreign exchange purchases, the SMP and the CBPP, which explicitly targeted stressed markets, complied with Friedman's criterion as the ECB carried out quite profitable interventions not only from an accounting perspective (as discussed in section 4) but also from a mark-to-market perspective. We assess in section 5.2 what the most recent asset purchase programmes, and in particular the dominant PSPP component, are delivering in mark-to-market terms.

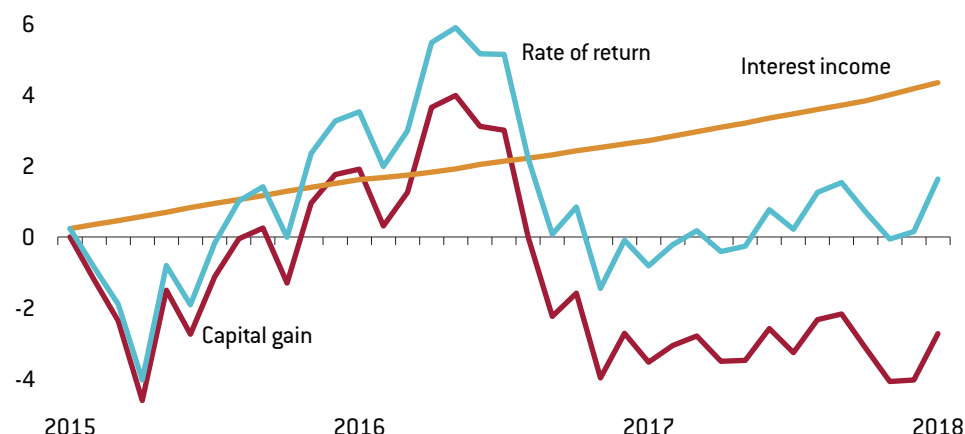
### 5.2 Mark-to-market profits from PSPP

Differently from what is done in accounting, to measure the mark-to-market performance of the PSPP portfolio and calculate the rate of return over time we can start from the following definitions:

- Cumulative rate of return at time  $t = (\text{capital gains} + \text{interest income}) / \text{book value}$
- Capital gain =  $(\text{market value} - \text{book value}) / \text{book value}$
- Interest income = coupon payments / book value
- Book value = price of bond at time of purchase
- Market Value = price of bond at time  $t$

Figure 4 shows the estimated rate of return, as well as its two components, capital gain (or loss) and interest income.

**Figure 4: Mark-to-market rate of return of PSPP portfolio**



Source: Bruegel based on ECB and Bloomberg. Note: Last observation is March 2018. We assume monthly coupon payments for each bond based on the derived monthly coupon rate. More information in Annex 1.

As Figure 4 shows, the cumulative return on PSPP purchases has been so far positive (at 1.6 percent), but only because the coupon earned on the securities (4.3 percent) has more than compensated for the current mark-to-market capital loss (2.7 percent). The total return would amount to roughly €32 billion in earnings, resulting from €87 billion coupon gains, and €54 billion capital losses. It should be emphasised again, however, that these figures are not directly relevant for the profit and loss account of the Eurosystem, which does not use mark-to-market for all the items in its accounts.

Given the capital losses, PSPP purchases do not comply with the Friedman criterion, as the Eurosystem seems to have bought, on average, at a price higher than the current market value. The difference in profitability compared to other episodes, such as the foreign exchange purchases, the SMP and the CBPP, is not really surprising: these latter interventions were carried out in stressed markets and the actions of the central bank could move prices from a distressed (bad equilibrium) to a more normal (good equilibrium) condition, thus generating large profits. PSPP purchases are carried out in normally-functioning markets, in which it is much more difficult to engineer price changes. In addition, bond prices had already rallied significantly since the summer of 2014, because the market expected the ECB to implement QE before the actual start of the programme. This significantly limited the programme's potential capital gains. While any analysis of the results of the PSPP should take into account that the programme led to capital losses rather than capital gains, the assessment of the macroeconomic effectiveness of the PSPP is of course an issue we do not cover.

Even if the Friedman condition was not satisfied, the other reasons for preferring a central bank to realise financial gains rather than losses (section 2) are satisfied by the PSPP, considering that, in total return terms, purchases under this programme have led to financial gains also on a mark-to-market basis.

## 6 Conclusions

While a central bank does not need to generate profits to fulfil its macroeconomic functions, it is better if it does. Overall, the Eurosystem has so far respected this principle. The accounts of the ECB, indeed of the entire Eurosystem, show that it generates a fairly stable profit flow. Monetary operations, ie refinancing operations and securities purchases, contribute substantially to these profits. This 'prudent' behaviour of the Eurosystem is confirmed by its asymmetric use of revaluation accounts and by the accumulation of reserves and provisions of various

kinds, which provide a buffer protecting against future possible losses.

Measuring profits from a mark-to-market perspective, instead of an accounting perspective, the financial results of past purchases of foreign exchange and more-recent purchase of securities show that an overall profit was achieved. In the specific case of the PSPP this was because the coupons on the securities more than offset the capital losses: overall the Eurosystem has bought securities under the PSPP programme at prices higher than current prices.

The considerations that might justify purchase operations, like the PSPP or other similar interventions, are very complex and require careful judgement. Once their macroeconomic desirability is established, however, the ECB can implement them safely, given its financial strength.

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## Annex 1: Estimation methodologies

For Figure 2, revenue obtained by maturity of the relevant item (maintenance period for minimum reserves, length of the individual MROs, overnight for deposit facility, marginal lending facility, and excess reserves) were aggregated at the quarterly level. LTROs were considered in annual mean (to smooth payments). TLTROs were not included in these calculations given they will start maturing in late 2018. However, early repayments have been taking place since mid-2016 (See <https://www.ecb.europa.eu/mopo/implement/omo/tltro/html/index.en.html>).

For Figure 3, where income data by programme was missing from annual accounts, total income was allocated using programme shares, taking into account average historical percentage changes and shares of QE-related income over aggregate figures.

For Figure 4, in the course of our calculations, we faced questions on the implications of the ECB's statement that "*purchases will in principle be weighed by nominal outstanding amounts*". In our view, there are two ways to think about this. For example, consider the simplified market situation:

Purchase = 100 par value of securities;

share 10-year maturity = 40%; price for 10-year maturity = 1.25

share 30-year maturity = 60%; price for 30-year maturity = 1.50.

Then, we could proceed in the following two ways (as illustrated in the table below):

a) Invest proportionally to the debt distribution of par values (ie not of market value),

	10-year	30-year
Par value	40	60
Quantity	$40/1.25 = 32$	$60/1.5 = 40$
Share within portfolio	$32/(32+40) = 0.44$	$40/(32+40) = 0.56$

b) Invest proportionally to the debt distribution of market values.

	10-year	30-year
Par value	35	65
Quantity	$35/1.25 = 28$	$65/1.5 = 43$
Share within portfolio	$28/(28+43) = 0.4$	$43/(28+43) = 0.6$

Under a), the maturity structure of the portfolio would not be proportional to the maturity structure of the outstanding debt. This is because the price differences (securities with longer maturities tend to have higher price) lead to difference quantities in par value terms. By contrast, under b) the maturity structure of the portfolio is proportional to the maturity structure of the outstanding debt. This implies that the ECB would always buy a greater (smaller) share of securities with a higher (lower) price in book value terms. Ultimately we decided to use method a).

Simulations were based on the 2018/03/23-26 ESCB portfolio (list of all bonds) published by the ECB for the purpose of securities lending, from which we gathered respective price and yield data since March 2015.

For each month (03/2015-03/2018) we modelled purchases in three steps:

1. Select a list of bonds based on the PSPP eligibility criteria (until 1/2017: residual maturity > 2 years, yield > deposit rate; after: residual maturity > 1 year, any yield);
2. Create bond-specific weights (by maturity group) based on their nominal outstanding amount;
3. Simulate monthly purchases for each bond based on purchase volumes by issuer and (1) and (2).

Note that we did not simulate reinvestment, but simply net purchases by month.

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## Annex 2: Profit distribution to private shareholders

The National Bank of Belgium (NBB) has capital of €10 million allocated to 400,000 shares. The Belgian state owns half of them, while the rest are privately-owned and listed on Euronext Brussels. The NBB pays to its shareholders first a fixed dividend of 6 percent on capital, and then (after allocating part of the residual profits to reserves) it pays *“a minimum of 50 percent of the net proceeds from the assets forming the counterpart to the reserve fund and available reserve”* (NBB, 2018). The first dividend is guaranteed by the available reserve and by the reserve fund, while the second is guaranteed by available reserves, as long as they are enough to protect from estimated risks (NBB, 2018).

A two-step dividend policy is also implemented by the National Bank of Greece, which initially distributes a 12 percent dividend on capital, and then, provided that the reserve fund is equal to capital, a percentage of net profits as a discretionary additional dividend (Article 71 of the Statute of the Bank of Greece, tenth edition, 2016). Capital amounts to about €111 million, held by approximately 19,000 shareholders. Shares are registered and traded on the Athens Stock Exchange (<https://www.bankofgreece.gr/Pages/en/Bank/shareholders.aspx>).

Finally, the Bank of Italy has capital of €7.5 billion in registered shares, which can be held by banks, insurance and re-insurance companies, foundations, social security institutions and pension funds (<https://www.bancaditalia.it/chi-siamo/funzioni-governance/partecipanti-capitale/index.html?com.dotmarketing.htmlpage.language=1>). Since 2014, shares in excess of 3 percent of capital have no voting rights and their dividends are transferred to statutory reserves (Bank of Italy, 2018). The Bank of Italy pays a dividend of up to 6 percent of capital, after distribution of up to 20 percent of net profits to ordinary reserves.